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

Ref: PSER:SCT:NKP-C2005:7745 Date: 06-01-2020

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:NKP-C2005:20.	
ii	Broad Scope of job	*Construction of 3 nos. 150 meter high reinforced concrete single steel flue chimney with borosilicate glass block lining system on MS flue can and other incidentals complete including raft foundation for FGD system of 3 x 660 MW North Karanpura STPP, Jharkhand.*	
iii	DETAILS OF TENDER DOCUMENT		
a	Volume-IA	*General conditions of contract (Supply)*	*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, DRG)*	*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: 06-01-2020*	*Applicable.*
v	DUE DATE & TIME OF OFFER SUBMISSION	*Date: 21-01-2020, Time: 15-00 Hrs.* *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: 21-01-2020* *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.*	*Applicable.*

		(2) Bidder may depute representative to witness the opening of tender.	
vii	EMD AMOUNT	*Rs 70,00,000/-.*	*Applicable.*
viii	COST OF TENDER	*Rs. 10,000/-.*	*Applicable.*
ix	LAST DATE FOR SEEKING CLARIFICATION	*Date: 13-01-2020* *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:* *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: 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. b. BHEL reserves the right to accept/reject the deviations without assigning any reasons, and BHEL decision is final and binding. i). In case of acceptance of the deviations, appropriate loading shall be done by BHEL 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. 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. (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 (To be attached in relevant Attachment section)	
vii.	Notice inviting Tender (NIT) (To be attached in relevant Attachment section)	
viii.	Volume – I F: Technical Conditions of Contract (TCC) (To be attached in relevant Attachment section)	
ix.	Volume – I D: Special Conditions of Contract (SCC)-Service (To be attached in relevant Attachment section)	
x.	Volume – IA & I B : General Conditions of Contract (GCC)-SUPPLY & Service (To be attached in relevant Attachment section)	
xii.	Volume – I E: Forms & Procedures etc. (To be attached in relevant Attachment section)	
xiii.	Volume–III - (UNPRICED – without disclosing rates/price, but mentioning only 'QUOTED' or 'UNQUOTED' against each item. (To be attached in Unpriced Bid Attachment section)	
xiv.	Any other details preferred by bidder with proper indexing. (To be attached in relevant Attachment section)	

PART-I B	EMD/ COST OF TENDER (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	

	2. Cost of Tender (Demand Draft or copy of Cash Receipt as the case may be)	

PART-II	PRICE BID (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) 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)

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)
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} ≥ 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 ii). Pile and Pile Caps iii). Civil Works including foundations iv). Structural Steel Fabrication & Erection v). Chimney vi). Cooling Tower vii). Others (Civil)	i). Electrical ii). C&I iii). Others (Elect. and C&I)	i). Boiler & Aux (All types including CW Piping if applicable) ii). Power Cycle Piping/Critical Piping iii). ESP iv). LP Piping v). Steam Turbine Generator set & Aux vi). Gas Turbine Generator set & Aux vii). Hydro Turbine Generator set & Aux viii). Turbo Blower (including Steam Turbine) ix). Material Management 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 reserves the right to go for Reverse Auction (RA) (Guidelines as available on www.bhel.com) instead of opening the sealed envelope price bid, submitted by the bidder. This will be decided after techno-commercial evaluation. Bidders to give their acceptance with the offer for participation in RA. Non-acceptance to participate in RA may result in non-consideration of their bids, in case BHEL decides to go for RA.

However, if reverse auction process is not adopted or is unsuccessful for whatsoever reason, absolute value price bid (Volume-III) uploaded in E-Procurement Site https://bhel.abcprocure.com will be opened for deciding the successful bidder. BHEL's decision in this regard will be final & binding on bidder.

Those bidders who have given their acceptance to participate in Reverse Auction will have to necessarily submit 'Process compliance form' (to the designated service provider) as well as 'Online sealed bid' in the Reverse Auction. Non-submission of 'Process compliance form' or 'Online sealed bid' by the agreed bidder(s) will be considered as tampering of the tender process and will invite action by BHEL as per extant guidelines for suspension of business dealings with suppliers/ contractors (as available on www.bhel.com).

The bidders have to necessarily submit online sealed bid less than or equal to their envelope sealed price bid already submitted to BHEL along with the offer. The envelope sealed price bid of successful L 1 bidder in RA, if conducted, shall also be opened after RA and the order will be placed on lower of the two bids (RA closing price & envelope sealed price) thus obtained. The bidder having submitted this offer specifically agrees to this condition and undertakes to execute the contract on thus awarded rates.

If it is found that L 1 bidder has quoted higher in online seal bid in comparison to envelope sealed bid for any item(s), the bidder will be issued a warning letter to this effect. However, if the same bidder again defaults on this count in any subsequent tender in the unit, it will be considered as fraud and will invite action by BHEL as per extant guidelines for suspension of business dealings with suppliers/ contractors (as available on www.bhel.com).

As a reminder to the bidders, system will flash following message (in Red Color) during the course of 'online sealed bid':
"Bidders to submit online sealed bid less than or equal to their envelope sealed bid already submitted to BHEL"

In case BHEL decides to go for reverse auction, the H1 bidder (whose quote is highest in online sealed bid) may not be allowed to participate in further RA process.

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 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	Address	Email
1.	Shri Arun Chandra Verma, IPS (Retd.)	Flat No. C -1204, C Tower, Amrapali, Platinum Complex, Sector 119, Noida (U.P.)	acverma1@gmail.com
2.	Shri Virendra Bahadur Singh, IPS (Retd.)	H. No. B-5/64, Vineet Khand, Gomti Nagar, Lucknow - 226010	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	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	033-2339 8226
Email	anupriya.mundu@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 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.

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 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/ 8000
	FAX no	033-23211960
	E-mail	anupriya.mundu@bhel.in/k.anish@bhel.in/subrata.sen@bhel.in

Enclosure

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

ANNEXURE-1

PRE QUALIFICATION CRITERIA

JOB	CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.
TENDER NO	PSER:SCT:NKP-C2005:20.

SL NO	CRITERIA
A	
1.0 (a)	BIDDER SHOULD HAVE AVERAGE MINIMUM ANNUAL FINANCIAL TURNOVER OF INR 18 CR DURING THE LAST 3 (THREE) YEARS, ENDING ON 31-03-2019 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. AUDITED BALANCE SHEET AND PROFIT & LOSS ACCOUNT OF THE COMPANY FOR LAST 3 (THREE) FINANCIAL YEARS, ENDING ON 31-03-2019 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 : A) 1 (SINGLE) WORK OF VALUE NOT LESS THAN INR 48 CRORE OR B) 2 (TWO) WORKS OF VALUE NOT LESS THAN INR 30 CRORE EACH OR C) 3 (THREE) WORKS OF VALUE NOT LESS THAN INR 24 CRORE EACH RELEVANT DOCUMENT IN SUPPORT OF ABOVE SHALL BE SUBMITTED.
2.2	BIDDER SHOULD HAVE EXECUTED FOLLOWING JOB IN ANY POWER / INDUSTRIAL PROJECT DURING LAST 7 (SEVEN) YEARS, ENDING ON THE LATEST DUE DATE OF SUBMISSION OF OFFER.; A. AT LEAST SHELL OF ONE NO. RCC CHIMNEY OF MINIMUM 100 MTR HEIGHT OR B. AT LEAST SHELL OF ONE NO. NDCT (NATURAL DRAUGHT COOLING TOWER) OF MIMIMUM 60 MTR HEIGHT. RELEVANT DOCUMENT IN SUPPORT OF ABOVE SHALL BE SUBMITTED.
3.0	BIDDER SHOULD HAVE VALID PAN. 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. NETWORTH : Shall be calculated based on the latest Audited Accounts as furnished. Net worth = Paid up share capital + Reserves. (Net worth is required to be evaluated in case of companies)
4. PROFIT : shall be NET profit (PAT + Non cash expenditure viz depreciation) earned during any one of the 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. Completion date for achievement of the 'Technical' criteria of PQR will be the last 7 years ending on the 'latest date of Bid submission' of Tender irrespective of date of the start of work
7. '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
8. Unless otherwise specified, for the purpose of 'Technical' criteria of PQR, the word 'EXECUTED' means achievement of milestones as defined below:
   a. "ACHIEVEMENT OF PHYSICAL QUANTITIES" as per respective PQRs.
   b. "READINESS FOR COAL FILLING" in respect of Mill Bunker.
   c. "CHARGING" in respect of Power Transformers / Bus Ducts / "HT/LT Switchgears" / "HT / LT Cabling".
   d. For C&I works: "SYNCHRONISATION" in case of power project and "WORK COMPLETION of the value as defined in PQR" in case of industry.
   e. "BOILER LIGHT UP" in respect of Boiler / CFBC / ESP.
   f. "GAS IN" in respect of HRSG.
   g. "STEAM BLOWING COMPLETION" in respect of Power Cycle Piping.
   h. "HYDRAULIC TEST" of the system in respect of Pressure parts / LP Piping / CW Piping.
   i. "FULL LOAD OPERATION OF THE UNIT" in respect of Insulation work.
   j. "SYNCHRONISATION" in respect of STG / GTG.
   k. "SPINNING" in respect of HTG.
   l. "COMPLETION AND HANDING OVER FOR MECHANICAL ERECTION" in respect of STG Deck and Machine/Equipment foundation.
9. Boiler means HRSG or WHRB or any other types of Steam Generator
10. Power Cycle piping means Main Steam, Hot Reheat, Cold Reheat, HP Bypass
11. For the purpose of evaluation of the PQR, one MW shall be considered equivalent to 3.5TPH 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 in terms of MW shall be considered for evaluation.
12. In case the experience/PO/WO certificate enclosed by bidders do not have separate break up prices for the E&C portion of Electrical and CI Works, (i.e. the certificates enclosed are for composite order for supply and erection of Electrical & CI and other works if any), then value of Erection and Commissioning for the Electrical & CI portion shall be considered as 15% of the supply & erection of Electrical & CI, unless otherwise specifically indicated in the PQR.
13. Scope for capital overhaul of STG shall cover Bearing Inspection work and overhauling of all cylinders of the Turbine.
14. In case the tendered scope is not a Pulverised Fuel Boiler, experience of Oil/Gas Fired Boilers also can be considered.
15. 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

16. PROFIT shall be PBT earned during any one year of last three financial years as mentioned in PQR.
17. For evaluation of PQR, the credentials of the Bidder alone, and not that of the Group Company shall be considered.
18. "Executed" means the bidder should have achieved the criteria specified in the PQR even if the Contract has not been completed or closed.
19. 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.

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 3 nos. 150 meter high reinforced concrete single steel flue chimney with borosilicate glass block lining system on MS flue can and other incidentals complete including raft foundation for FGD system of 3 x 660 MW North Karanpura STPP, Jharkhand.	
Ref	1.0	Tender no PSER:SCT:NKP-C2005:20.
	2.0	BHEL's NIT, vide reference no PSER:SCT:NKP-C2005:7745 Date: 06-01-2020
	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 3 nos. 150 meter high reinforced concrete single steel flue chimney with borosilicate glass block lining system on MS flue can and other incidentals complete including raft foundation for FGD system of 3 x 660 MW North Karanpura STPP, Jharkhand.
TENDER NO	PSER:SCT:NKP-C2005:20.

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 Designation: Telephone No: Mobile No: Email ID: Fax No:
3.b	Details of alternate Contact person for this Tender	Name : Mr/Ms Designation: Telephone No: Mobile No: Email ID: Fax No:
4	EMD DETAILS	DD No: Date : Bank : Amount: Please tick (√) whichever applicable:- 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-SERVICE(IB)/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 atleast 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% {[(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 AB/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 Commodity Code: 1202000005 (See Note E)	5	3	5	5	5
iii)	WELDING ROD	Name of Commodity: MANUFACTURE OF BASIC METALS Commodity Code: 1314000000 (See Note E)				15	
iv)	CEMENT	Name of Commodity: ORDINARY PORTLAND CEMENT Commodity Code: 1313050003 (See Note E)		20	30		
v)	STEEL (Structural and Reinforcement Steel)	Name of Commodity: MILD STEEL: LONG PRODUCTS Commodity Code: 1314040000 (See Note E)		25			
vi)	All OTHER MATERIALS (Other than Cement & Steel)	Name of Commodity: ALL COMMODITIES 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.

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

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 ('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 of a period of 14 days' by BHEL 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): 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 may resort 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. Those bidders who have given their acceptance for Reverse Auction (quoted against this tender enquiry) will have to necessarily submit "online sealed bid" in the Reverse Auction. Non-submission of "online sealed bid" by the bidder for any of the eligible items for which techno- commercially qualified, will be considered as tampering of the tender process and will invite action by BHEL as per extant guidelines in vogue.
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 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. In case BHEL decides not to go for Reverse Auction procedure for this tender enquiry, the Price bids and price impacts, if any, already submitted and available with BHEL shall be opened as per BHEL"s standard practice.
12. 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.
13. 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.
14. The Bidder shall not divulge either his Bids or any other exclusive details of BHEL to any other party.
15. In case BHEL decides to go for reverse auction, the H1 bidder (whose quote is highest in online sealed bid) will not be allowed to participate in further RA process provided minimum three bidders are left after removal of H1 bidder. In case of tie for H1 bid (identical online sealed bids), 15 minutes' additional time shall be provided and all the participating bidders shall be informed by mail/message on bidding screen to enable bidders submit revised online sealed bids so as to break the tie.

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

(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} 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*	

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.

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

CONTENT

SL NO	DESCRIPTION	PAGE NO
01	PART-I - INSTRUCTION TO TENDERER	03
02	PART-II - GENERAL CONDITIONS OF CONTRACT	06

PART – I

INSTRUCTION TO TENDERER

CLAUSE NO	DESCRIPTION
1.0	**SUBMISSION OF TENDERS**
	The tenderers must submit their tenders in two parts in separate sealed covers as detailed below and as per instructions of NIT.
	PART – I (TECHNO-COMMERCIAL PART).
	PART – II (PRICE PART).
1.1	PART – I (TECHNO-COMMERCIAL PART)
1.1.1	This shall include the following.
1.1.1.1	Covering letter of tenderer.
1.1.1.2	Volume-IA/IB/IC/ID – General and Special Conditions of Contract.
1.1.1.3	Volume-II – Technical specification including drawings, if any.
1.1.1.4	Volume-III – 'Price schedule', (No rate shall be entered in the rate column. Only write 'quote' against each rate of the schedule).
1.1.1.5	Drawings.
1.1.1.6	Schedules, annexures, proformas and other documents as indicated in the tender document and as specified in the tender enquiry letter.
1.1.1.7	The above documents shall form one set of the Part –I tender. Tenderers shall submit requisite sets of Part-I tender, i.e. original and duplicate sets as specified in the tender enquiry letter. All the sets shall be sealed and marked 'Original Part – I tender' and 'Copies of Part – I tender' on the respective sets and superscribed as : PART – I (TECNHO-COMMERCIAL PART). TENDER DOCUMENT NO. NAME OF WORK AND PROJECT. SUE DATE OF SUBMISSION.
1.2	PART –II (PRICE PART)
	This shall include following:
1.2.1	Copy of the covering letter enclosed in Part-I tender.
1.2.2	Volume III – Schedule of item of work (in the rate /price column the rate / price figures should be entered in words as well as in figures).
1.2.3	Tenderer shall submit requisite sets of Part-II tender duly sealed in one cover, superscribed as: PART – I (PRICE PART). TENDER DOCUMENT NO. NAME OF WORK AND PROJECT. SUE DATE OF SUBMISSION.
1.3	PART – III (EMD)
	Earnest Money Deposit should be made in the form as indicated in tender document and shall be submitted inside a sealed envelope superscribing the following. PART – III (EMD). TENDER DOCUMENT NO. NAME OF WORK AND PROJECT. SUE DATE OF SUBMISSION.
1.4	MAIN COVER
	Duly sealed and superscibed, as detailed above of Part – I, Part- II and Part – III tenders shall be enclosed in one main cover duly sealed and superscirbed as: PART – IV (TECNHO-COMMERCIAL PART, PRICE PART AND EMD). TENDER DOCUMENT NO. NAME OF WORK AND PROJECT. SUE DATE OF SUBMISSION.
2.0	**OPENING OF TENDERS**
2.1	Unless otherwise specified, techno-commercial bids will be opened one day after latest due date of submission of offer at 15-00 hrs for which bidder may depute representative.
2.2	While BHEL reserve the right to open the price bid (Cover-II) of the offers in camera, the date & time to open to Cover-II tender opening shall be intimated to the bidders in case

	BHEL decides it to be 'Public opening' and in such a case, one representative of the bidder shall be allowed to attend.
2.3	Price bids of those bidders who will be qualified for the subject job on the basis of pre-bid discussions, evaluation of techno commercial bids etc will be opened on specified date. Bidders may depute their representatives to participate in opening of price bids. BHEL's decision in this regard is final & binding.
3.0	**RATES TO BE IN FIGURES AND WORDS**
3.1	The tenderer shall quote in English both in figures as well as in words the rates and amounts tendered by him in the priced schedule of items of work forming part of the tender in such a way that interpolation is not possible. The amount for each item shall be worked out and entered and requisite totals given of all items. The tendered amount for the work shall be entered in the tender and duly signed by the tenderer.
3.2	If some discrepancies are found between the rate given in words and figures or the amount shown in the tender the following procedure shall be followed.
3.2.1	When there is a difference between the rates in figures and words, the rates which correspond to the amount worked out by the tenderer shall be taken as correct.
3.2.2	When the rate quoted by the tenderer in figures and words tallies but the amount is incorrect, the rate quoted by the tenderer shall be taken as correct.
3.2.3	When it is not possible to ascertain the correct rate, in the manner prescribed above, the lesser of the two (ie between figures and words) will be treated as valid rate.
4.0	**CORRECTIONS AND ALTERATIONS**
	All entries in the tender shall either be typed or be in ink, erasures and over-writing are not permitted and may render such tenders liable to summary rejection. All corrections and alterations shall be duly attested by the tenderer with date.
5.0	**ALL PAGES TO BE INITIALLED**
	All signatures in tender documents shall be dated as well. All pages of all volumes and sections including drawing of tender documents shall be initialed with seal at the lower right hand corner or signed with seal wherever required in the tender documents by the tenderer or by a person holding power of attorney (copy to be enclosed with Part-I of tender) authorizing him to sign on behalf of the tenderer before submission of tender.
6.0	**ADDENDA**
	Addenda to the tender documents may be issued prior to the date of opening of the tenders to clarify documents or to reflect modifications in the design or contract terms. All such addenda issued shall form part of tender documents.
7.0	**RATES TO BE ALL INCLUSIVE**
	The tenderer shall quote for the jobs on the basis of the items entered in the schedule of items of work and shall quote separately for each and every items entered in schedule of items of work. The rates and prices quoted shall be all inclusive as provided for in the schedule of items of work and any claim whatsoever for enhancement of rates or prices quoted on any account shall not be entertained.
8.0	**INFORMATION**
	The information given in the tender documents and the plans and drawings forming part thereof is merely intended as general information without undertaking on the part of BHEL as to their accuracy and without obligation relative thereto upon BHEL. Before tendering, 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 labour etc. No claim will be entertained later on the ground of lack of knowledge.
9.0	**QUANTITIES**
	The qualities indicated in the schedule of items of work with respect to the various items are only approximate and are intended merely as a general information without undertaking as to the correctness thereof and without any obligation relative thereto upon BHEL.
10.0	**ENCLOSURES**
	The enclosures to be enclosed alongwith Part-I of the tender shall include the following besides other such enclosures which may have been specified elsewhere in the tender documents.
10.1	Valid Income Tax Clearance Certificate and Sales Tax Clearance Certificate in original or true copies/ photocopies duly attested by a Gazetted Officer.
10.2	Solvency certificate from a nationalized scheduled bank.
10.3	In case of an proprietorship firm, full name of proprietor, address, place and nature of business shall be furnished. In case of partnership firm, names of all the partners and their address, attested copy of partnership deed, instrument of partnership duly certified by the Notary Publics shall be enclosed. In case of company, date and place of registration including date of commencement – certificate, certified copies of Memorandum and Articles

	of Association, nature of business carried on by the company and provisions of the memorandum relating thereof, names and particulars including addresses of all the directors and their previous experiences etc shall be furnished.
10.4	Power of Attorney or other proof of authority of the person who has signed the tender.
10.5	Provident Fund Account No through which PF of the Employees are deposited including supporting document for the same.
10.6	In case of a consortium arrangement consisting of prime bidder and his associate, the prime bidder to furnish as exclusive undertaking jointly executed by him and his associate for the successful performance of the entire contract. At the time of contract finalisation, a legal document on the formation of such group has to be submitted to BHEL which will be a part of the contract document.
10.7	Any other documents required in terms of this notice.
11.0	**GENERAL**
11.1	The tender shall be completely filled in all respects and shall be tendered together with requisite information in the manner detailed above. Any tender incomplete in any respect and violating any of the instructions shall be liable to be rejected. If the space in the tender or any schedule or proforma is insufficient pages shall be separately added and numbered.
11.2	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 :-
11.2.1	To reject any or all the tender.
11.2.2	To split up the work amongst two or more tenderers.
11.2.3	To award the work in part.
11.2.4	Either of the contingencies stated in 11.2.2 and 11.2.3 to modify the time for completion suitably.
11.3	Conditions and unwitnesses tenders, tenders containing absurd or unworkable rates and amounts and tenders which are incomplete and otherwise considered defective and not in accordance with the tender conditions, specification, etc are liable to be rejected.
11.4	If a tenderer expires after his submission of the 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 the tender or after the acceptance of the tender, BHEL may cancel such tender at their discretion unless the firm retains its character.
11.5	BHEL will not be bound by any power of attorney / granted by the tenderer or by changes in the composition of the firm made subsequent to the execution of the contract. They may however, recognize such power of attorney and changes after obtaining proper legal advice, the cost of which will be chargeable to the contractor, concerned.
11.6	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 Earnest money / Security Deposits.
11.7	Canvassing in any form in connection with the tenders is strictly prohibited and the tenders submitted by the contractor who resort to canvassing are liable to rejection.
11.8	Should a tenderer or contractor or in the case of a firm or Company one or more of its partners / shareholders / directors have a relation or relations employed in the capacity of an officer of BHEL, the authority inviting tender shall be informed of the fact alongwith detail of the officer. Failing this, BHEL may, at its sole discretion, reject the tender or cancel the contract and forfeit the Earnest Money /Security Deposit.
11.9	The tender submitted by a bidder shall become property of BHEL who shall have no obligation to return the same to the bidder.
11.10	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.

PART – II

GENERAL CONDITIONS OF CONTRACT

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CLAUSE NO	DESCRIPTION
1.0	**APPLICATION**
	Unless otherwise provided in the contract documents, these general conditions shall govern the works of the accompanying technical specifications. special conditions of this volume shall be read in conjunction with these general condition and these conditions will from a part of the contract documents.
2.0	**DEFINITION OF TERMS :**
	In construing these General Conditions, Special conditions and accompanying Specification the following words shall have the meaning herein assigned to them except where the context otherwise requires.
2.1	The owner/ purchaser shall mean CUSTOMER and shall include its successor in office, legal representative and permitted assigns.
2.2	Purchaser/ vendee/ BHEL shall mean Bharat Heavy Electricity Limited a Company registered under the Indian Companies Act 1956, with its Registered Office at BHEL House, Siri Fort, New Delhi. Power Sector Eastern Region, Kolkata or its Administrative Officers or its engineer or other employees are authorised to deal with any matter with which these persons are concerned on its behalf.
2.3	EXECUTIVE DIRECTOR/ GENERAL MANAGER shall mean the officer in administrative charge of BHEL, Power Sector - Eastern Region or their other regional offices
2.4	The bidder/ tenderer shall mean well established reputed organisations, manufacturer etc having requisite financial and technical capability and experience participating in the Tender invited by BHEL for supply and delivery, erection, testing and commissioning or plant equipment and status including associated civil structural and architectural works complete as per applicable technical specifications.
2.5	The contractor shall mean the successful bidder/ tenderer who is awarded the contract and shall be deemed to include the contractor's successors assigns, heirs executors, administrators of representatives approved by the BHEL.
2.6	The sub-contractor shall mean individual or firm to whom any part of the work has been subletted by the contractor with the consent in writing of BHEL and shall include his/its heirs, executers, administrators, legal representative and permitted assigns.
2.7	The Engineer shall mean an Officer of BHEL as may be duly appointed and authorised in writing by BHEL to act as Engineer on his behalf for the purpose of the Contract, to perform the duty set forth in this General Condition of Contract and other Contract Documents.
2.8	The Consulting Engineer shall mean any firm or person as may be duly appointed and authorised in writing by BHEL/Purchaser from time to time to review plant and equipment, works and services under the Contract.
2.9	The "Review Conslutant" shall mean any firm or person as may be duly appointed and authorised in writing by BHEL/Purchaser from time to time for final review of the plant and equipment, works and services under the Contract.
2.10	The "Inspector" shall mean any firm or person as may be duly appointed and authorised in writing by BHEL/Purchaser from time to time to inspect plant and equipment, works and services under the Contract.
2.11	'Acceptance of Tender" shall mean Telegraphic/ Telex/ Tele-fax Letter of Intent or Notification communicating to the Contractor the acceptance by BHEL of his tender.
2.12	"Contract Price' shall mean the agreed sum of money stated in the Contract to be paid to the Contractor for the successful fulfilment of the Works in accordance with the terms of the Contract Documents.
2.13	"Contract" shall mean the Agreement between the Contractor and BHEL for execution of and payment for the works as defined in the Contract Documents.
2.14	The "Contract Documents" shall mean and includes the General Conditions of Contract. Specifications and Schedules. Drawings, Form of Tender, Covering Letters, Schedule of Prices and Quantities submitted by the successful Bidder, Letter of Interest of BHEL, Drawings, subsequent amendments mutually agreed upon and the Agreement to be entered in to between BHEL and the Contractor duly signed by them under the Clause – Contract" of these General Conditions and other documents that may form part (s) of the Contract Documents.
2.15	"Work or Works' shall mean the plant / equipment to be supplied and / or works to be done by the Contractor under the contract Documents.
2.16	"Plant" shall mean the portion of the work (under the scope of this contract) which includes permanent equipment, machinery, apparatus, materials, articles and civil, structural and

	architectural works and things of all kinds to be provided under the contract documents.
2.17	"Test" shall mean such test as is prescribed or considered necessary by BHEL / purchaser whether performed or made by the Engineer or any Agency acting under the direction of the Engineer.
2.18	"Constructional Plant" means all appliances or things of whatsoever nature required in or about the execution completion or maintenance of the works or temporary works by the contractor at his own cost and risk (as hereinafter defined) but does not include materials or other things intended to form or forming part of the permanent work.
2.19	"Goods" shall mean plants, equipment or materials to be supplied under the Contract Documents.
2.20	"Temporary Work" shall mean all temporary works of every kind required in or about the execution, completion or maintenance of the work by the contractor at their cost and risk.
2.21	"Completion Time" shall mean the period by date/month specified in the acceptance of tender for handing over of the intended scope of work, erected equipment / plant, which are found acceptable by the engineer being of required standard and conforming to the specifications of the contract.
2.22	"Consignee" shall mean the authorised representative or officer of the Purchaser / BHEL to whom the plant, equipment and materials are required to be delivered in the manner indicated in the Contract Documents.
2.23	The "Specification" or Specification / Technical Specifications" shall mean all Specifications including technical specifications of the Works and the Tender Drawings and schedules attached thereto and any modification made thereof.
2.24	"Drawings" shall mean drawings referred to in the Contract Documents including modifications if any and such other drawings as may be from time to time furnished by the Contractor and approved by BHEL / purchaser.
2.25	"Site" shall mean the land and other places including existing roads, paths etc., put at the disposal of the Contractor by BHEL / purchaser in connection with the execution of the Contract.
2.26	"Tests on Completion" shall mean such tests as are prescribed in the specifications and/or other tests as mutually agreed upon by BHEL/ Purchaser and the Contract to be carried out by the Contractor on erection of the plant to prove satisfactory performance as per Specification.
2.27	"Acceptance Test / Performance Guarantee Test" shall mean such test as are required to determine and demonstrate guaranteed capacity, efficiency and operating characteristics of the Plant as stipulated in the contract Documents.
2.28	"Commissioning" shall mean the successful completion of trial operations and readiness of the contracted / ordered plant and materials for commercial use. This will include all consumables and inputs required for pre-commissioning.
2.29	"Initial Operation", "Reliability Run" or "Trial Run" shall mean the first continuous operation of the plant by the Contractor covered under the Contract with sub-systems under varying loads to demonstrate satisfactory operation for a specified period which shall not be less than fifteen (15) days.
2.30	"Commercial Operation" shall mean the conditions of operation in which all the equipment covered under the Contract are officially declared by BHEL/ purchaser, to be available for continuous operation at different loads and including rated capacity. Such declaration by BHEL / purchaser will be issued within thirty days after successful trial run made by the Contractor.
2.31	"Service" shall mean furnishing of labour and services as per specifications and supervision of complete erection, testing and putting equipment and materials to be supplied into satisfactory operation, supervision of inland transportation, loading and unloading and storage at the site as defined in the Contract Documents.
2.32	"Warranty Period" shall mean the period during which the Contractor shall remain liable for repair or replacement of any defective part of the plant supplied, works done and services rendered under the Contract.
2.33	"Code" shall mean the applicable International and Indian standards as on the date of letter of intent and any subsequent modification thereof.
2.34	"Month" shall mean calender month. "Day" or "Days" unless herein otherwise expressly defined shall mean calender day or days of twenty four (24) hours each. A week shall mean continuous period of seven (7) days.
2.3	"Letter of Intent" / "Purchaser Order" shall mean BHEL's letter or notification conveying his acceptance of the Tender subject to such conditions as may have been stated therein.
2.36	"Writing" shall include any manuscript typed or handwritten or printed statement, including Telex, Cable and facsimile transmission under or over signature or seal as the case may

	be.
2.37	"Approved" or "Approval" shall mean as approved by or approval of the Purchaser/ BHEL.
2.38	Words incorporating "Persons" shall include firms, companies, corporations and other bodies whether incorporated or not.
2.39	"Words" incorporating the singular only shall also include the plural and vice-versa where the context requires.
2.40	"F.O.B" shall mean delivery free of expenses to the Purchaser / BHEL on board the vessel at the port of shipment.
2.41	"CIF Price" shall mean delivery free of expenses to the purchaser / BHEL on board the vessel at the port of entry including the insurance coverage.
2.42	"F.O.R. " Destination" shall mean delivery free of expenses to the Purchaser / BHEL on rail wagons at destination Railway Station or the purchaser's siding as may be named or / and by road transport at customer's destination.
2.43	"F.O.R. Works" shall mean loaded and stowed or trimmed free of expenses to the purchaser / BHEL on board rail wagons at the Contractor's Works siding or the nearest Railway station for transportation.
2.44	"Tonne" shall mean 1000 Kilogram weight. "Gallon" shall mean Imperial gallon, unless otherwise mentioned specifically.
2.45	"Final Acceptances" mean the BHEL's/ purchaser's acceptance of the work/plant completed in every respect as per terms of the contract Documents on expiry of the Warranty / guarantee / maintenance period.
2.46	Terms and conditions not herein defined shall have the same meaning as are assigned to them in the latest edition of Indian Sale of Goods Act/Indian Contract Act as applicable.
2.47	SINGULAR AND PLURAL
	Words importing the masculine gender or singular number shall also include the feminine gender and plural and vice versa where the context so requires.
2.48	HEADINGS OR NOTES
	The headings or notes in these conditions are solely for the purpose of facilitating reference and shall not be deemed to be part thereof or be taken into consideration in the interpretation or construction thereof or of the contract.
2.49	LANGUAGE
	All documentations and correspondence regarding the contract shall be in English language.
2.50	DOCUMENTS MUTUALLY EXPLANATORY
	Except if and to the extent otherwise provided by the contract the provisions of special Conditions of contract shall prevail over General Conditions of Contract and over those of any other documents forming part of the Contract. Subject to the foregoing the several documents forming the Contract are to be taken as mutually explanatory of one another but in case of ambiguities or discrepancies the same shall be explained and adjusted by the Engineer who shall thereupon issue to the contractor instructions directing in what manner the work is to be carried out.
3.0	**SCOPE ON CONTRACT**
	The scope of work, if not otherwise mentioned in the contract, shall be on the basis of a single contractor's responsibility, completely covering all Technical Specifications under the accompanying Technical Specification. Some of the salient features are hereunder.
3.1	Detailed design of all the equipment and subsystem and work as per specification.
3.2	Complete, manufacture of all the equipment / subsystem including shop, field testing and assembly as per specification.
3.3	Providing of special tools and tackles and services necessary for satisfactory execution of the contract.
3.4	Providing engineering drawings, data operation manual, etc.
3.5	Packing and transportations of the Goods from the manufacturer's works to the site.
3.6	Receipt, storage, preservation and conservation of the Goods at the site as applicable.
3.7	Supply of spares.
4.0	**CONTRACT PRICE** **(**UNLESS SPECIFIED OTHERWISE IN SPECIAL CONDITION OF CONTRACT)
4.1	The contract price is the agreed sum of money stated in the contract documents to be paid to the contractor for the successful completion of the works in accordance with the terms of the contract documents. The contract price shall be for the entire scope of the work with the break-ups as specified.
4.2	The individual item rates or lumpsum price as the case may be, in the schedule of this contract shall be deemed to be firm for the entire period of the Contract or extended period of contract and no escalation in the rates or price shall be permissible for any reason

	whatsoever unless otherwise specified.
4.3	The contract price shall not be varied in respect of the fluctuations in rate of wages or allowances payable to the labour or in the cost of materials, consumables, water, fuel, power or for anticipated profit or alleged losses or for any reason whatsoever,
5.0	**TAXES AND DUTIES** **(**UNLESS SPECIFIED OTHERWISE IN SPECIAL CONDITION OF CONTRACT)
5.1	EXCISE DUTY
5.1.1	Excise duty actually incurred by contractor against the despatch made from his factory constituting sale under the contract alone shall be reimbursed at actuals against requisite documentary evidence like clean invoice cum excise duty gate pass in original or certificate copy, if separately indicated in the prices bid. If excise duty is included in the price quoted by the contractor then he is not eligible for reimbursement of excise duty or statutory variation of excise duty.
5.1.2	The invoice cum excise duty gate pass should show the name of ultimate consignee as specified in the contract. If excise duty is paid under protest or dispute it shall not be eligible for reimbursement until the dispute is settled.
5.1.3	No excise duty shall be payable by BHEL on inputs bought out items, raw materials and components consigned directly to site from sources other than contractor's factory.
5.1.4	The contractor is required to ensure that excise duty is properly calculated and paid and available exemption and benefits are fully availed.
5.1.5	If required by BHEL the contractor will provide certificate, if modvat benefit has been availed on his inputs and have been passed on to BHEL.
5.1.6	If the contractor claims / obtains any refund of the excise duty paid and got reimbursed, the same shall be refunded to BHEL.
5.1.7	Excise duty shall be restricted to the amount and percentage shown in the price format. BHEL is not liable to reimburse if the excise duty shown by the contractor in his offer is incorrect.
5.1.8	The excise duty on self manufactured items of the contractor alone shall be reimbursed against submission of clean original excise duty invoice or true copy thereof duly attested by excise authorities. The payment of excise duty shall however be limited to the amount indicated in the price in the schedule. Statutory variation shall be limited to change in the tariff within the delivery specified in the order/contract only. Provisional / Conditional gate passes / excise duty invoices are not acceptable for reimbursement.
5.1.9	Contractors are required to ensure that excise duty including surcharge , if any, quoted are as per the existing tariff on the date of the offer and have availed all benefits as per existing rules.
5.1.10	EXCISE DUTY (IN CASE OF DEEMED EXPORT)
	In case of deemed export and order placed under similar financing arrangement, contractors are required to ensure that original gate passes and document to claim draw backs are made available to BHEL alongwith disclaimer certificate. In the absence of above the offer is liable to be loaded. In these cases, excise duty shall be billed separately with the above documents.
5.1.11	No statutory variation during extended period shall be allowed.
5.2	SALES TAX
5.2.1	Sales tax can be reimbursed only if the same is payable by the contractor to the respective authorities. In case any concessional provisions are applicable the same shall be availed by the bidder/ contractor.
5.2.2	Contractors are expected to meet all statutory requirements and ensure that the Sales Tax charged are not exempted under the respective Sales Tax Act. The bid/offer should clearly indicate the percentage and total amount. Concessional forms required should be clearly indicated in the bid/offer.
5.2.3	BHEL is registered in Kolkata vide registration number WB Sales Tax No - PS/2214, dated 14-12-1998.
5.2.4	Tenderers are to ensure that their offer includes all applicable taxes. In case of Intra-state sales tax. The same shall be specified.
5.2.5	Sales tax on direct sales by the contractor to BHEL shall be reimbursed, as per tariff applicable to the approved items but restricted to the amount shown in the price bid separately. If it is shown as included in the quoted price. Then it shall not be eligible for reimbursement by BHEL.
5.2.6	BHEL proposed to make sale-in-transit "C" form shall be issued / exchanged against E1/E2 forms "C" form shall be issued based on financial year transaction. Contractors are required to submit their request for issue of "C" forms in the format enclosed.

5.2.7	Form "C" will be issued after the financial year against the issue of E-1/E-2 form. Contractors are required to give the details for claiming "C" form.
5.2.8	If documents are submitted through bank. Form-C shall not be insisted for retirement.
5.2.9	Contractors are expected to avail taxation benefit. The bid/offer should clearly indicate the percentage and total amount. Concessional forms requirement should be clearly indicated in the bid/offer.
5.3	OTHER TAXES
	Bidder/tenderer are required to include all other taxes applicable on the date of the offer/bid over and above ED. ST. This will include but not limited to Octroi, turnover, works contract tax, entry tax, consignment tax, income tax, etc as applicable.
5.4	CUSTOMS DUTY
	Contractor shall arrange for their own import licence if required since BHEL will not provide any import licence. The custom duty element for imported items shall be included in the basic price. No. variation in customs duty / exchange rate for imported items shall be payable by BHEL.
5.5	FREIGHT CHARGES
	Contractor shall be required to transport the items through transport contractor of repute and with due consent / approval of BHEL. Freight charges shall be payable by the contractor. However, all documents in proof of payment of freight charges are to be submitted along with the bills to BHEL.
6.0	**PRICE VARIATION** **(**UNLESS SPECIFIED OTHERWISE IN SPECIAL CONDITION OF CONTRACT)
6.1	The price shall remain firm, for any increase or decrease in order value upto +/- 30% BHEL shall have the right to increase / decrease quantity upto the above order value and tenderer shall be bound to accept the same at the same price without any escalation.
6.2	Transport: If for any reason, the contractor has to resort to a mode of transport other than what was contemplated by him at the time of tendering to keep up the completion schedule and consequently has to incur more expenditure, BHEL will not under any circumstances reimburse such extra expenditure and price will not exceed the firm contract / order price.
7.0	**STATURORY VARIATIONS** **(**UNLESS SPECIFIED OTHERWISE IN SPECIAL CONDITION OF CONTRACT)
7.1	It is the responsibility of the tenderer to inform himself of the correct rates of customs or other duties or taxes leviable on the on the materials at the time of tendering. If the rates assumed by the tenderer are less than the correct rates prevailing at the time of tendering the tenderer will be responsible for such errors.
7.2	If the rates assumed are higher than the correct rates prevailing at the time of tendering, the difference will be to the credit of BHEL.
7.3	Should, however, any statutory alternation be made based on the rate prevailing at the time of tendering, the difference for excise duty & sales tax only, either up or down, will be to the account of BHEL. No variations on customs duty / exchange rate / minimum wages, prices of controlled commodities or any other input shall be payable by BHEL.
7.4	Notwithstanding the above, where the actual completion of the supply occurs beyond the period stipulated in the order/contract, variations above referred to will be limited to the rates prevailing on the dates of the stipulated completion period only and for variations after the agreed completion period the tenderer alone shall bear the impact if it is upward revision and if it is downward revision BHEL shall be given credit to the extent. This will be without prejudice to the levy of penalty for delay in completion.
8.0	**TERMS OF PAYMENT** **(**UNLESS SPECIFIED OTHERWISE IN SPECIAL CONDITION OF CONTRACT)
8.1	SUPPLY
8.1.1	Ninety (90%) percent value of equipment supplied alongwith applicable 100% taxes and duties etc. for the consignment shall be paid against despatch documents on pro-rata basis. All bank charges shall be to the account of the contractor.
8.1.2	Balance ten (10%) percent payment shall be made after receipt and physical verification of materials at site by site engineer on pro-rata basis (against material receipt certificate (MRC) from site office) and on availability of extended security bank guarantee to cover the guarantee period.
8.1.3	No advance payments shall be made.
8.2	SUPERVISION, ERECTION AND COMMISSIONING / SUPERVISION OF ERECTION & COMMISSIONING
	Hundred (100%) percent payment shall be made only after commissioning of the equipment, final acceptance and receipt of bank guarantee to cover guarantee period.
8.3	Recommended/ Mandatory Spares.

	Same as clause no 8.1 above.
9.0	**DOCUMENTS FOR CLAIMING SUPPLY PAYMENT** (FOR INDIGENOUS SUPPLIERS ONLY) **(**UNLESS SPECIFIED OTHERWISE IN SPECIAL CONDITION OF CONTRACT)
	Following documents shall be submitted for claiming supply payments in required number of sets.
9.1	Invoice.
9.2	LR/RR/GR
9.3	Delivery challan.
9.4	Packing list showing item-wise details, size, quantity/ number, net & gross weight, number of packages and their identification.
9.5	BHEL MDCC (Material Despatch Clearance Certificate).
9.6	QS note issued by BHEL inspection agency.
9.7	Copy of letter to Insurance company to cover items despatched under insurance policy.
9.8	Original material receipt certificate (MRC) from site office shall be required for claiming payment against receipt of material at site.
10.0	**BANK CHARGES**
10.1	All bank charges for documents through bank shall be to the account of contractor.
10.2	The address of BHEL banker is STATE BANK OF INDIA, N. S.ROAD BRANCH,KOLKATA
11.0	**TIME (THE ESSENCE OF CONTRACT)**
11.1	The time and date of completion of the work as stipulated in the contract Documents shall be deemed to be the essence of the Contract. The contractor shall commence the works and shall proceed with the same with due expedition and without delay except as may be expressly sanctioned or ordered by the Engineer. If the contractor fails to commence the work within the stipulated time. BHEL at his sole discretion will have the right to cancel the contract. In such an event the contractor's security deposit with BHEL will stand forfeited without any further reference to the contractor, without prejudice to any and all of the BHEL's other rights and remedies in this regard. The Contractor shall so organise his resources and perform so as to complete the work not later than the aforesaid date of completion.
11.2	The contractor shall submit a PERT Network showing various key phases of the work such as design, procurement, manufacturing, shipment, etc. within thirty (30) days after the date of Letter of intent/purchase order. This network shall also indicate the interface facilities to be provided by the owner / BHEL and the dates by which such facilities are needed by the contractor and also the programme for phase wise release of work site for construction work as may be needed by the contractor, as applicable.
11.3	The Contractor shall discuss the network so submitted with BHEL. The agreed network may be in the form as submitted or in revised form in line with the outcome of discussion and shall from a part of the contract documents.
11.4	The above PERT Network shall be reviewed and periodic review reports shall be submitted by the Contractor to BHEL as directed by him.
11.5	The Contractor shall make available to BHEL detailed manufacturing, erection, testing and commissioning and construction programmes, as applicable, in line with the agreed PERT Network in the form of PERT or Bar Chart as desired by BHEL within 30 days from the date of receipt of LO1/PO. During performance of the contract, such programmes shall be renewed, updated and submitted to BHEL as and when needed by him or periodically as specified by him. If in the opinion of BHEL proper progress is not maintained suitable changes suitable changes shall be made in the Contractor's operation to ensure proper progress.
11.6	PROGRESS REPORTS AND PHOTOGRAPHS
11.6.1	The Contractor shall furnish eight(8) prints each of monthly progress reports as approved by BHEL and photographs of the work done. Photographs shall be taken when and where indicated by the Engineer or his representative. Photographs shall be approximately 100mm x 125mm in size including margin of 5 mm side for fixing. Adequate number of photographs shall be submitted indicating various stages of manufacture and / or installation as applicable. Each photograph shall contain the date, the name of the contractor and the title of the view taken.
11.6.2	Monthly progress report shall be submitted. These shall detail the status of design, drawings, procurement of raw materials and manufacture of the equipment and delivery of the equipment. BHEL shall advised the contractor about the progress schedule and photographs he has to submit each month together with the names and address of persons to whom they are to be sent. The contractor shall also furnish actual progress against schedule and such other information as BHEL may require to satisfy himself about

	the timely manufacture and delivery of equipment and timely construction and erection work to suit the commissioning date. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measure wherever necessary.
11.6.3	The submission and acceptance of the photographs and / or reports shall not prejudice the rights of BHEL in any manner.
11.6.4	In the event of contractor's continued poor progress of work, BHEL shall at his option treat this as breach of the contract by the contractor. In such an event it shall be open to BHEL to have the work completed through any other agency or agencies and claim the difference in cost in addition to damages from the contractor without prejudice to any other right or remedy of BHEL under this contract.
11.6.5	The contractor shall be responsible, wherever applicable, for developing detail drawings to adopt equipment and materials to be supplied to the requirement indicated in the specification and shall submit a list of such drawings and programme for submission of these drawings and programme within 30 days from the date of LO1.
11.6.6	Within a reasonable time not exceeding 30 days from the date of LO1 the contractor shall also provide BHEL with the following drawings and date as applicable :
11.6.6.1	Eight (8) marked up copies of technical particulars conforming to the specification.
11.6.6.2	Outline drawings of all equipment together with weights and sufficient overall dimensions.
11.6.6.3	Other drawings and data as indicated in different sections of the tender documents.
11.6.6.4	The contractor shall within 3 weeks form the date of LO1 submit for approval of BHEL the original copies of Codes and Standards which shall govern the design, manufacture, construction, erection, testing, commissioning and trial operation of the plant as applicable under scope of contract.
11.7	MISTAKE IN DRAWINGS
	The Engineer shall have the right at all reasonable times to inspect at the office / premises of contactor all shop and / or detailed drawings of the works or any portion of the works. The Contractor shall be responsible for and shall pay for any alternations of the work due to any discrepancies, errors or omission in the drawings or other particulars supplied by him whether such drawings or particulars has been approved by the Engineer or not. Provided that such discrepancies, errors or omissions be not due to inaccurate information or particulars furnished to the contractor by the Engineer, in which event BHEL shall pay for any alternations of work necessitated by reason of inaccurate information supplied by the Engineer to the Contractor.
12.0	**DELIVERY FAILURE TERMINATION/ LIQUIDATED DAMAGES** **(**UNLESS SPECIFIED OTHERWISE IN SPECIAL CONDITION OF CONTRACT)
12.1	It should be clearly understood by the Contractor that time and the date of delivery of despatch stipulated in the order/contract is the essence of the contract, If the contractor fails to complete the order / contract within the time fixed in the order / contract, or within any extension of time granted by BHEL, it shall be lawful for BHEL to recover damages for breach or order / contract without prejudice to any other rights and / or remedies provided for, in the order / contract and hereunder. To be entitled to impose such damage, BHEL will not be required to prove that he has incurred such amount as actual damage.
12.2	DELAYED DELIVERY
12.2.1	This being a turnkey BOP package, if vendor fail to complete the total job of (supply & service parts) as per the completion period for the service part (as per of Vol-1D), BHEL shall have the right to recover from the contractor, as agreed liquidated damages a sum equivalent to half percent (1/2%) of the executed contract price(for the supply part) for the delayed portion per week or part thereof subject to a maximum of ten percent (10%) of the total executed contract price (i.e. sum total of supply & service part) if the contractor fails to install any part of equipment /item within the period fixed for installation of the same (as per Vol-1D). **Note:** 1. The cumulative LD for the supply & service part shall be limited to 10% of the executed contract value (for the supply & service parts). 2. (applicable for supply of the Mandatory spares, if ordered separately only): Recovery shall be done as agreed liquidated damages a sum equivalent to half percent (1/2%) of the order /contract price (only for mandatory spares) for the delayed portion per week or part thereof subject to a maximum of ten percent (10%) of total order/contract price (for mandatory spares only) if the contractor has fails to deliver any part of equipment /item within the period fixed for delivery of the same as per Vol-1C.

12.2.2	Purchase from elsewhere on account and at the risk of the contractor of the equipment /item not so delivered or others of a similar description without cancelling the order / contract in respect of the instalment not yet due for delivery or	
12.2.3	Cancel the order / contract or a portion thereof and if so desired purchase the equipment/item not so delivered at the risk and cost of the contractor and the contractor shall be liable to BHEL for any excess costs provided that the contractor shall continue the performance of the contract to the extent not cancelled under the provisions of this clause.	
12.2.4	Where action is taken under clause mentioned above at b & c, contractor shall be liable for any loss which BHEL may sustain on that account. The contractor shall not be entitled to any gain on such purchase and the manner and the method of such purchase shall be at the entire discretion of BHEL. It shall not be necessary for BHEL to serve a notice of such purchase on the contractor.	
13.0	**COMPETENCE AND GUARANTEES**	
13.1	Contractor shall have sound technical and financial capabilities and possess recognised experience in executing the works of similar kind and magnitude. The contractor shall properly fill in the various schedules and proforma prescribed in the tender documents. Non submission of the information in the prescribed schedules and proforma may lead to rejection of the bid.	
13.2	SECURITY DEPOSIT (SD)	
13.2.1	Upon acceptance of tender, the successful tenderer within the time specified in the letter of intent must deposit required amount as security deposit for satisfactory completion of work and shall not commence work under the contract before remitting security deposit except as directed by BHEL.	
13.2.2	The amount of Security Deposit shall be as follows.	
	a) In the case of work upto ten lakh	10%
	b) In the case of work costing above Rs. 10 lakh upto Rs. 50 lakhs	Rs. 1[One] lakh plus 7.5% of the the amount exceeding Rs 10 lakhs.
	c) Above Rs 50 lakhs	Rs. 4 [Four] lakh plus 5% of the the amount exceeding Rs 50 lakhs.
13.2.3	The Security deposit may be deposited in any of the following form.	
13.2.3.1	The security deposit as indicated in letter of intent can be paid in the form of bank guarantee/cash (as permissible under the Income Tax Act)/Pay Order or Demand Draft (in favour of Bharat Heavy Electricals Limited payable at Kolkata)/ local cheques of Scheduled Banks (subject to realization) to BHEL, Power Sector, Eastern Region, Kolkata within the time limit stipulated in the letter of intent. The bank guarantee shall be from Scheduled Banks/ Public Financial Institutions as defined in the Companies Act in the prescribed proforma, validity being upto completion of work as stipulated in letter of intent or stipulated otherwise in the proforma, whichever is later. The bank guarantee furnished towards security deposit should be kept valid by proper renewal till said work is actually completed	
13.2.3.2	50% of Security Deposit as indicated in the letter of intent can either be paid in the form of Bank Guarantee from Scheduled Banks/Public Financial institutions as defined in the Companies Act in the prescribed proforma, the validity being upto completion of work as stipulated in the letter of intent and balance 50% of the security deposit can paid either in cash/ other form of security or may be recovered by deduction from running bills @ 10% of the value of each running bills till the full Security Deposit is made up. The Bank Guarantee furnished towards Security Deposit should be kept valid by proper renewal till the said work is actually completed.	
13.2.3.3	The security deposit may be submitted through securities from Post Offices such as National Savings Certificates/Kisan Vikas Patras etc (certificates should be held in the name of the contractor furnishing the security and duly pledged in favour of Bharat Heavy Electricals Limited, Power Sector, Eastern Region, Kolkata and discharged on the back).	
13.2.3.4	The security deposit may be submitted by 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 Bharat Heavy Electricals Limited, Power Sector, Eastern Region, Kolkata, duly discharged on the back.	
13.2.4	Acceptance of security deposit against sl. No. 13.2.3.3 & 13.2.3.4 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 collection of interest or renewal of the documents or in any other matter connected therewith.	
13.2.5	If the value of the work done at any time exceeds accepted agreement value, the security deposit shall be correspondingly enhanced and the extra security deposit shall be	

	immediately deposited by the contractor or recovered from payments due to him.
13.2.6	Regarding adjustment of Earnest Money deposit towards part of Security Deposit, refer clause under EMD above.
13.2.7	Failure to deposit security money within stipulated time may lead to forfeiture of Earnest Money and cancellation of award of work.
13.2.8	If any parts of security deposit of the contractor is held in the form of approved securities it shall be kept transferred in the name of Bharat Heavy Electricals Limited, Power Sector, Eastern Region, Kolkata in such a manner the BHEL can realize it fully without reference to the contractor. BHEL shall not be responsible for any depreciation in the value of the security while in BHEL's custody or for any loss of interest thereon.
13.2.9	BHEL reserve the right of forfeiture of security deposit in addition to other claims and penalties in the event of the contractor's failure to fulfil any of the contractual obligations (including liquidation or bankruptcy of the contractor, non-payment of money payable by means of arbitration award in favour of BHEL) or in the event of termination of contract as per terms and conditions of contract. BHEL reserve the right to set off these security deposit, against any claims of any other contract with BHEL.
13.2.10	"If the final price of successful bidder is lesser by 'more than 30%' of BHEL's estimate and the difference between the price of L-1 & L-2 is more than 10% of BHEL's estimate then only, '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 minimum 5% & maximum 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."
13.2.11	RETURN OF SECURITY DEPOSIT
	If the contractor duly performs and completes the contract in all respects to the entire satisfaction of BHEL and presents an absolute no Demand Certificate in the prescribed form and returns properties belonging to BHEL taken / borrowed or hired by him for carrying out the said works, half of the amount of Security Deposit will be released to the contractor after deducting all costs of expenses or other amounts that are to be paid to BHEL under this or other contracts entered into with the contractor. It may be noted that in no case the Security Deposit shall be refunded/released prior to passing of final bill. Balance half of the amount of Security Deposit will be released only after the satisfactory completion of Warranty / Guarantee Period as per terms of specification.
13.3	PERFORMANCE BOND
13.3.1	In addition to the security deposit the contractor shall provide to BHEL guarantee of an approved nationalised bank for an amount equal to 5% of the awarded/executed contract price (as per LOI/RA bills) as Performance Bond (under the terms of a bond) within 30 days from the date of LOI (Letter of Intent) and terms of the said bond shall be such as shall be approved by BHEL. The bond shall remain valid until 6 (SIX) month 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.
13.3.2	BHEL reserve the right of forfeiture of the above bond in addition to other claims and damages 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 contract. BHEL reserve the right to set off this bond against any claims of any other contract with BHEL.
14.0	**DELIVERY TERMS**
	When the goods are ready for shipment BHEL / owner should be notified by the contractor through Fax or Telex. Notification of delivery or despatch in regard to each and every consignment shall be made to the owner/BHEL immediately after despatch or delivery ensuring arrangements for its receipt at the site at least 48 hours ahead of actual delivery. The contractor shall further supply to the consignee a priced invoice and packing list of all goods delivered or despatched by him and other shipping particulars. All packages,

	containers, bundles and loose materials forming part of each and every consignment shall be described fully in the packing list, and full details of the contents of packages and quantity of goods shall be submitted to enable the consignee to check the goods on arrival at destination.
15.0	**SHOP ASSEMBLY AND INSPECTION**
15.1	Shop assembly to the largest extent feasible shall be performed by the contractor to assure proper fitting of the various parts and for checking the correctness of clearances and dimensions. Parts thus assembled shall be match – marked for reassembly at the site. Prior to be dismantled for shipment. A detailed description of the intended shop assemblies shall be submitted along with the Quality Assurance Plan.
15.2	No Goods shall be shipped before all tests and inspection have been carried out according to the approved Quality Assurance Plan unless otherwise instructed by BHEL.
15.3	The acceptance of any Goods prior to shipment shall in no way relieve the contractor of any of his responsibilities for meeting all the requirement of the specification and shall not prevent subsequent rejection if such Goods are found to be defective.
15.4	BHEL/ owner and his duly authorized representative shall have the power at all reasonable times to inspect drawings of any portion of the work or examine the materials and workmanship of the equipments/ items during its manufacture
15.5	Such inspection, examination and testing shall not relieve the contractor from any obligation under the contract.
15.6	BHEL engineer shall on giving seven (7) days notice in writing to the contractor setting our any ground of objection which he may have in respect of the plant/equipment /work, be at liberty to reject any drawings and all or any plant or workmanship, subject to any of the said ground of objection, which in his opinion are not in accordance with the contract / order. The contractor shall give due consideration to such objection and shall either make the modifications that may be necessary to meet the said objections or shall satisfy the engineer that no modifications are necessary to comply with the contract/order.
15.6	The contractor shall give the engineer and his duly authorized representatives notice of any material being ready for testing, and the engineer or the said representative shall (unless the inspection of tests voluntarily waived) on giving reasonable previous notice in writing to the contractor attend at the contractor's premises (as the case may be) within twenty (20) days of the date on which the material is notified as being ready, failing which the contractor may proceed with the tests which shall be deemed to have been made in the engineer's presence. All standard shop tests physical and chemical tests required by the standards or as may be prescribed or approved by the engineer reserves the right to waive any of the above tests requirement and to prescribe new tests required if fours necessary to expedite the work or to confirm to the latest and best practice. Definition, method of measurement, calibration of inspection, measuring and test equipments and required procedure as referred in the above standard and / or those approved by the engineer and equivalent shall be followed. The contractor shall forthwith forward to the engineer duly certified copies of the test certificates in quadruplicate for approval. Further copies of the shop test certificate shall be bound will the instruction manuals.
15.7	In all cases where the order/ contract provided for tests/ inspections whether at the premises or works of the contractor or any sub-contractor the contractor, except where otherwise specified shall provide free of charge to BHEL such labour, materials, electricity, fuel, water, stores, apparatus, inspection measuring and test equipments as may reasonably be required to carry out efficiently such tests of the equipment/ plant, in accordance with the order/ contract and shall give facilities to the engineer or his authorised representative to accomplish such testing.
15.8	The contractor shall maintain & ensure necessary safety measures as required for inspection and tests like HV test, Pneumatic test, Hydraulic test, Loan test Spring test, Bend test etc, of his/his subcontractors works to enable inspection Agency for performing inspections. If any test equipment is found not complying with proper safety requirements, then the inspection agency may withheld inspection, till such time desired safety requirements are met.
15.9	INSPECTION MEASURING AND TEST EQUIPMENTS (IMTE)/ MMD
15.9.1	Inspection measuring and test equipments (IMTE) whether used by the contractor or his sub-contractor shall be calibrated, maintained and controlled. Calibration shall be valid and IMTE shall be in sound condition during usage.
15.9.2	In addition to above, contractor shall ensure the following.
15.9.2.1	Measurement uncertainly is known and consistent with required measurement capability of the IMTE.
15.9.2.2	Selection of IMTEs is compatible with the necessary accuracy precision of required

	measurement.
15.9.2.3	IMTEs are calibrated at the required internal against certified equipments having known valid relationship to nationality recognised standard/ recognised calibration labs.
15.9.2.4	Calibration records are available and traceable to the particular IMTE.
15.9.2.5	In case during recalibration the IMTE is found out of calibration, report on action taken to validate the previous results along with both calibration records of the IMTE should be furnished to BHEL. NOTE: BHEL decision on acceptability of the product in such case shall be binding.
15.9.2.6	IMTEs are stored, handled and preserved such that accuracy and fitness are maintained and safeguarded from adjustments.
15.9.2.7	Responsibility of usage of valid and calibrated IMTEs by sub-contractors shall be of the contractor.
15.9.2.8	In case calibration records are required by owner/ BHEL, copies of the same shall be furnished.
16.0	**MATERIALS AND WORKMANSHIP**
16.1	All Goods to be supplied and all works to be done by the Contractor under Contract shall be manufactured and executed in the manner stipulated in the specification or where not specified, to the satisfaction of the Engineer.
16.2	All materials used in the manufacture of the plant/equipment/system shall be selected from the best available for the purpose considering strength, durability and best engineering practice, free from defects and imperfection of recent manufacture and unused. Liberal factors of safety shall be used throughout the design and specially in the design of all parts subject to alternating stresses or shocks.
16.3	All the work shall be performed and completed in a thorough work-man like manner and shall follow the best modern practice in the manufacture of high grade equipment notwithstanding any omission in the Specification.
16.4	Castings shall be free from blow holes, flaws, cracks or other defects and shall be smooth, close – grained and of true forms and dimensions. No plugged or filled –up holes or other defects will be allowed. Such castings are liable to be rejected. However, the Contractor may rectify minor casting defects by welding or other method in accordance with the standard manufacturing practice provided such rectifications does not affect the strength of the casting or impair with the efficient working of the Plant and prior approval of BHEL is obtained for the same.
17.0	**COMPLETENESS OF EQUIPMENT**
17.1	The equipment shall be completely installed in every respect with all mountings, fixtures and standard accessories which are normally supplied even through not specifically detailed in the Specification. The Contractor shall not be eligible for any extra payment in respect of such mountings, fittings, fixtures and accessories if needed for safe operation of the equipment as require as per applicable codes of the country through they may not have been included in the Contract.
17.2	Parts of all similar equipment supplied shall be interchangeable with on another.
17.3	All the equipment supplied under this contract shall be subject to BHEL/owner's approval according to applicable stipulations set-forth in the specifications.
18.0	**REJECTION OF DEFECTIVE PLANT**
18.1	If the completed plant or any portion thereof before it is taken over under clause taking over or during the guarantee / warranty period, be found defective or fails to fulfil the requirements of the contract, the Engineer shall give the contractor notice setting forth particulars of such defects or failure, and the contractor shall forthwith make the defective plant good or alter the same to make it comply with the requirements of the contract. Should he fail to do so within a reasonable time, BHEL after giving seven (7) days written notice may reject and replace at the cost of the contractor the whole or any portion of the plant, as the case may be, which is defective or fails to fulfil the requirements of the contract. The contractor's full and extreme liability under this clause shall be satisfied by the payment to BHEL of erection plus difference, if any between the replacement price of the equipment including charges for erection and supervision of erection and the original contract price including charges for erection and supervision of erection in respect of such defective plant.
18.2	In the event of such rejection, BHEL shall have the right to operate any and all equipment as long as it is in operating condition, whether or not, such equipment has been accepted as complete and satisfactory to enable him to obtain necessary replacement except that this shall not be constructed to permit operation of any equipment which may become damaged by such operation before any required alterations or repairs and /or replacements have been made. All repairs or alterations or replacements required of the

	contractor shall be made by the contractor at such times as directed and in such a manner as will cause the minimum interruption in the use of the equipment. Should the contractor not so replace the rejected plant within the time frame as directed by the engineer upto the requirement of the specification, the contractor's full and extreme liability under this clause will be satisfied by the repayment of all money paid by BHEL to him in respect of such plants.
18.3	Nothing in this clause shall be deemed to deprive BHEL or, effect any right under the contract which he may otherwise have in respect of such defects or deficiencies or in any way relieve the contractor or his obligation under the contract.
19.0	**TAKING OVER**
	Upon successful completion of all the tests to be performed at the site on equipment, systems and material furnished and erected by the contractor and on completion of successful trial run, BHEL shall issue to the contractor a taking over certificate. Issuance of such certificate shall not be reasonably with held on account of minor omissions or defects which do not affect the satisfactory operation and / or causes any serious risk to the equipment and systems provided the contractor gives an under taking to rectify such defects / omissions within a reasonable period time. However until a final acceptance certificate is issued on completion of warranty / guarantee period by BHEL/owner, the contractor shall not be relieved of any of his obligations, duties, responsibilities under the terms and conditions of the contract including insurance as specified elsewhere in the contract documents. The taking over by BHEL / the owner may be for each unit completed in all respects for satisfactory operation at the discretion of BHEL/ the owner.
20.0	**GUARANTEE/ WARRANTY**
20.1	The contractor shall warrant that the equipment / item supplied shall be free from all defects and faults in design, material, workmanship and manufacture and shall be of the highest rate and consistent with the established and generally accepted standards for stores of the type ordered in full conformity with the order/contract, specifications, drawings or samples, if any Contractor shall be responsible for the quality of products supplied by its sub-contractors.
20.2	The contractor shall provide guarantee / warranty in respect of the equipment, materials and services furnished by him as enumerated in section "Special Condition of Contract" of this tender document.
20.3	The contractor shall, if required, replace, or repair the equipment/item of such portion thereof, as is rejected by BHEL free of cost at the site or at the option of BHEL the contractor shall pay to BHEL value thereof at the order/contract price and such other expenditure and damages, as may arise by reason of the breach of the condition therein specified.
20.4	All replacements and repairs that BHEL shall call upon the contractor to deliver or perform under the guarantee shall be delivered free cost and performed promptly and satisfactorily by the contractor within three months. If the contractor so desires and BHEL agrees subject to import control regulation, the replaced parts can be taken over by him or his representative or the same can be arranged to be despatched by the contractor or his representative at contractor's cost as he deems fit within a period of three months from the date of replacement of equipment/ item/ parts.
20.5	The cost of any special or general overhaul rendered necessary during guarantee / warranty period due to defects in the plant or, defective work carried out by the contractor the same shall be borne by the contractor.
20.6	If for rectification or replacement of any part of equipment or work due to defective materials, manufacture or design or workmanship, the services of the contractor's personal are requisitioned within the guarantee/ warranty period, these services shall be made available free any cost to BHEL/ owner.
20.7	All the replaced equipment/ item shall also be guaranteed as per provision of guarantee/ warranty.
21.0	**INSURANCE**
21.1	BHEL shall arrange for insuring the materials / properties of BHEL/Customer covering the risks during transit, storage, erection and commissioning.
21.2	It is the sole responsibility of the contractor to insure the workmen, his properties including tools and plants against accident and injury while work as required by relevant rules and to pay compensation, if any, to workmen as per workmen's compensation Act. This policy shall also cover the contractor against claims for injury, disability, disease or death of his or his sub-contractor's employee, which for any reasons are not covered under the Workmen's Compensation Act & Employee's liability, the liability of which shall not be less than statutory provisions.

21.3	All the rules and regulations of the purchaser/ BHEL in the area of project which are in force from time to time will have to be followed by the contractor.
21.4	If due to negligence and / or non-observance of safety and other precautions and accident/ injury occurs to any other person/ public, the contractor shall have to pay necessary compensation and other expenses. If so decided by the appropriate authorities.
21.5	If due to contractor's carelessness, negligence or non-observance of safety precautions damage to BHEL's/ owner's property and personnel should occur, and if BHEL is unable to recover, in full cost from the insurance company, the balance will be recovered from the contractor. The damage is to be reported within 48 hours of occurrence along with Engineers report. In the event of loss/ theft of BHEL's/ purchaser's property while in the custody of the contractor, it will be the responsibility of the contractor to lodge an FIR with responsibility of the contractor to lodge an FIR with local policy authorities and furnish the details of FIR and Engineer's investigation report about loss/ theft within 48 hours of occurrence. This is for the purpose of lodging insurance claim. If BHEL is unable to recover full cost from Insurance Company, the balance including deductable franchise wherever applicable will be recovered from the contractor.
21.6	The contactor shall be responsible for furnishing all the despatch details including invoice value, plant / components despatched, packing slip, LR/RR/CR copy, shipping details etc. to underwriter and BHEL, to cover no. to be intimated to he contractor afterwards.
21.7	Failure to comply the above on time and in case any loss / damage occurs in transit, the contractor shall responsible for making good such loss / damage.
21.8	Save provisions as stated above the contractor at his cost shall arrange, secure and maintain insurance as may be necessary to protect his interests and the interests of BHEL against all risk and the responsibility to maintain such insurance coverage at all times during the period of contract shall be that of the contractor alone. Contractor's failure in this regard shall not relieve him of any of his contractual responsibilities and obligations.
22.0	**NO WAIVER OF RIGHTS**
	Neither the inspection by the BHEL or any other official, employee or agent nor any order by BHEL for payment of money or any payment for or acceptance of the whole or any part of the scope under this contract by BHEL, nor any extension of time, nor any possession taken by BHEL shall operate as a waiver, of any provision of the contract or of any power herein reserved to BHEL or any right to damages herein provided nor shall any waiver of any breach in the contract / order be held to be a waiver or any other subsequent breach.
23.0	**MATERIAL DESPATCH CLEARANCE CERTIFICATE (MDCC)**
	When the tests have been satisfactorily completed at the contractor's work, the Engineer shall issue a certificate to that effect within fifteen (15) days after completion of test, but if the tests were not witnessed by the engineer or his representative, the certificate would be issued within fifteen (15) days of the receipt of the test certificates by the Engineer. No plant / equipment shall be transported before such a certificate has been issued. The satisfactory completion of these tests or the issue of this certificate, shall not bind BHEL to accept the plant / equipment should it, on further test after erection, be found not to comply with the order / contract provisions.
24.0	**PACKING**
24.1	The packing shall be in conformity with specification and shall be such as to ensure prevention of damages, corrosion, deterioration, shortages, pilferage and loss in transit or storage.
24.2	The packing shall be capable of withstanding the rigours of transit and handling at various points / ports.
24.3	In case of shipment by sea the packing shall be sea worthy of international standard.
24.4	Packing list shall also be submitted along with advance set of documents for claiming payment indicating following. Packing size. Gross weight and set weight of each package.
25.0	**SHORTAGE/ DAMAGE**
25.1	In case of shortages/ damages noticed on receipt of materials at site, the contractor should replenish the same immediately. Replenishment of damages arising out of faulty and insufficient packing will be to the cost of contractor and shortages out of sound cases, if not accepted by under writer, will have to be replenished free of cost by the contractor.
25.2	In case of faults, deficiencies in materials, components assemblies, subassemblies etc, these are to be supplied free of cost to enable the equipment to be put in order.
26.0	**INTER-CHANGEABILITY**
26.1	All similar components / parts of similar equipment supplied shall be interchangeable with

	one another.
26.2	Even though all the work and materials necessary to the satisfactory completion of the works may not be detailed in the specifications and schedules, their cost will be considered to be within the order / contract and no extra charges will be accepted.
27.0	**DEFAULT BREACH OF CONTACT, INSOLVENCY AND RISK PURCHASE**
27.1	If the contractor fails to deliver the equipment / plant or any instalment thereof within the period (s) fixed for such delivery or at any time repudiates or otherwise abandons the order /contract before expiry of such period or otherwise fails to perform the order/contract or commits any breach of the order / contract not herein specifically provided for or if the contractor being an individual or if a firm on a partner thereof, shall at any time, be adjudged insolvent or shall have a receiving order for administration of his estate made against him or shall take any proceeding for composition under any insolvency Act for the time composition under any insolvency Act for the time being in force or make any assignment of the order / contract or enter into any assignment of the order/contract or enter into any arrangement or composition with his creditors or suspend payment or if the firm dissolved under the partnership Act or if the contractor being a company is wound up voluntarily or by order of a court or a Receiver. Liquidator or Manager on behalf of the debenture holders/ creditors is appointed or circumstances shall have arisen which entitles the Court of debenture holder / creditors to appoint a receiver, liquidator or manager, BHEL without prejudice to his right to recover any expenses, losses or damages to which BHEL may be put to incur or sustain by reason of the contract shall be entitled to cancel the order/contract on whole or portion thereof without compensation to contractor and if so desires, he may procure upon such terms and in such manner as he deems appropriate items not so delivered or others of a similar description where items exactly complying with particulars are not, in the opinion of BHEL, which shall be final, readily procurable, at the risk and cost of the contractor and the contractor shall be liable to BHEL for any excess costs provided that the contractor shall continue the performance of the order/contract to the extent not cancelled under the provisions of this clause. Provided also that the contractor shall not be entitled to any gain on repurchase etc.
27.2	NEGLIGENCE
	If the Contractor shall neglect to execute the work with due diligence and expedition or such refuse or neglect to comply with any reasonable orders given to him in writing by BHEL in connection with the work, or shall contravention the provisions of the contract BHEL may give notice in writing to the Contractor calling upon him to make good the failure, neglect or contravention complained of, Should the Contractor fall so comply with such notice within a period considered reasonable by BHEL from the date of such notice service thereof, in the case of a failure, neglect or contravention capable of being made good within that time, or otherwise within such time as may be in the opinion of BHEL be reasonably necessary for making it good, then and in such cash BHEL shall the option and be at liberty to take the work wholly or in part, out of the Contractor's hand and may carry on the work envisaged in the Contract either by himself or his agents or may re-contract with any other person or person to execute the same or any part thereof and provide, as applicable, any other materials, tools, tackle or labour for the purpose or completing the works or any parts thereof. In such event BHEL shall without being responsible to the Contractor for normal wear and tear or the same, be entitled to seize and take possession and have free use of all materials, tools, tackle, or other things which may be on the Site, for use at any time in connection with the work to the exclusion of any right of the Contractor over the same and BHEL shall be entitled to retain and apply any balance sum which may otherwise be then due on the contract by him to the contractor or such part thereof as may be necessary to the payment of the cost of execution of such work as aforesaid . If the cost of completing the works or executing a part thereof as aforesaid shall exceed the balance due to the contractor, the contractor shall pay such excess.
28.0	**FORECLOSURE OF CONTRACT**
	If at any time after acceptance of the Tender the owner/BHEL shall decide to abandon or reduce the scope of the work for any reason whatsoever and hence not require the whole or any part of the work to be carried out, BHEL shall give notice I writing to that effect to contract and the Contractor shall have no claim to any payment of compensation or otherwise, whatsoever, on account of any profit or advance which he might have derived from the execution of the works in full but which he could not derive in consequence of the foreclosure of the whole or part of the work. The contractor shall have no claim for compensation against certificate vouchers or explanations, to enable the contractor to properly identify such claims. Such claims shall be paid by the contractor within fifteen (IS) days of the receipt of the corresponding bills and if not paid by the contractor within the

	said period. BHEL may then deducted the amount from any money due or becoming due by him to the contractor under the contract or may be recovered by actions of law or otherwise, if the contractor fails to satisfy BHEL of such claims.
30.0	**ASSIGNMENT AND SUB-CONTRACTING**
30.1	ASSIGMENT
	The Contract shall not assign or transfer the Contract or any part thereof or any benefit or any obligation thereof or interest therein or there under (otherwise than by a charge in favour of the Contractor's Bankers of and moneys due to become due under this contract) without the prior written consent of BHEL.
30.2	SUB-CONTRACTING
	Subcontracting of work, normally should not be permitted. However in case of unavoidable instances, the contractor may, after informing BHEL and getting his written approval along with approval of the owner, assign or subcontract any part of the contract other than for raw materials, for minor details or any part of the plant for which details or any part of the plant for which makes are identified in the contact. BHEL shall not be liable in any way, in case such approval for sub-contracting is not permitted by the owner. Sub-contractor of the equipment not identified in the contract or any change in the identified sub-contractor shall be subject to approval by BHEL and the owner. The experience list of the equipment sub-contractor under consideration by the contractor for this contract shall be furnished to BHEL, for approval prior to procurement of all such items / equipment such assignments/ subcontracting shall not relieve the contractor from any obligation, duty or responsibility under the contract. Any assignment as above without prior written approval of BHEL and the purchaser shall be null and void. For components/equipments procured by the contractor for the purposes of the contract after obtaining written approval of BHEL/ the owner, the contractor's purchase specifications and enquiries shall call for quality plans to be submitted by his subcontractor alongwith their proposals. The quality plans called for from the subcontractor shall set out during the various stages of manufacture and installation, the quality practices and procedures followed by the sub-contractor quality control organisation, the relevant reference documents, standards used, acceptance levels inspection of documentation raised, etc. Such quality plans of the sub-contractor shall be discussed and finalised in consultation with BHEL and shall form a part of the contract between the contractor and the sub-contractor, The contractor along with the subcontractor and BHEL shall furnish a joint undertaking to the owner for guaranteed performance or the equipment and subsystems. The contractor should desist from seeking approval for two-tier sub-contracting which may not be permitted by BHEL/the owner.
31.0	**FORCE MAJEURE**
	The Following shall amount to force majeure.
31.1	Acts of God, acts of any Government, war, sabotage, riots civil commotion, police action, revolution, flood, fire, cyclone, earthquake, epidemic and other similar causes over which the contractor has no control.
31.2	If the contractor suffers delay in the due execution of the contractual obligation due to delays caused for force majeure as defined above the agreed time of completion of the job covered by this contract or the obligations of the contract shall be extended by a period or time equal to the period of delay provided that on the occurance of any such contingency the contractor immediately reports of BHEL in writing the causes or delay and contractor shall not be eligible for any compensation.
32.0	**RISK IN STORES**
	The contractor shall perform the order / contract in all respects in accordance with the terms and conditions thereof. The equipment / plant and every constituent part thereof, whether in the possession or control of the contractor his agents or servants or a carrier, or in the joint possession of the contractor his agent or servants and BHEL, his agents or servants shall remain in every respect at the risk of the contractor until their actual delivery to the consignee at the stipulated place or destination or where so provided in the acceptance of offer until their delivery to a person specified by the BHEL as inter in consignee for the purpose of despatch to the consignee. The contractor shall be solely responsible for all loss destruction damage or deterioration of or to the plants / equipment / items from any cause whatsoever while the same, after approval by the engineer, are awaiting despatch or delivery or are in the course or transit from the seller / contractor to the consignee or interim consignee as the case may be.
33.0	**CONSIGNEE'S RIGHT OF REJECTION**
	Notwithstanding any approval which BHEL or the engineer may have given in respect of the plants / equipment / items or any materials or other particulars or the work or workmanship involved in the performance of the order / contract (whether with or without any test carried out by contractor or the engineer or under the direction of the engineer),

	and notwithstanding delivery of the same where so provided to the interim consignee, it is shall be lawful for the consignee, on behalf of BHEL, to reject the plants /equipments / items or any part, portion or consignment thereof within thirty (30) days after actual delivery, thereof to him at the stipulated place or destination, if such plants / equipment or part, portion of consignment thereof is not in all respects in conformity with the terms and conditions of order / contract whether on account of any loss, storage, deterioration or damage before despatch or delivery or during transit or otherwise, howsoever.
34.0	**SETTLEMENT OF DISPUTE AND ARBITRATION**
34.1	If any dispute or differences of any kind whatsoever shall arise between BHEL and the contractor, arising out of the contract for the performance of the work whether during the progress of termination, abandonment or breach of the contract, it shall in the first place be referred to and settled by the Designated Engineer (nominated by BHEL for settlement of the disputes arising out of this contract) who within a reasonable period after being requested shall give written notice of his decision to the contractor. Save as hereinafter provided, such decision in respect of every matter so referred shall forthwith be given effect to by the contractor who shall proceed with the work with all due diligence, whether he or BHEL required arbitration as hereinafter provided or not.
34.2	If after the Designated Engineer has given written notice of this decision to the party, no claim to arbitration has been communicated to him by the party within 30 days from the receipt of such notice, the said decision shall become final and binding on the parties. In the event the contractor being dissatisfied with any such decision or if amicable settlement can not be reached then all such disputed issues shall be referred to the sole arbitration of the person appointed by BHEL.
34.3	Except as provided elsewhere in this Contract, in case amicable settlement is not reached between the Parties, 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, then, either Party may, by a notice in writing to the other Party refer such dispute or difference to the sole arbitration of an arbitrator appointed by Head of the BHEL Power Sector Region issuing the Contract. It shall not be open to the Contractor to object to such arbitrator only on the ground that such arbitrator is an employee/ex-employee of BHEL or has dealt with or has expressed any opinion on any issue touching upon the Contract. The Arbitrator shall pass a reasoned award and the award of the Arbitrator shall be final and binding upon the Parties. Subject as aforesaid, the provisions of Arbitration and Conciliation Act 1996 (India) or statutory modifications or re-enactments thereof and the rules made thereunder and for the time being in force shall apply to the arbitration proceedings under this clause. The seat of arbitration shall be Kolkata (the place from where the contract is issued)
34.4	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 by either Party for arbitration to the sole arbitrator in the Department of Public Enterprises to be nominated by the Secretary to the Government of India in-charge of the Department of Public Enterprises. The Arbitration and Conciliation Act, 1996 shall not be applicable to arbitration under this clause. 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.
34.5	The cost of arbitration shall be borne equally by the Parties.
34.6	Notwithstanding the existence or 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.
35.0	**CONTRACT AGREEMENT, EFFECT AND JURISDICTION**
35.1	The contractor shall within 60 days from the date of LOI/P.O. but in any case before

	submitting his first bill for payment enter into and execute a contract agreement (to be prepared at the cost of the contractor). In the event of the failure of the contractor to execute the contract agreement within the time specified above, BHEL may cancel the LOI and forfeit his SD unless this period is extended by BHEL.
35.2	The agreement will be signed in seven (7) originals and the contractor shall be provided with one (1) signed original and the rest will be retained by BHEL. These General conditions tog ether with the specifications, tenders drawings and technical particulars, tender data with subsequent agreed modification thereof. Tender, all correspondences with BHEL and signed agreement and other supporting documents shall constitute the contract document(s) No variation or modification of terms and conditions of the contract documents or waiver of any of these terms and conditions shall be deemed valid unless agreed in writing and signed by the BHEL and the Contractor.
35.3	The failure of either party to endorse at any time of the provisions of the contract or any right thereto or to an option herein provided shall in no way be construed to be a waiver of such provisions, rights or option or in any way to affect the validity of the Contract. The exercise by either by either party or any of his rights herein shall not preclude or prejudice either party from exercising the name or any other right in may have hereunder.
35.4	The contract shall in all respects be deemed to be and shall be construed and shall operate as an Indian contract as defined in the Indian Contract Act 1972 and all payments there under shall be made in Indian Rupees unless otherwise specified.
35.5	The Contract shall be considered to come into force on the date of notification of Award by the BHEL to the Contractor which may be in the form of a Fax. of Award or Letter of Intent / purchase order.
35.6	The law applicable to the Contract, shall be the law in force in India. The Courts of Kolkata under this contract shall have exclusive Jurisdiction in all matters arising under this contract, including Arbitration Awards.
36.0	**DIRECT TAX**
36.1	BHEL shall not be liable towards income tax of whatever nature including variations thereof arising out of this order/contract as well as tax liability of the contractor and his personnel.
36.2	Deductions of tax at soured at the prevailing rate shall be effected by BHEL before payment as a statutory obligation.
37.0	**PATENT RIGHTS**
37.1	The Contractor shall defend any claim which allege in a suit of proceeding against BHEL that equipment or any part thereof constitutes an infringement of any patent, if notified promptly in writing and given authority, information and assistance for the defence and the Contractor shall pay all damage and costs awarded against BHEL in such suit or proceeding for the patent infringement and the use of equipment or part is prohibited, the contractor shall, at his own expenses either procure for BHEL the right to continue using the equipment or replace the same with a non-infringing equipment, or modify it so that it becomes non-infringing, or move the equipment and refund the Contract Price plus the transportation and installation costs thereof.
37.2	The contractor shall indemnify BHEL from and against all claims and proceeding for or on account of infringement or alleged infringement of any patent rights, design trade mark or name or other protected rights in respect of execution of the contract.
38.0	**INDEMNIFICATION OF BHEL**
	The Contractor shall insure all his personnel, tools and tackles, drawings etc. and shall also take a third party liability cover to indemnify BHEL of all liabilities such may come up due to any act or omission on the part of Contractor, his agent, representative, or sub-contractor(s) and cause harm/damage to other contractor / representatives of the owner / BHEL or all or anybody rendering service to the owner/BHEL or is connected with the owner's /BHEL's work in any manner whatsoever. The Contractor shall necessarily indemnify BHEL in all these respects and the indemnification and insurance policy shall be subject to approval of the owner / BHEL.
39.0	**PREVENTION OF EXTRAORDINARY TRAFFIC AND PROTECTION OF HIGHWAY**
	The Contractor shall use every reasonable means to prevent any of the highways of bridges communicating with or on the routes to the Site from being damaged or injured by any traffic of the contractor or any or his sub-contractors and in particulars shall select routes, choose and use vehicles and restrict and distribute loads so that any such extraordinary traffic as will inevitably arise from the moving of Plant and material from and to the site shall be limited as far as reasonably possible and so that no damage or injury may be occasioned to such highways and bridges. Should it be found necessary for the Contractor to move one of more loads or construction plant machinery or reconstructed units or parts of units or work as applicable over part of a highway or bridge and that the

	moving or such load must in all probability damage the damage highway or bridge unless means of protection of strengthening are carried out then the contractor shall before moving the load on to such highway or bridge. Carryout such protection or strengthening at his own cost. If during the execution of the works or at anytime thereafter BHEL or purchaser shall receive any claim arising out of the execution of the works in respect or damage or injury to highways or bridges, he shall immediately notify the same to the contractor and thereafter the contractor shall negotiate the settlement of and pay all sum due in respect of such claim and shall indemnify BHEL in respect thereof and in respect or all claims demands, cost charges and expenses in relation thereto.
40.0	**MEMBERS OF STAFF ETC NOT PERSONALLY LIABLE**
	Neither any member of BHEL's staff nor the Engineer, nor the Engineer's representative shall be in any way personally liable for the acts or obligations under the contract or answerable for any default or omission on the part of BHEL in the observance or performance of any of the acts, matters, or things which are herein contained.
41.0	**POWER TO VARY OR OMIT WORK**
41.1	No alternations, amendments, omissions, additions, suspensions or variation of the work (hereinafter referred as "variations") under the contract shall be made by the contractor except as directed in writing by BHEL. But BHEL shall have full power, subject to the provision hereinafter contained from time to time during the execution of the contract by notice in writing to instruct the contractor to make such variation without prejudice to the contract and the contractor shall carry out such variations and be bound by the same conditions as far as applicable, as though the said variations occurred in the contract Documents.
41.2	If any suggested variations would in the opinion of the contractor, if carried out, prevent him from fulfilling any of his obligations or guarantee under the contract he shall notify BHEL thereof in writing and BHEL shall decide forthwith whether or not the same shall be carried out and if BHEL confirms his instruction, the contractor's obligations and guarantee shall be modified to such and extent as may be justified.
42.0	**SUSPENSION OF WORK**
42.1	BHEL reserves the right to suspend and reinstate execution of the whole or any part of the work without invalidating the provision of the contract. Orders for suspension or reinstatement of the work will be issued by BHEL to the contractor in writing. The time for completion of the work be extended for a period equal to duration of the suspension.
42.2	Any necessary demonstrable costs incurred by the contractor as a result of such suspension of the work will be paid by BHEL, provided such costs are substantiated to the satisfaction of BHEL/owner. BHEL shall not be responsible for any liabilities is suspension or delay is due to some default on the part of the contractor or his sub-contractor.
43.0	**LIST OF STANDARDS FOR REFERENCE**
43.1	International Standards Organisation (ISO).
43.2	International Electro-technical Commission (IEC).
43.3	American Society of Mechanical Engineers (ASME).
43.4	American National Standards Institute (ANSI).
43.5	American Society for Testing and Materials (ASTM).
43.6	American Institute of Steel Construction (AISC).
43.7	American Wilding Society (AWS).
43.8	Architecture Institute of Japan (AIJ).
43.9	National Fire Protection Association (NFPA).
43.10	National Electrical Manufacturer's Association (NEMA).
43.11	Japanese Electro-Technical Committee (JEC).
43.12	Institute of Electrical and Electronics Engineers (IEEE).
43.13	Federal Occupation Safety and Health Regulations (FOSHA).
43.14	Instrument Society of America (ISA).
43.15	National Electric Code (NEC).
43.16	Heat Exchanger Institute (HEI).
43.17	Tubular Exchanger Manufacturer's Association (TEMA).
43.18	Hydraulic Institute (HIS).
43.19	International Electro-Technical Commission Publications.
43.20	Power Test Code for Steam Turbines (PTC).
43.21	Application German Standards (AGS).
43.22	Application British Standards (ABS).
43.23	Application Japanese Standards (AJS).
43.24	Electric Power Research Institute (EPRI).
43.25	Standard of Manufacturer's Standardisation Society (MSS).

43.26	Bureau of Indian Standards Institute (BIS).
43.27	Indian Electricity Rules.
43.28	Indian Boiler Regulations (IBR).
43.29	Indian Explosives Act.
43.30	Indian Factories Act.
43.31	Tariff Advisory Committee (TAC) Rules.
43.32	Emission regulation of Central Pollution Control board (CPCB).
43.33	Pollution Control regulations of Dept of Environment Govt of India.
43.34	Central Board of Irrigation and Power (CBIP) Publications.
43.35	Any other statutory Codes/ Standards/ Regulations.

TENDER NO: PSER:SCT:NKP-C2005:20

VOLUME -IB

GENERAL CONDITIONS OF CONTRACT

(SUPPLY)

FOR

CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

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:NKP-C2005:20

VOLUME -IB

GENERAL CONDITIONS OF CONTRACT

(SERVICE)

FOR

CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

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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 of a period of two weeks by BHEL, 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

	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:NKP-C2005:20

VOLUME -ID

SPECIAL CONDITIONS OF CONTRACT

FOR

CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

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.

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.

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.

SPECIAL CONDITIONS OF CONTRACT (SCC)
Chapter - III : General Technical Requirements (Codes and Standards)

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.

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> 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

	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

	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.

	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. 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

	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. *: 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

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. 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

	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. 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. 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

	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.

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

	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.

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

	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

	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

	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.

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.

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. 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. 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. 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

	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

	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. The work related statutory inspections, though not limited to, are as under: 1) Inspectorate of Steam Boilers and Smoke Nuisance 2) Electrical Inspector 3) Factory Inspector, Labour Commissioner, PF Commissioner and other authoritiy connected to this project work

	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: 1. Registration Fee as per Regulation 385 of Chapter IX of Indian Boiler Regulations-1950 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 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

	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.

9.0	OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT MANAGEMENT/ QUALITY ASSURANCE PROGRAMME: 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): 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. Contractor should highlight the requirement of safety to staff and labour through daily tool box meeting before start of the days job. 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

	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 .

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

	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

	■ 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 : 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

	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

	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

	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

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

	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

	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.

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

	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

	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

	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. 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 : 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. 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: 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.

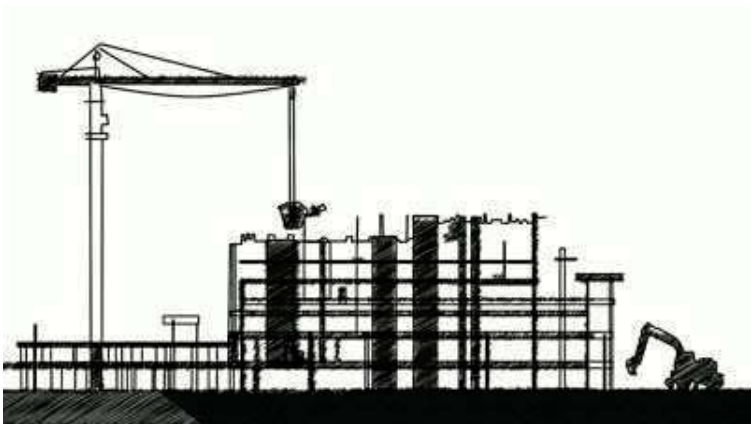
11.0	Performance Monitoring
11.1	Performance of the contractor is monitored through various reports/reviews and shall be jointly evaluated every month for unit wise identified packages as per prescribed formats. Based on the net weighted scores obtained, Contractors shall be rated 'Good' or 'Satisfactory' 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: a) Bidder does not honour his own offer or any of its conditions within the validity period. b) Bidder fails to respond against three consecutive enquires of BHEL. c) After placement of order, Bidder fails to execute a contract. d) Bidder fails to settle sundry debt account, for which he is legitimately liable, within one year of its occurrence. e) Bidder's performance rating falls below 60% in specific category (more fully described in chapter 'Performance Monitoring') 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:- a) Bidder tampers with tendering procedure affecting ordering process or commits any misconduct which is contrary to business ethics. b) Bidder has substituted, damaged, failed to return, short returned or unauthorizedly disposedoff materials/ documents/ drawings/ tools etc of BHEL. 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: a) Bidder is found to be responsible for submitting fake/ false/ forged documents, certificates, or information prejudicial to BHEL's interest. b) In spite of warnings, the Bidder persistently violates or circumvents the provisions of labour laws/ regulations/ rules and other statutory requirements. 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. e) The Bidder is found guilty by any court of law for criminal activity/ offences involving moral turpitude in relation to business dealings. f) The Bidder is declared bankrupt, insolvent, has wound up or been dissolved; i.e ceases to exist for all practical purposes. g) Bidder is found to have obtained Official Company information/ documentation by questionable means. 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	Saswajeet Rout	
DESIGNATION		
SIGNATURE		Pradip Ghosh Digitally signed by Pradip Ghosh DN: cn=Pradip Ghosh, o=BHEL, ou=HSE-PSER, email=pradipg@bhelpser.co.in, c=IN Date: 2019.06.15 13:02:14 +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 • **1 (one) safety officer for every 300 workers or part thereof** • **1(one) safety-supervisor for every 150 workers** • **1(one) safety-steward/ supervisor for every 50 workers** As per Cl. 7.1	**HSE Roles and responsibilities** • All employees as per 7.2.1 • Site In-charge & Package In-charges- As per clause 7.2.2 • Safety officer- As per clause 7.2.3

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

PROVIDE

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

TRAIN

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

COMMUNICATE

HSE COMMUNICATION	
Incident Reporting • Accident- Fatal, Major & Minor • Property damage • Near Miss **Safety Performance Reporting**	**Event Reporting** • Celebrations • Training • Medical camp • 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 (FAC)

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 (MTC)

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

6.5 Dangerous Occurrence is defined as:

(1) Collapse or failure of lifting appliances or hoist or conveyors or other similar equipment/machine;
(2) Collapse or failure of a crane, derrick, winch, hoist or other appliance used in raising or lowering persons or goods or any part thereof, or the overturning of a crane;
(3) Explosion or fire causing damage to the structure of any room or place in which persons are employed, or to any machine or plant, resulting in the complete suspension of ordinary work;
(4) Electrical short circuit or failure of electrical machinery, plant or apparatus, attended by explosion or fire, causing structural damage involving its stoppage or disuse;
(5) Explosion of a receiver or container used for the storage at a pressure greater than atmospheric pressure of any gas or gases (including air) or any liquid or solid resulting from the compression of gas;
(6) Collapse in whole or part from any cause whatsoever of any roof, wall, floor, Structure or foundation forming part of the construction site in which persons are employed;
(7) Total or partial collapse of any overburden, face, tip or embankment on the Construction site;
(8) The overturning of, or collision with any object by any bulldozer, dumper, excavator, grader, lorry or shovel loader, or any mobile machine used for the handling of any substance on the construction site.

6.6 **Fire**: Except Dangerous occurrence, any incident involving fire.

6.7 **Property Damage**: Except Dangerous Occurrences and Fire, any incident of property (materials, building, equipment etc) getting damaged.

6.8 TYPE OF INCIDENT / ACCIDENT & THEIR REPORTING:

The categories of Incident / accident are as follows:

<u>Non-Reportable Cases or NON-LTI: (Including First-aid cases as per 6.3 and MTC as per 6.4)</u>

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

Reportable Cases (LTI or Loss Time Injury Cases):

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). It includes fatality.

All incidents must be reported orally immediately and in writing within 24 hours of time of incident. However, in case of fatality, it shall be reported to the statutory authority within prescribed timeline through proper channel. Internal reporting shall be done within 6 hours of time of the incident

6.9 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:

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

6.10 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:

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

6.11 FREQUENCY SEVERITY INDEX (FSI)

Frequency Severity Index, $FSI = \sqrt{FR * SR/1000}$

6.12 INCIDENCE RATE

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

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

6.13 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.

6.14 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.

6.15 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.

6.16 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.

6.17 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. 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, or 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. ii. Recognized degree or diploma in Industrial safety ii. (Preferably) have adequate knowledge of the language spoken by majority of the workers at the construction site. **Alternatively:** B. 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: A recognized graduation Degree in Science (with Physics & Chemistry) or a recognized diploma in Engg. or Tech. with: a. Minimum Two years of practical experience in construction work environment and b. Should possess requisite skills to deal with construction safety & fire related day-to-day issues.	As a minimum, (s)he shall possess: 1. Class XII pass certificate and 2. Trained in fire-fighting as well as in safety / occupational health related subjects, with: a. Minimum two year of practical experience in construction work environment and 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* *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 25th of the preceding month to 24th 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

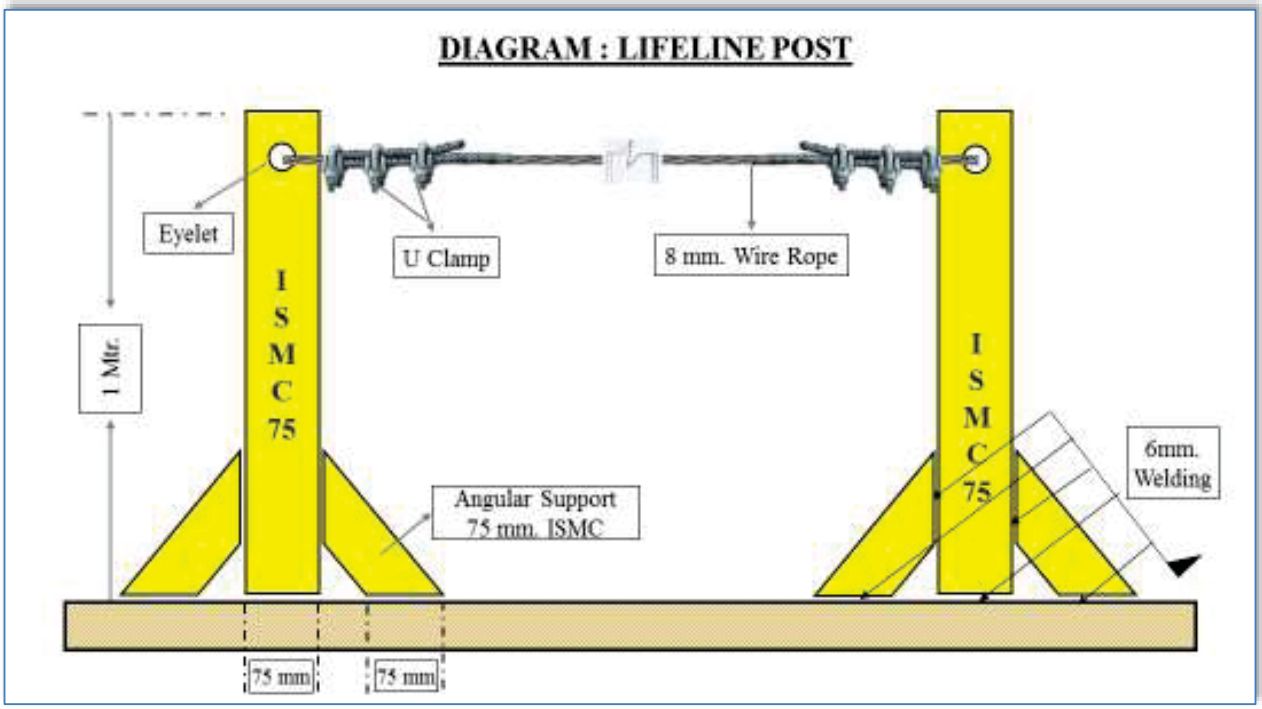


Fig. 13.2.1.1 Lifeline Post

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.

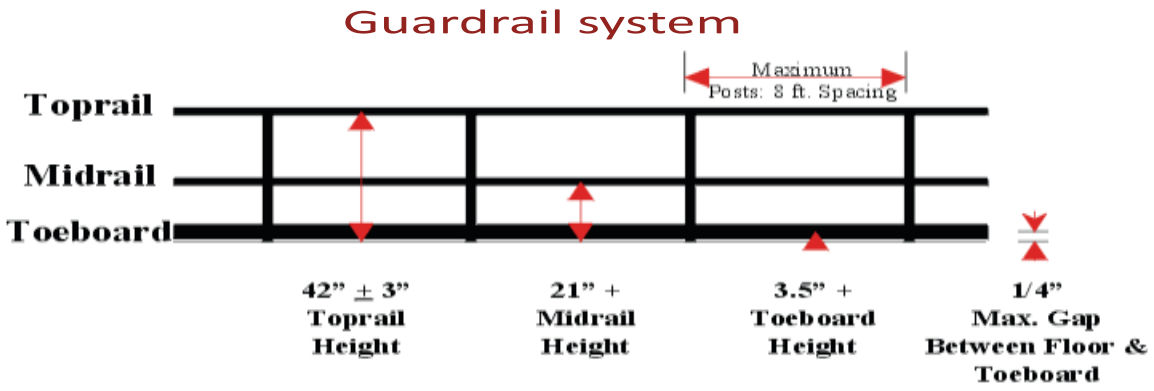


Fig. 13.2.1.2 Guard Rail System

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.

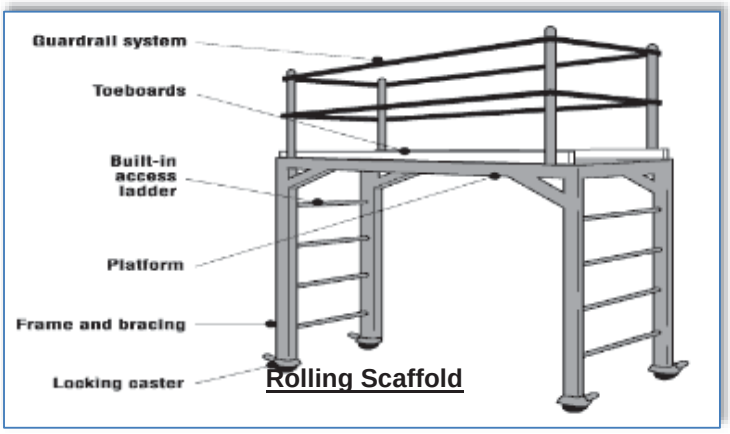
24. Requirements for different types of Scaffolds:

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.



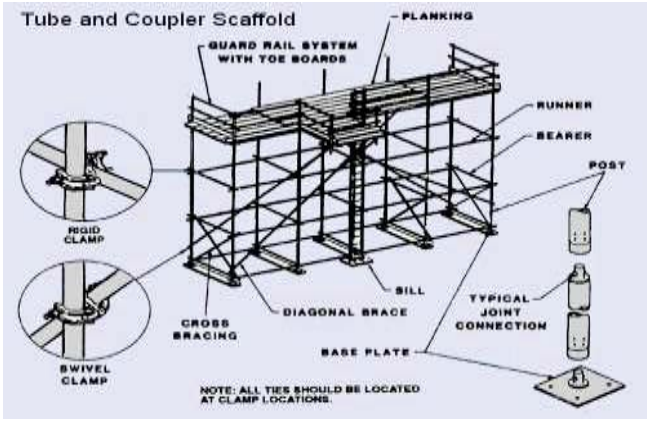


Fig. 13.2.1.3 Types of Scaffolds

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

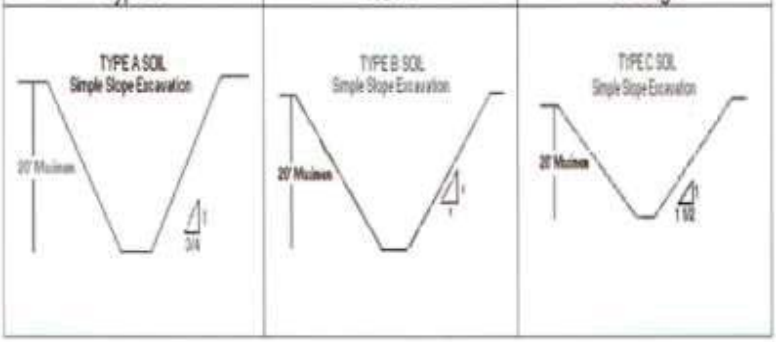
All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

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**

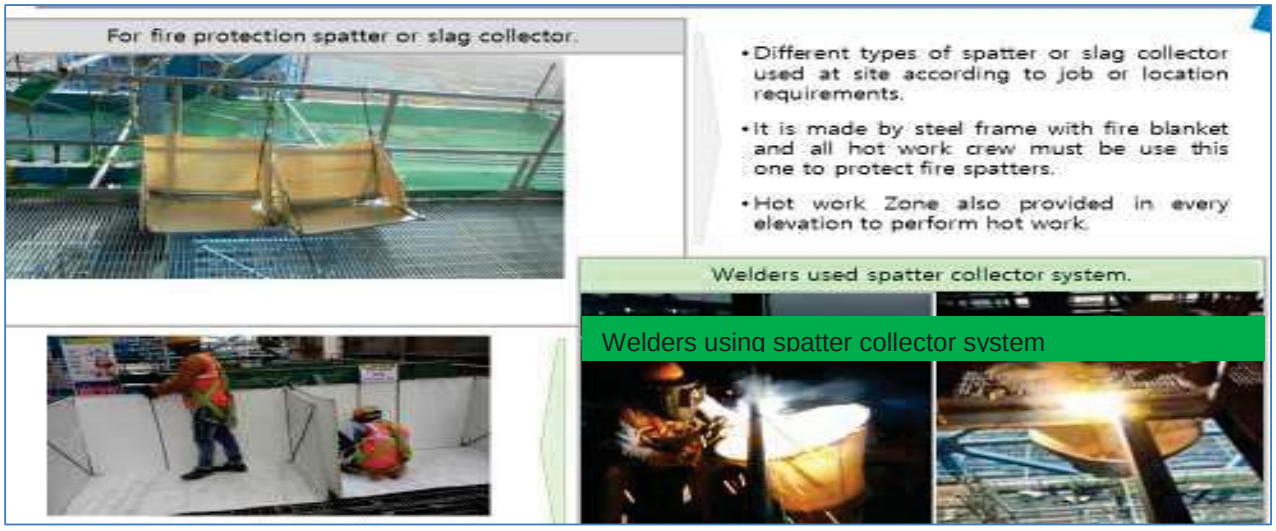


Fig. 13.2.3.1 Splatter / Slag Collector

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.

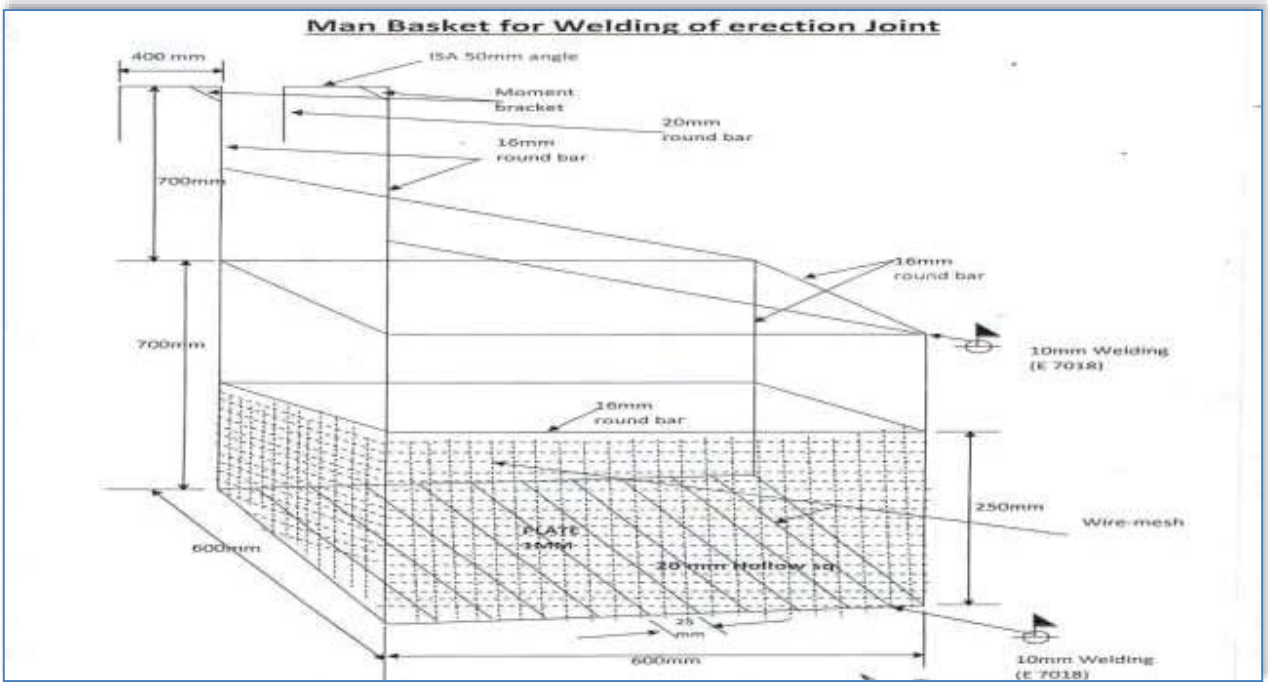


Fig. 13.2.4.1 Man Basket for Welding Erection Joint

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.

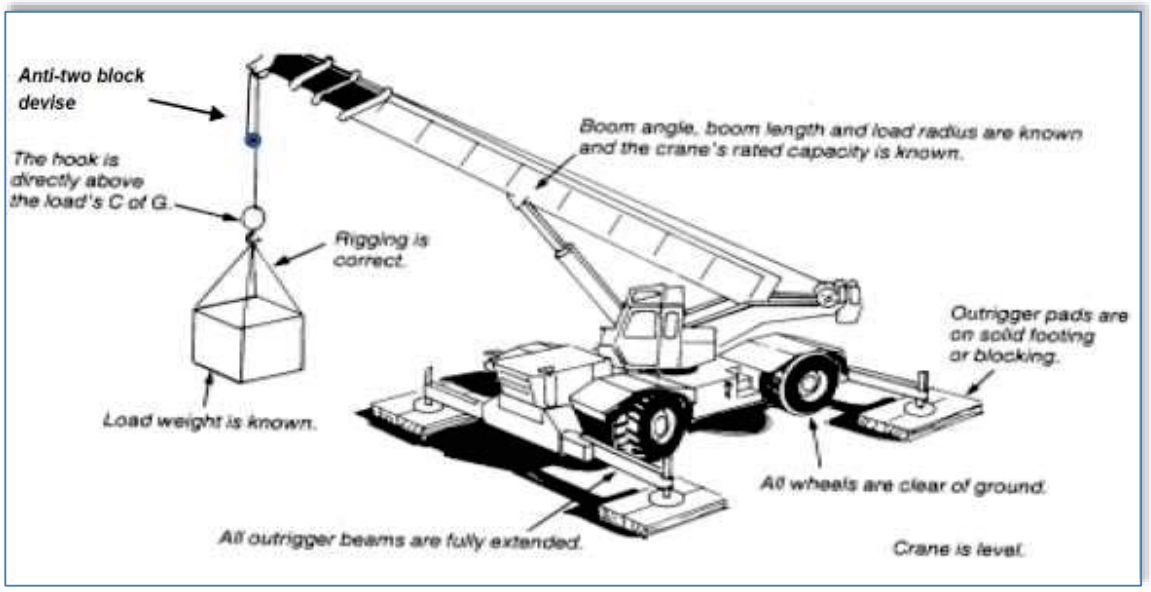


Fig. 13.2.4.2 Proper Crane Setup

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)

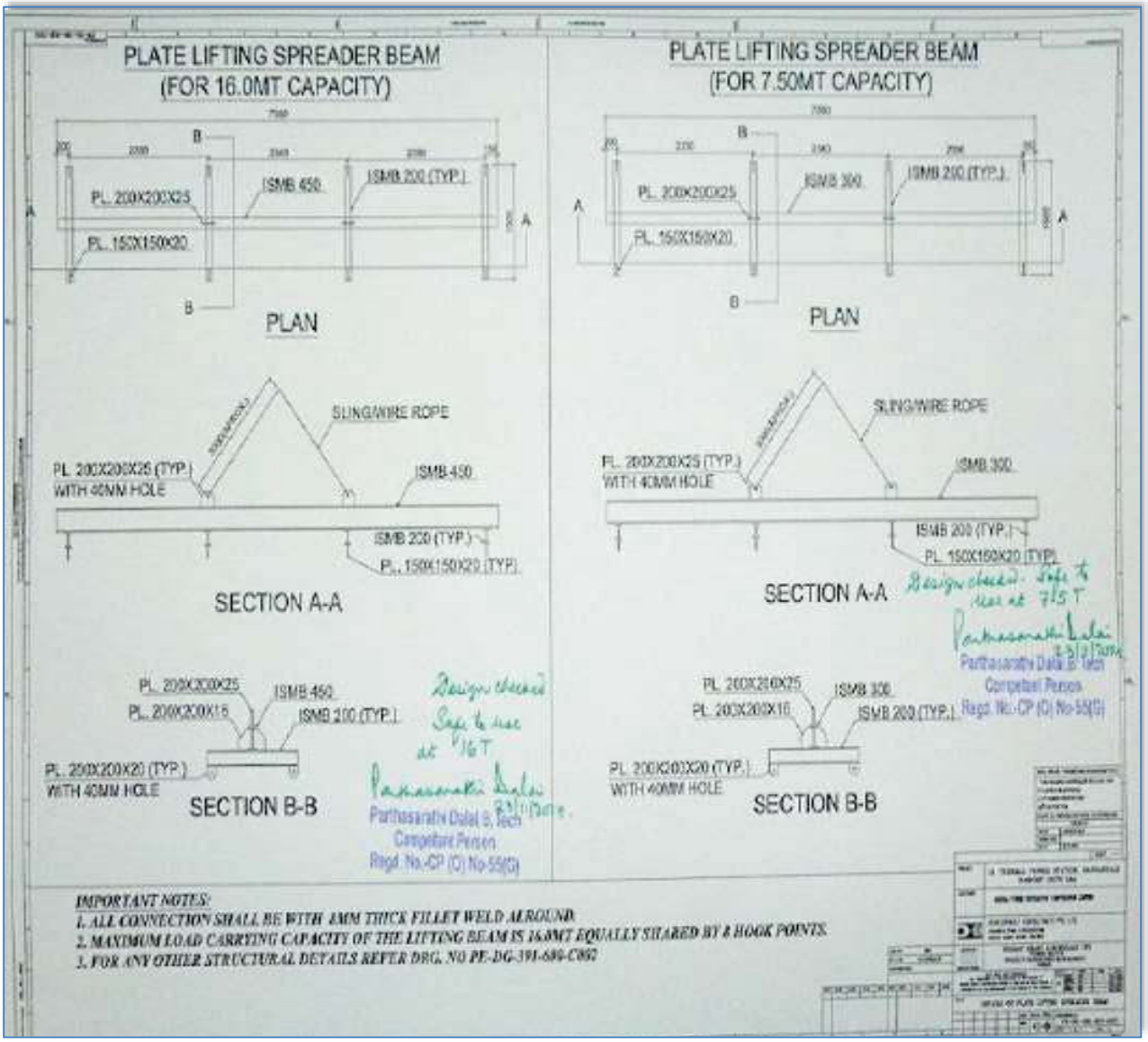


Fig. 13.2.4.3 Typical Plate Lifting Spreader Beam Configuration for 7.5 MT and 15 MT Loads

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

vii. 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.

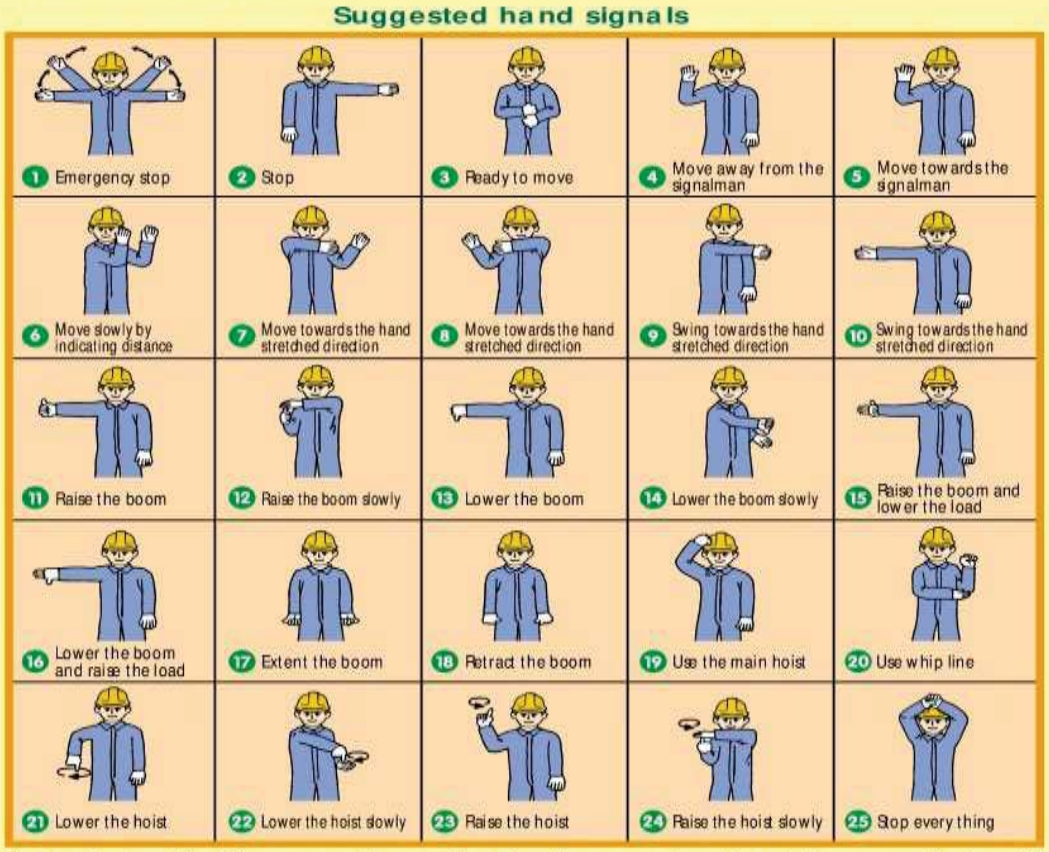


Fig. 13.2.4.4 Recommended Signalling Practices

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 February March	April May June	July August September	October November 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'** 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) 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'** (Extra hazard & high fire load)	-do	-do – (Also, consult local fire authority).
3.	**CLASS 'A'** (Special hazards)	-do	-do – Extra provision 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'** (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- (but minimum 3 numbers per room)
6.	**CLASS 'C'** (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'** 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** (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 b. Lifelines c. Safety nets	d. Fencing and barricading e. Warning signage f. Covering of opening	g. Proper scaffolding with valid Tags, access and egress. 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	

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** REV NO.: 00 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 SECTOR	FORMAT NO: **HSEP:14-F02** REV NO.: 00 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 HSE Induction / Regular / On-the-Job Training Records	FORMAT NO: **HSEP:14-F03** REV NO.: 02 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

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** REV NO.: 00 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**

Signature of Site I/C of Subcontractor **Date:**

	POWER SECTOR	FORMAT NO: **HSEP:14-F05** REV NO.: 00 Page 01 of **6**
	Monthly Site HSE Report	

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_____): **(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** REV NO.: 00 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** REV NO.: 00 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

	POWER SECTOR Inspection Of T&Ps	FORMAT NO: **HSEP:14-F07** REV NO.: 00 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** REV NO.: 00 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** REV NO.: 00 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** REV NO.: 00 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 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 (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** REV NO.: 00 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 **Inspection Of Electrical Installation**	FORMAT NO: **HSEP:14-F12** REV NO.: 00 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	FORMAT NO: **HSEP:14-F13** REV NO.: 00 PAGE NO. 01 OF 01
	Inspection of Elevator	

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** **HSE Penalty Format**	FORMAT NO: **HSEP:14-F14** REV NO.: 00 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 **Format for Initial Verification of PPE's & Lifting Tools & Tackles**	FORMAT NO: **HSEP:14-F15** REV NO.: 00 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
	Checked **(Name & Sign. Of Subcontractor HSE Officer)**	**Verified** **(Name & Sign. Of Subcontractor Site In-charge)**	

	POWER SECTOR **Format for Inspection of Labor Colony**	FORMAT NO: **HSEP:14-F16** REV NO.: 00 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: (A) Potential injuries determined (B) Local EMS response determined (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** **HSE Officer**		

	POWER SECTOR **Format for Recording of First Aid Injuries**	FORMAT NO: **HSEP:14-F17** REV NO.: 00 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

	POWER SECTOR **Format for Maintaining Records of E-waste Handled / Generated**	FORMAT NO: **HSEP:14-F18** REV NO.: 00 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 for Maintaining Records of Hazardous Waste at the Facility**	FORMAT NO: **HSEP:14-F19** REV NO.: 00 PAGE NO. 01 OF 1

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 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 **Format for Inspection of Illumination / Lux Levels**	FORMAT NO: **HSEP:14-F21** REV NO.: 00 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 **Format for Incident Reporting**	FORMAT NO: **HSEP:14-F22** REV NO.: 00 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	FORMAT NO: **HSEP:14-F23** REV NO.: 00 PAGE NO. 01 OF 1
	Format for Incident Recording	

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**

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:

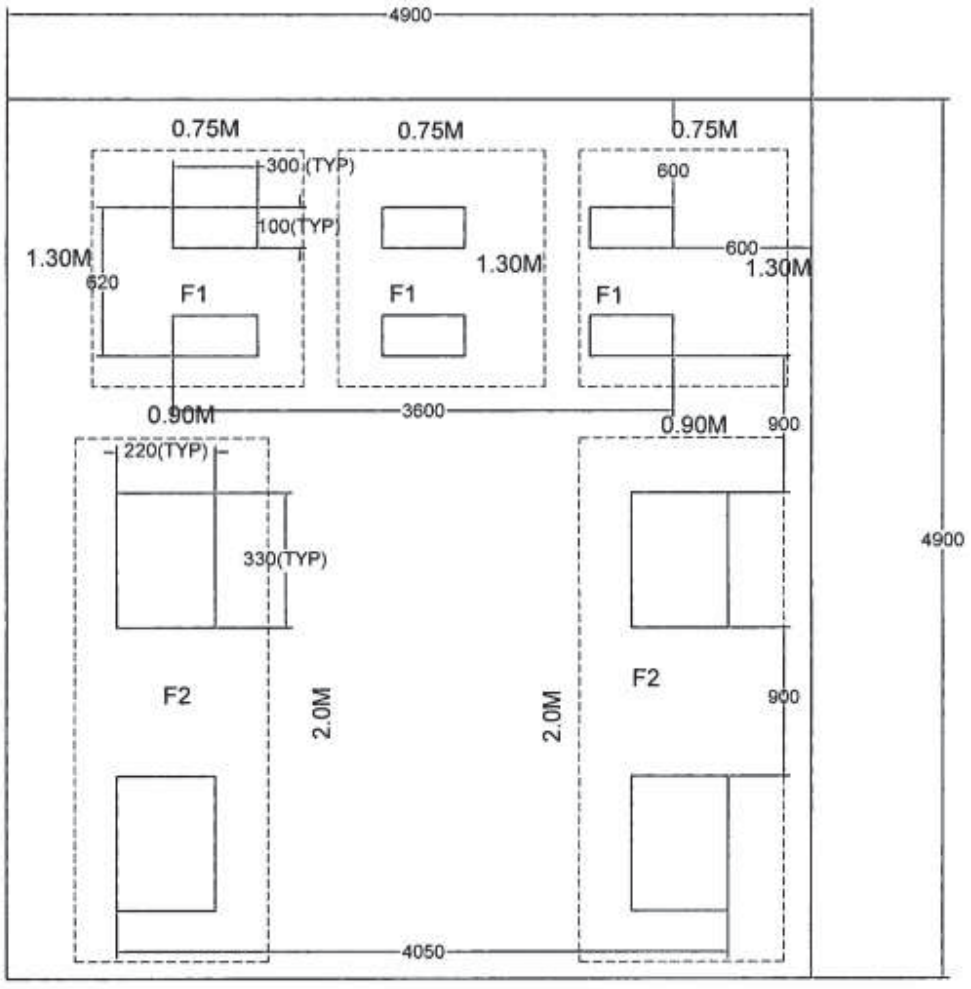
(i)	6 small sterilized dressings
(ii)	3 medium size sterilized dressings
(iii)	3 large size sterilized dressings
(iv)	6 pieces of sterilized eye pads in separate sealed packets.
(v)	6 roller bandages 10 cm wide.
(vi)	6 roller bandages 5 cm wide.
(vii)	One tourniquet
(viii)	A supply of suitable splints
(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**

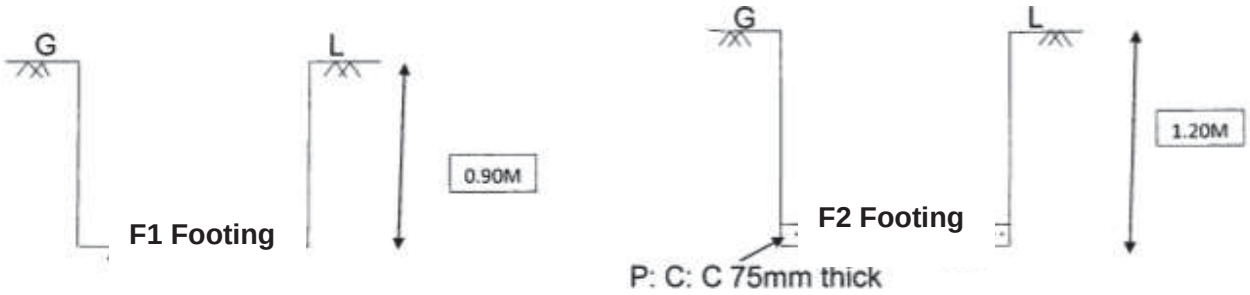


Note:

- 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

Vertigo Test Structure Specifications



Note:

- Concrete Grade is M15
- Drawing is not to scale
- TOC is at Road Level
- G L refers to Ground Level

Figure 2

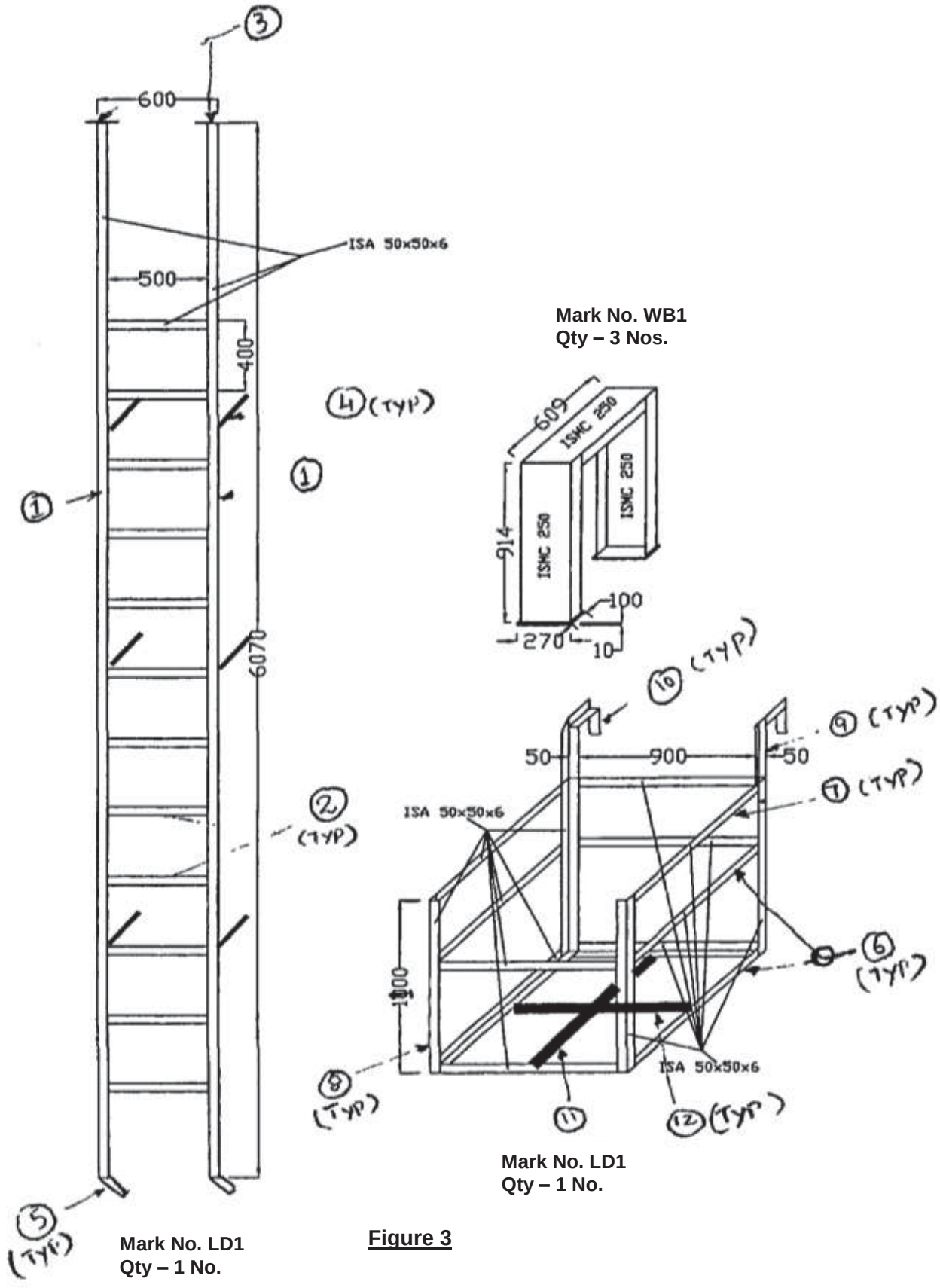
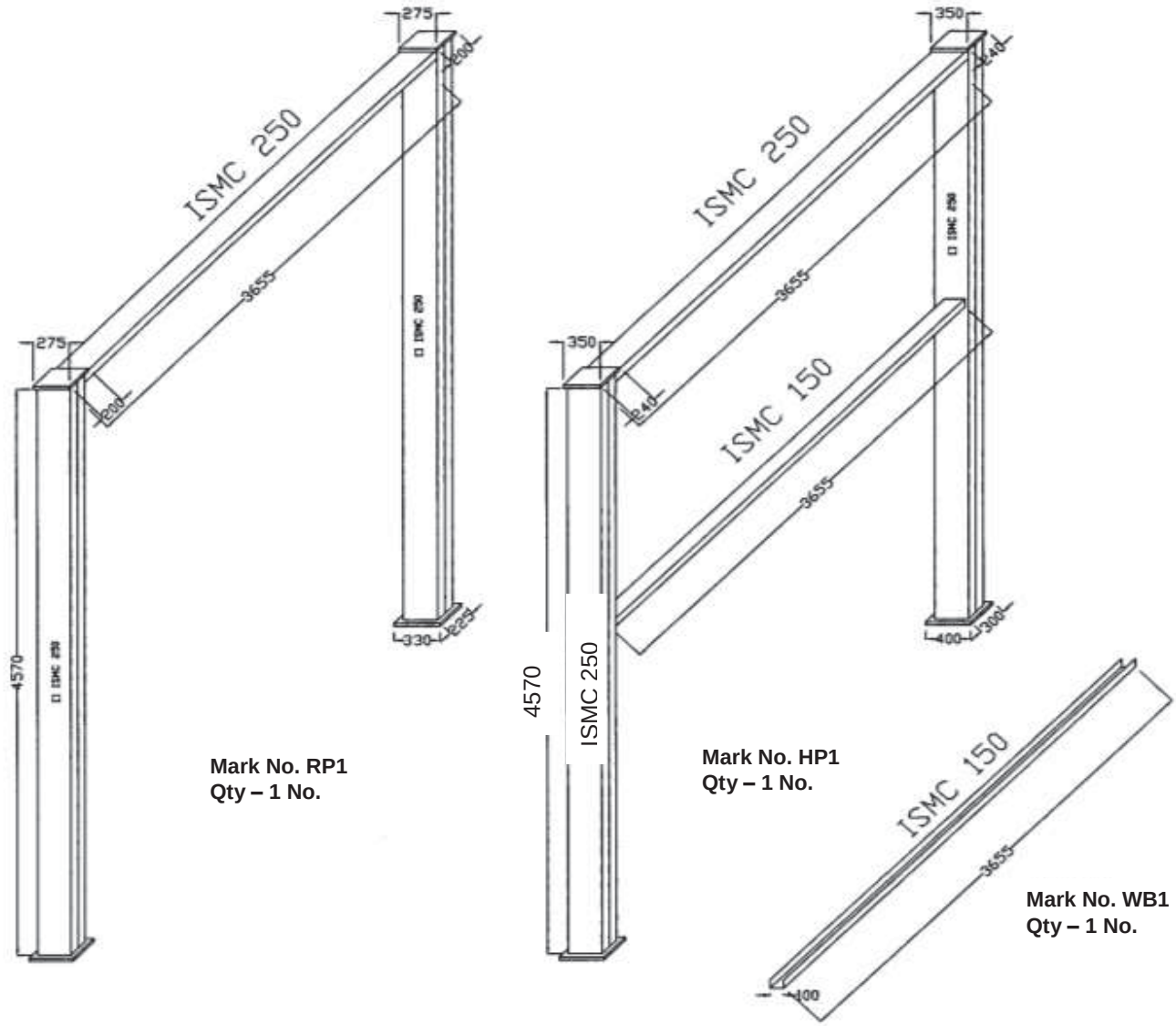

3
600
ISA 50x50x6
500
400
4 (TYP)
1
1
6070
2 (TYP)
5 (TYP)
Mark No. LD1
Qty – 1 No.
Mark No. WB1
Qty – 3 Nos.
609
ISMC 250
ISMC 250
ISMC 250
914
100
270
10
10 (TYP)
9 (TYP)
50
900
50
7 (TYP)
ISA 50x50x6
6 (TYP)
1000
8 (TYP)
ISA 50x50x6
11
12 (TYP)
Mark No. LD1
Qty – 1 No.

Figure 3

Vertigo Test Structure Specifications

Figure 4





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:NKP-C2005:20

VOLUME -IE

FORMS & PROCEDURES

FOR

CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

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.

INDEX

SN	Description	Form No	Remarks
1.0	**Forms**		
1.1	Offer forwarding Letter/Submission of Tender	F-1 (Rev 00)	
1.2	Declaration by Authorised Signatory	F-2 (Rev 00)	
1.3	No Deviation Certificate	F-3 (Rev 00)	
1.4	Declaration confirming knowledge about Site Conditions	F-4 (Rev 00)	
1.5	Declaration for relation in BHEL	F-5 (Rev 00)	
1.6	Non Disclosure Certificate	F-6 (Rev 00)	
1.7	Bank Account Details for E-Payment	F-7 (Rev 00)	
1.8	Form for seeking clarifications	F-8 (Rev 00)	
1.9	Capacity Evaluation of Bidder for current Tender	F-9 (Rev 00)	
1.10	Contract Agreement	F-10 (Rev 00)	
1.11	Bank Guarantee for Security Deposit	F-11 (Rev 00)	
1.12	Bank Guarantee for ~~Interest Bearing Refundable~~ Advance	F-12 (Rev 00)	
1.13	Extension of Validity of Bank Guarantee	F-13 (Rev 00)	
1.14	Monthly Plan & Review with Contractors	F-14 (Rev 00)	
1.15	Monthly Performance Evaluation of Contractor	F-15 (Rev 01)	Revised
1.16	~~Evaluation of Contractor Performance (Quarterly)~~	~~F-16 (Rev 00)~~	Deleted
1.17	Evaluation of Contractor Performance (Annual)	F-17 (Rev 01)	Under revision ##
1.18	Evaluation of Contractor Performance for the Contract (Overall)	F-18 (Rev 01)	Under revision ##

SN	Description	Form No	Remarks
1.19	Milestone Completion Certificate	F-19 (Rev 00)	
1.20	Completion Certificate	F-20 (Rev 01)	Revised
1.21	Indemnity Bond	F-21 (Rev 00)	
1.22	Consortium Agreement	F-22 (Rev 00)	
1.23	Refund of Security Deposit	F-23 (Rev 00)	
1.24	Refund of Guarantee Money	F-24 (WAM-11)	
1.25	Power of Attorney for Submission of Tender/Signing Contract Agreement	F-25 (Rev 00)	
1.26	Analysis of Unit Rates Quoted	F-26 (Rev 00)	
1.27	RA Bill Format	WAM-6	
1.28	Final Bill Submission format with No Claim Certificate and No Demand Certificate	WAM-7	
1.29	PROFORMA FOR PERFORMANCE BANK GUARANTEE		
1.30	BANK GUARANTEE FOR SD CUM PBG BOND		
2.0	**Procedures**		
2.1	Procedure and Business Rules for Reverse Auction	As per Company Policy	
2.2	Integrity Pact	As per Company Policy	
3.0	**Customer specific procedures**		
3.1			

• 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 SATISFACTORY 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)

This 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

(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

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:

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:----------

FOR USE IN ACCOUNTS DEPARTMENT

Passed for Rs_____ (Rupees _____ only)

Accountant Accounts Officer

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

Total value of work done up to date (A) …

Running Account Bill — 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.	Empty containers not returned			Cost of empty gunny bags and				
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.	Difference _ _ _ _ _ _ _ _ _ _ _ _ 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 **			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:NKP-C2005:20

1	2	3	4	5	6	7	8	9	10	11	12	13

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			

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
						Total	……				
	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
						Total	……			
						Add Departmental Charges Add Sales Tax (wherever applicable)	……..			
						Total	……..			
	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
				Total	……		
	Signature of Contractor			Signature of Engineer in charge			Signature of Senior Engineer
	Date			Date			Date
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
			Total								

Signature of Contractor — Signature of Engineer Incharge — Signature of Sr. Engineer

Date — Date — Date

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:NKP-C2005:20

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 :

Contract Agreement/Work Order No. :

Name of the Work :

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:

Form No: F-14 (Rev 01)

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)

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)

PS-	MONTHLY PLAN & REVIEW WITH CONTRACTOR	Page **4** of **6**

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)

PS-	MONTHLY PLAN & REVIEW WITH CONTRACTOR	Page **5** of **6**

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)

Form No: F-14 (Rev 01)

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.इ.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:NKP-C2005:20

VOLUME -IF

TECHNICAL CONDITIONS OF CONTRACT

(TCC)

FOR

CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

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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6.0	TAXES AND DUTIES
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27.0	OTHER ITEMS

This section of Technical Conditions of Contract (TCC) is applicable for supply part of contract. The conditions mentioned inscribed hereunder shall be read along with other volumes of tender, i.e. general conditions of contract (GCC, Volume-IB), Volume-III etc.

CLAUSE NO	DESCRIPTION
1.0	**PROJECT SYNOPSIS AND GENERAL INFORMATION**
1.1	DETAILS OF PROPOSED STAGE/ UNITS
	Name of the Owner : NTPC Capacity : 3 x 660 MW Nearest Railway Station : Khalari Railway Station on Ranchi Garhwa section of Eastern Railways (40 km from Project site) Nearest Town : Tandwa in Chatra District Nearest commercial airport : Ranchi (150 km from Project site) The site is located near Tandwa town having latitude and longitude of about 230 50' N to 230 52' N and 84059' E to 850 2' E respectively. It is essential that the bidder visit site and acquaint with the conditions prevailing at site before submission of the bid. The information given herein is for general guidance and shall not be contractually binding on BHEL.
2.0	**SITE VISIT**
	The bidder must visit site, to acquaint themselves with the conditions prevailing at site and in & around the plant premises, together with all statutory, obligatory, mandatory requirements of various authorities before submission of bid.
3.0	**BROAD SCOPE OF WORK**
3.1	The work to be done broadly under this specification comprises of design, engineering, manufacturing, assembly, inspection, testing at manufacturer's/ sub-vendor's works, painting, proper packing, transportation, delivery, handing over at site of materials as detailed in the specification and elsewhere in the tender document (SCH-4 of price schedule, Volume-III) for SINGLE FLUE CHIMNEY OF UNIT 1,2 & 3 However, completeness of the supply for completion of the package is to be ensured by the bidder.
3.6	As instructed by BHEL and as per approved MQP, 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.
4.0	**QUALITY PLAN**
	The bidder shall furnish the quality assurance plan which would be approved by BHEL/ NTPC.
5.0	**INSURANCE**
5.1	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 each unit including theft, sabotage, fire, lightning and other natural calamities.
5.2	Vendor shall timely intimate dispatches to the underwriter failing which the contractor shall be held responsible for the loss/damage/theft of materials during transit The name of the underwriter and Policy No. shall be intimated in due course of time.
5.3	Vendor shall report to BHEL in writing any damages to equipments/ components on receipt, storing and during withdrawal of the materials from stores, in transit to site &

	unloading at place of work and during erection & commissioning till trial operation completion. The report shall be as prescribed by BHEL site. Any consequential loss arising out of non-compliance of this stipulation will be borne by vendor.
5.4	The vendor 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 taken over by BHEL or customer at Project site. For lodging/ processing of insurance claim the vendor will submit necessary documents. BHEL will reserve the right to recover the loss from the vendor as detailed below in case the damage/loss is due to negligence/ carelessness on the part of the vendor. In case of theft of material under vendor's custody, the same shall be reported to police by the vendor 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 vendor of his contractual obligation for the material in his custody.
5.5	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 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.
5.6	It will be responsibility of vendor to replenish the items lost/ damaged in time without hampering the schedule of work and without waiting for settlement of insurance claim. Amount received from the underwriters on settlement of insurance claim shall be passed on to the vendor as and when available.
5.7	Other conditions of Insurance shall be as per relevant clause of GCC/SCC.
6.0	**TAXES AND DUTIES**
6.1	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.
6.2	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.
6.3	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.
6.4	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.
6.5	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.
6.6	TDS under GST (if/ as & when applicable later) shall be deducted at applicable rates on gross invoice value from the running bills (RA bills). However, as on date no TDS under GST is applicable.
6.6	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: 20AAACB4146P5ZP. Name: Bharat Heavy Electricals Ltd. Address: Shall be intimated later. Any change to above shall be notified by BHEL at appropriate juncture..
6.7	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 notified by BHEL at appropriate juncture.
6.8	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.
6.9	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.
6.10	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.
6.11	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 on BHEL, as the case may be.
6.12	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.
6.13	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.
6.14	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.
6.15	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.
6.16	**(APPLICABLE FOR IMPORTED ITEMS/SUPPLIES)**
6.16.1	In case of foreign vendor, bidder's quoted price shall be inclusive of all taxes & duties except customs duty.
6.16.2	The customs duty element for imported items shall be excluded in the basic prices. No variation in customs duty and exchange rate for imported items shall be payable by purchaser.
6.16.3	Seller/Their Indian Agent/Associate shall arrange the import license, if required and the necessary documents provided by the purchaser. Therefore, Seller/Contractor alone shall be responsible for any delay in getting import license or non-availability of the same or completion of other related formalities. Purchaser shall not be responsible for any financial liability, whatsoever, on this account except for payment of statutory fees. **<u>Foreign Bidder</u>** : **Purchaser / BHEL will arrange Import License and pay Customs Duty for imported items for Foreign Bidder only .**
7.0	**COMPLETION PERIOD**
	The contractor shall supply the materials including supply of Mandatory spares, Start-up and Commissioning spares etc. in such manner that supply will be completed within 6 (Six) months for Unit # 1, 8 (Eight) months for Unit # 2 and the entire scope of supply

	within 10 (Ten) months from the date of LOI.
8.0	**SCHEDULE OF SUPPLY**
	The vendor shall furnish the L-1, L-2/ L-3 schedule indicating break-up of supply of various items within 15 days from date of LOI under this specification matching with project schedule as referred in the tender within the stipulated completion period.
9.0	**ESCALATION/ PVC**
	Not applicable for this tender.
10.0	**OVER RUN COMPENSATION (ORC)/ RATE REVISION**
	Not applicable for this tender.
11.0	**MOBILISATION ADVANCE/ INTERST BEARING RECOVERABLE ADVANCE**
	No mobilization advance /IBRA is applicable for this contract.
12.0	**SECURITY DEPOSIT**
	Security deposit for this part of specification shall be governed by the provision of GCC, Volume-IA.
13.0	**PERFORMANCE BOND**
	Performance bond for this part of specification shall be governed by the provision of GCC, Volume-IA.
14.0	**PAYMENT TERMS**
14.1	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.
14.2	For all items of work as per rate/price schedule of main supply, payment shall be made as per following break-up of contract price.
14.2.1	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.
14.2.2	65 % of basic price of materials supplied along with 100 % ED, CST, VAT (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.
14.2.2.1	Invoice/ excisable invoice in original.
14.2.2.2	LR/ RR (consignee copy).
14.2.2.3	Packing list.
14.2.2.4	BHEL/ customer MDCC enclosing QS note, inspection & test certificate, wherever applicable.
14.2.2.5	Copy of letter, addressed to insurance company intimating dispatch.
14.2.3	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.
14.2.4	10 % of the basic price shall be released against completion of erection of the equipments supplied.
14.2.5	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. 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. However, vendor has to complete all other activities and fulfill all formalities for final billing/contract closing prior to drawing this payment.
14.3	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.
14.4	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.
14.5	Applicable GST, which can be claimed at any point, shall be released to you upon compliance of following:
14.5.1	You declaring such Invoice in his GSTR-1
14.5.2	Receipt of Goods / services and Tax Invoice by BHEL
14.5.3	Confirmation of payment of GST thereon by you on GSTN Portal
15.0	**GUARANTEE**
15.1	The vendor shall warrant that the equipment will be new and in accordance with the contract documents and free from defects arising due to deficiencies in design and engineering and from defects in material and workmanship for a period of twelve (12) calendar months commencing immediately upon the satisfactory completion of trial operations and handing over. The equipment shall operate satisfactorily and reliably and the performance and efficiency of the equipment(s) shall not be less than the respective guaranteed values.
15.2	The vendor shall be liable to replace/ upgrade with specific consent of NTPC, any defective parts that may develop in the plant of his own manufacture or those his sub suppliers under the conditions provided for by the contract and under proper use and arising solely from faulty design, materials and/ or workmanship. Any defect removal at site by repair/ up-gradation of the installed equipment/ component/ material will be permitted by the NTPC only when up-gradation in the meantime, is not detrimental to the commercial use of the plant. All replaced defective parts shall be returned to the vendor unless otherwise arranged. No repairs or replacement shall normally be carried out by the engineer when the plant is under the supervision of the vendor's supervisory engineers.
15.3	The vendor's obligations against the above clause shall be limited to replacing with all incidental charges from site to the vendor's work and/ or his sub-supplier's works and back to site. In case of defective parts not repairable at site but, essential in the meantime for the commercial operation of the equipment, the vendor and the purchaser/ NTPC shall mutually agree to a program of replacement or renewal which will minimize to the maximum extent interruption in the operation of the equipment.
15.4	The acceptance of the equipment by the engineer shall in no way relieve the vendor of his obligation under this clause.
15.5	In the event of any emergency where, in the judgment of the engineer, delay would cause serious loss or damages, repairs or adjustment may be made by the engineer or a third party chosen by the engineer without advance notice to the vendor and the cost of such work shall be paid by the vendor. In the event such action is taken by the engineer, the vendor will be notified promptly and he shall assist wherever possible in making necessary corrections. This shall not relieve the vendor's liability under the terms and conditions of the contract.
15.6	If the replacement or renewals are of such character as may affect the efficiency of the plant, the purchaser/ NTPC shall have the right to give to the vendor within one month of such replacement or renewal, notice in writing that `acceptance tests on completion' be made, in which case such tests shall be carried out as per approved QAP/ BHEL guidelines.
15.7	The repaired or new parts will be furnished and erected free of cost by the vendor. If any repair is carried out on his behalf at the site, the vendor shall bear the cost of such repairs.
15.8	The cost of any special or general overhaul rendered necessary during the maintenance period due to defects in the plant or defective work carried out by the vendor shall be borne by the vendor.
15.9	In respect of goods supplied by sub-vendors to the vendor where a longer guarantee (more than 12 months) is provided by such sub-vendors, the NTPC shall be entitled to the benefit of such longer guarantee.
16.0	**LIQUIDATED DAMAGES**
16.1	If vendor fail to complete the job as per aforesaid completion period, BHEL shall have the right to recover as liquidated damages (LD) a sum equivalent to 0.25 % of the contract price, including taxes, duties of contract price (supply part) for delay of each week or part thereof. The liability for delay shall not in any case exceed 5 % (five percent) of the contract price, including taxes, duties (Supply part).
16.2	LD rates/ acceptance criteria for the guaranteed parameters as per relevant clause of

	technical specification.
16.3	BHEL shall deduct the amount of such compensation from any money due or which may become due to the vendor and/or recover such compensation from the bank guarantees/ security deposit of the vendor. To be entitled to impose such compensation, BHEL will not be required to prove that he has incurred such amount as actual damage.
16.4	BHEL reserve the right to purchase from elsewhere on account of and at the risk & cost of the vendor without notice to the vendor of the equipment/ materials not so delivered, without canceling the order/ contract in respect of the equipment/ materials not yet due for delivery.
16.5	BHEL reserve the right to cancel the order/ contract or a portion thereof for the stores not so delivered at the risk & cost of the vendor and the vendor shall be liable to BHEL for any excess costs thereof.
16.6	The vendor shall continue performance of order/ contract under all circumstances, to the extent not cancelled.
16.7	Where action is taken as per above, the vendor shall be liable for any loss, which BHEL may sustain on that account. The vendor shall not be entitled to any gain on such purchase and the manner and the method of such purchase shall be at the discretion of BHEL. It shall not be obligatory on any part of BHEL to serve a notice of such purchase on vendor.
17.0	**CONTRACT PRICE**
17.1	Bidder shall quote their rates/ prices strictly as per Volume-III, Price Schedule (latest revision) only.
17.2	While, total price (Supply & service parts together) will be considered for evaluation, separate order will be placed for supply part as per price schedule.
18.0	**DIVISIBLE CONTRACT**
	Notwithstanding anything stated elsewhere in this tender, the contract to be awarded shall be on the basis of supply & service contract (divisible contract) on single source responsibility. In the mode of contracting on the basis of supply & service, the supply part & service part of the contract will relate to pertinent price components Volume-III. But the two contract shall not in any way dilute the responsibility of the bidder for the successful completion of the job as per tender specification and both the contracts shall contain a cross-fall breach clause, namely that a breach in one contract shall automatically be classified as a breach on the other contract which will confer a right on BHEL to terminate the other contract at the risk and cost of the bidder. The title of the Ownership of goods to be supplied shall pass on to the NTPC on dispatch ex-works/ FOR destination. However till the scope is completed in all respect and the plant/ equipment is taken over by the NTPC the goods shall remain with the custody of the bidder.
19.0	**MATERIAL DESPATCH CLEARANCE CERIFICATE (MDCC)**
19.1	Material Despatch Clearance Certificate (MDCC) for Supply of various items shall be issued by customer/BHEL before supply of finished material. In case the tests are not witnessed by BHEL/ NTPC's representative, the test certificates shall be submitted to NTPC through BHEL and MDCC will be issued thereafter. Seller/Contractor will not dispatch any material before issue of MDCC by BHEL /NTPC.
19.2	For all category item (Cat –I,II & III) , MDCC shall be issued by NTPC and it is the responsibility of vendor to collect MDCC from them, and original MDCC shall be attached with Invoice by Vendor for claiming payment from BHEL.
	Original MDCC and other dispatch document shall accompany with every dispatch, failing which the consignment shall not be allowed to enter the project premises.
20.0	**MATERIAL RECEIPT CERTIFICATE (MRC)**
	The Seller/Contractor shall arrange Material Receipt Certificate (MRC) at project site, duly signed by the BHEL/ NTPC Site Engineer, after receipt of the material at site in good condition and after it's physical verification.
21.0	**CONSIGNEE**
	Consignee for material shall be intimated on a later date by Site incharge, BHEL.
22.0	**DESPATCH**

22.1	All materials/ plants/ equipments shall be transported by road including ODC consignment. Dispatch shall only be made after inspection and issue of MDCC by BHEL/ NTPC. Advance information by fax/ courier of dispatch details shall be sent to Construction Manager, BHEL.
22.2	No consignment shall be dispatched on SELF basis. Material shall be dispatched prepaid, door delivery basis, else ensure the clearance and collection of goods from lorry go down and arrangement to transport the same to site store shall be in the scope of vendor.
22.3	Each package should carry the packing slip/ details of contents and should be put inside a metal enclosure, properly fixed to the packing from outside. The packing shall be such as to ensure prevention of damage, corrosion, pilferage, deterioration, loss in transit or storage and road-worthy.
22.4	The title of the Ownership of goods to be supplied shall pass on to the NTPC on dispatch ex works/ FOR destination. However till the scope is completed in all respect and the plant/ equipment is taken over by the NTPC the goods shall remain with the custody of the bidder.
23.0	**INSPECTION & JOINT VERIFICATION (AT VENDOR'S WORKS)**
	Inspection of packages shall be carried out by agency as per below Inspection category of packages: 1. Cat I:- Inspection shall be done jointly by NTPC, BHEL & bidder. 2. Cat-II:- Inspection shall be done by BHEL & Successful bidder. 3. Cat-III:- Certificate of Compliance shall be furnished by bidder. Please note, for Cat I & II items BHEL reserve the right to carry inspection by themselves or through nominated third party. For Inspection agency of various items, vendor may refer to Quality Plan. Inspection will be conducted based on NTPC/BHEL approved manufacturing quality plan. Bidder may submitted the MQP of all major each items for its approval.
24.0	**COMMUNICATION**
	The vendor shall be responsible for arranging all communication facilities at office. The vendor has to establish independent internet/ e-mail facilities with mobile connection for all key site personnel and same shall be integrated with BHEL's voice/ data network & database systems at site. The vendor's office must have facilities of communications like Fax, E-mail, and telephone with STD facility etc.
25.0	**ENGINEERING SERVICES**
	As part of the overall project management activity, the vendor shall be responsible for proper engineering and coordination activities during various phases of execution of the contract. The vendor shall identify one Engineering Manager with whom BHEL will interact on all matters on coordination between BHEL and the contactors. The Engineering Manager shall be the single point contact person on behalf of the vendor and shall be responsible for all engineering co ordination.
26.0	**EXTENSION OF TIME FOR COMPLETION**
26.1	If the completion of supply as detailed in the scope of supply work gets delayed beyond the contract/ completion period, the vendor shall request for an extension of the contract and BHEL at its discretion may extend the contract.
26.2	Based on the reviews jointly signed, the scope balance at the end of original contract period less the backlog attributable to the vendor 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 vendor is bound to complete the portion of backlog attributable to the vendor. Any further 'Time extension' or 'Time extensions' at the end of the previous extension shall be worked out similarly.
26.3	However if any 'Time extension' is granted to the vendor to facilitate continuation of work and completion of contract, due to backlog attributable to the vendor alone, then it shall be without prejudice to the rights of BHEL to impose penalty/ LD for the delays attributable to the vendor, in addition to any other actions BHEL may wish to take at the risk and cost of vendor.
26.4	A joint programme shall be drawn for the balance amount of supply to be completed during the period of 'Time Extension'. Review of the programme and record of shortfall shall be done.
26.5	At the end of total supply work completion as certified by BHEL engineer, and upon

	analysis of the total delay, the portion of time extensions attributable to (i) Vendor, (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 vendor and recoverable from the dues payable to the vendor.
27.0	**OTHER TERMS**
27.1	All other relevant terms & conditions of this specification (technical part) indicated in the TCC-Vol-IC-Supply part shall be applicable unless otherwise specified in this document. Technical specification of our customer (NTPC) may be followed on any case raised by customer during execution.
27.2	All other term & conditions of this specification shall be governed by the pertinent provisions of GCC & other volumes of this tender, as applicable.

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 CICO TECHNOLOGIES LIMITED FOSROC CHEMICALS (I) PVT LTD, BSF
2	PAINT AND PAINTING SYSTEM	BERGER SHALIMAR PAINTS JENSON AND NICHOLSON KANSAI NEROLAC AKZO NOBEL ASIAN PAINTS
3	ACID RESISTANT BRICKS	CARBORANDUM UNIVERSAL, CHENNAI PELICAN, BHIWADI CAMBRIAN, ALWAR KERATECH, VADODARA CHAMPION CERAMICS, CHAMPA SUNSHINE CERAMICS, CHAMPA MAHAKOSHAL POTTRIES, KATNI PERFECT ACIDWARE, JABALPUR BABA BAIDNATH REFRACTORIES, PURULIA
4	MINERAL WOOL FOR THERMAL INSULATION	ROCKWOOL INDIA LIMITED, HYDERABAD ROCKWOOL INDUSTRIES, BHILAI LAPINUS, MALANPUR (MP) MINWOOLRAJANANDGAON LLOYD INSULATION, BHILAI U.P. TWIGA, BULENDSHAHAR
5	CHIMNEY ELEVATOR	MEKASTER ENGG & EQPT (P) LTD. (GUJARAT) ALIMAK, AB (SWEDEN)

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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
1.1	**PROJECT SYNOPSIS AND GENERAL INFORMATION** Name of the NTPC : NTPC Capacity : 3 x 660 MW Nearest Railway Station : Khalari Railway Station on Ranchi Garhwa section of Eastern Railways (40 km from Project site) Nearest Town : Tandwa in Chatra District Nearest commercial airport : Ranchi (150 km from Project site) The site is located near Tandwa town having latitude and longitude of about 230 50' N to 230 52' N and 84059' E to 850 2' E respectively. It is essential that the bidder visit site and acquaint with the conditions prevailing at site before submission of the bid. The information given herein is for general guidance and shall not be contractually binding on BHEL.
2.0	**SITE VISIT**
	The bidder must visit site, to acquaint themselves with the conditions prevailing at site and in & around the plant premises, together with all statutory, obligatory, mandatory requirements of various authorities before submission of bid.
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 at 3 X 660 MW North Karanpura STPP, Jharkhand as follows: SINGLE FLUE CHIMNEY OF UNIT # 1, 2 & 3
3.2	Mix design (M 15, M 20, M 25, M 30, M 35) for all concreting shall be carried out from customer approved listed institute specially for North Karanpura STPP Project, contractor has to ensure adding of approved brand product of admixture and minimizing of cement content in line with IS 456 as advised by BHEL time to time without any additional cost. Some of the design mixes are available at site. Vendor may adopt the existing design mixes if approved by customer or mix design may be carried out from listed approved laboratory for North Karanpura STPP Project.
3.3	The work to be performed under this specification consists of providing all labour, materials, consumables, equipment, temporary works, temporary storage sheds for contractors own use, temporary colony for labour and staff, temporary site offices, constructional plant's 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.
3.4	The scope shall also include setting up by the bidder a testing laboratory in the field to carry out all relevant tests. Detail of laboratory equipments as per Annexure-A, as applicable is to be arranged by the contractor within quoted rate. For conducting day to

	day one no. chemist is to be deployed as necessary.
3.5	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.
3.6	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.
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**
6.1	The contractor has to plan and use the existing land inside the Project Premise considering the use of land by other Civil / mechanical / electrical contractors and the storage of plant machineries and materials. The existing land shall be shared by all erections agencies. Land will be allocated with certain time frame and to the extent available / considered necessary, and will be reviewed by BHEL depending upon the area availability.
6.2	Land for labour colony near Project Premise may be available free of cost from NTPC, the contractor shall construct labour colony / hutment as per his requirements after obtaining approval of formalities from statutory body.
6.3	The contractor will be responsible for handing back all lands, as handed over to him by BHEL / NTPC.
6.4	Land within plant premises for fabrication, batching plant, office, storage area etc. for construction purpose shall be provided as per availability free of cost.
7.0	**WATER**
7.1	BHEL will provide construction water at two points, within 500 m from given work premises, free of cost to the contractor.
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 on their own, drinking water in their labour colony.
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 for which no separate payment shall be made by BHEL.
7.5	Contractor will have to arrange for storage of water to meet the day-to-day requirement. Bidder will ensure adequate supply of construction water to meet the requirement of water during major concreting.
7.6	The availability of water (construction as well as drinking) in North Karanpura project 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	CONSTRUCTION POWER & GENERAL ILLUMINATION NET-WORK: Construction Power BHEL Shall Provide Construction Power free of charge at 415V level at two points (within 500 M from his workplace), bidder has to make his own distribution arrangement to draw electricity. The bidder will have to Procure & install illumination system during construction right from start of his work though BHEL has established general illumination system at project areas. Vendor has to make arrangement for temporary lights at different floors / working areas for execution of the work & safety of workmen till the permanent illumination system is established, within the quoted rate. The illumination should be such that minimum illumination requirement as spefied by Indian standards for general illumination is maintained. GENERAL: If any other voltage level (other than normally available) is required, the same shall be arranged by the contractor from power supply as above. Contractor will have to provide at his own cost necessary calibrated energy meters (tamper proof, suitably housed in a weather proof box with lock & key arrangement) at point of power supply along with calibration certificate from authorized / accredited agency for working out the power consumption. In case of recalibration required for any reason the necessary charges including replacement by calibrated meters is to be borne by the contractor. Supply of electricity shall be governed by Indian Electricity Act and Installation Rules and other Rules and Regulation as applicable. The contractor shall ensure usage of electricity in an efficient manner and the same may be audited by BHEL time to time. In case of any major deviation from normally accepted norms is observed, BHEL will reserve the right to impose penalty as deemed fit for such cases.
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	The contractor shall have to make arrangement at their own cost for illumination etc in labor colony. However there may be provision of Chargeable Power for labor colony for which contractor has to install meters and necessary accessories
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.
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. 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. 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. 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 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 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)
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	Rs. 1,000.00	$16.00	Per equipment per

	as prescribed in the manual / FQP / guidelines / Contract			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 inspection as per approved QP) within 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
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:				

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	**WORK & SAFETY REGULATIONS**
13.1	REFER DOCUMENT NUMBER : PSER:HSEP: NKP DATE:19.12.2018
	DOCUMENT TITLE: SITE HSE PLAN FOR 3X660MW NORTH KARANPURA SUPER CRITICAL PROJECT
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 2 nos PCs (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 A3 size printing (duplex) & scanning (flatbed & ADF Duplex), ink / cartridge for which to be supplied as and when required, one no laser jet printer (duplex) cum scanner (flatbed & ADF Duplex) 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. 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. The contractor shall also provide 2 (two) nos computer operators and 2 (two) numbers 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. If contractor fails to provide computer / printer / personnel as per requirement, for a 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/- (Fifteeen 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.	
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. 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.	
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) One no. assistant (from start of work)
14.3.2.2	Site supervising staff for Civil work	Minimum 2 no. engineer 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 no. (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	Engineer 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 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 conflrm 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**	
16.1	No T&P shall be provided by BHEL.	
17.0	**MATERIAL HANDLING (BHEL ISSUED MATERIAL)**	

17.1	Cement, 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 cement & 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 supplyer or from BHEL Store.
17.3	Handling of all steel, cement, 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 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, cements 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 cement store (capacity minimum 500 MT or 500 sqm area) as indicated above for storing and stacking of cement. In addition to cement store, contractor has 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. Cement has to be kept over wooden raised platform. Stacking of materials is to be done as per IS codes or manufacturer / supplier recommendation with proper illumination and locking arrangements.
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	Clotting of cement, rusting of steel, damage of packing of Borosilicate lining materials must be avoided. In case, due to any cause attributable to the contractor, such clotting of cement, 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, ie cement, 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.
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 CEMENT
18.1.1	Cement as received from the manufacturer/ stockiest will be issued free of cost to the

	contractor. The theoretical weight or each bag of cement for issued purposes will be considered as 50 kg, the contractor shall be accountable for the cement issued to him on this notional weight only. No claim whatsoever will be entertained because of difference between theoretical and actual weight of the bags of cement.
18.1.2	The empty cement bags duly accounted for against issue shall be the property of the bidder and the same shall be disposed by the bidder as per statutory regulation prevailing in the project.
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 the 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. IS: 808-1989 - Beams, channels and angles IS: 1730-1961 - Plates 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 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 CEMENT
19.1.1	Sealed cement bags remaining unused and in perfectly good condition at the time of completion or termination of the contract shall be returned promptly, (within 15 days from assessment) if BHEL/ engineer is satisfied of the physical condition of the cement. Return of such cement to the project stores/ place as identified within the project area by engineer/ BHEL will not be entitled to handling and incidental charges. Surplus

	sealed and good conditioned cement bags will be taken back on weighment basis.		
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 / membranCe 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	CEMENT CONSUMPTION		
20.1.1	The theoretical consumption of cement shall be based on the following.		
20.1.1.1	For design mix concrete as per approved design mix.		
20.1.1.2	For nominal mix concrete work, as per minimum cement as specified or as approved by Engineer-in-charge.		
20.1.2	For item of works, where volume mix is permitted in writing by the BHEL, for masonry works, plaster other miscellaneous items, the cement consumption shall be governed by the “Statement of Cement Consumption” attached to Delhi schedule of Rates of CPWD-DSR-2013 unless otherwise specified in the specifications or the drawing of contract of contract or mutually agreed by Engineer-in-charge and contractor.		
20.1.3	Actual consumption = Issue – Surplus/ unused quantity of cement returned in good condition by contractor to store. (No sweep cement will be taken back by BHEL).		
20.2	CEMENT WASTAGE		
20.2.1	Allowable wastage – One and half percent (+1.5 %) of theoretical consumption of cement unless specified otherwise in the technical specification.		
20.2.2	For any material issued by BHEL to the contractor free of cost, and which is not accounted for by the contractor to BHEL, then recovery for such material shall be affected at penal rates.		
20.2.3	Sl no	Cement consumption	Basis of issue & penal recovery
	C-1	Theoretical consumption (without considering any wastage or loss).	Free
	C-2	Actual consumption being Limited to plus one and half percent (+1.5%) of aforesaid theoretical consumption towards allowable wastage.	Free
	C-3	Actual consumption beyond one and half percent (+1.5%) of above (C-1).	Penal rate
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.		
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 (i.e. five percent).		
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	Consumption shall be calculated based on actual required of no. of block /sqm or supplier recommendation which ever is less.		
20..8.2	Allowable wastage: Two percent (+2%) of theoretical consumption unless specified		

	otherwise in the technical specification. Consumption beyond 2% shall be recovered at penal rate. Basis of recovery shall be as follows:		
	Sl no	Borosilicate Glass Block consumption	Basis of issue & penal recovery
	B-1	Theoretical consumption (without considering any wastage or loss).	Free
	B-2	Actual consumption being Limited to Two percent (+2%) of aforesaid theoretical consumption towards allowable wastage.	Free
	B-3	Actual consumption beyond Two percent (+2%) of above (B-1).	Penal rate
20.9	ADHESIVES / MEMBRANCE		
20.9.1	Actual consumption of adhesive / membrance per sqm or supplier recommendation which ever is less.		
20.9.2	Allowable wastage: Three percent (+3%) of theoretical consumption unless specified otherwise in the technical specification. Consumption beyond 3% shall be recovered at penal rate. Basis of recovery shall be as follows:		
	Sl no	Adhesives / Membrance consumption	Basis of issue & penal recovery
	M-1	Theoretical consumption (without considering any wastage or loss).	Free
	M-2	Actual consumption being Limited to Three percent (+3%) of aforesaid theoretical consumption towards allowable wastage.	Free
	M-3	Actual consumption beyond Three percent (3%) of above (C-1).	Penal rate
20.10	PRIMER PAINT		
20.10.1	Actual consumption of paint per sqm or supplier recommendation which ever is less.		
20.10.2	Allowable wastage: Ten percent (+10%) of theoretical consumption unless specified otherwise in the technical specification. Consumption beyond 10% shall be recovered at penal rate. Basis of recovery shall be as follows:		
	Sl no	PRIMER PAINT consumption	Basis of issue & penal recovery
	P-1	Theoretical consumption (without considering any wastage or loss).	Free
	P-2	Actual consumption being Limited Ten percent **(+10%)** of aforesaid theoretical consumption towards allowable wastage.	Free
	P-3	Actual consumption beyond Ten percent **(+10%)** of above (P-1).	Penal rate
21.0	**RECONCILIATION OF BHEL ISSUED MATERIALS**		
21.1	The contractor shall submit a reconciliation statement of 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	Cement (OPC/ PPC/PSC).	Rs 9000/- per MT.
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.
22.2.5	Borosilicate Glass Block	Rs 28000 / Sqm
22.2.6	Adhesives / Membrance	Rs. 2500 / Kg
22.2.7	Primer Paint	Rs. 300 / Litre
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.	
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	1 No. Hydraulic Excavator/Poclain	Within 30 days
24.4.2	1 No. Dozer	Within 20 days
24.4.3	4 No. Dumper	Within 30 days
24.4.4	1 No. Vibromax/Earth Compactor	As per site requirement
24.4.5	1 No. Air Compressor	As per site requirement
24.4.6	1 No 18 / 20 T Crawler Crane	Within 210 days.
24.4.7	1 No Hydra (10 / 12 T Cap)	within 90 days.
24.4.9	10 Nos Welding Rectifier	As per requirement
24.4.10	Motorized MS plate bending machine along with angle bending device – 1 no.	Within 120 days
24.4.11	2 Nos. Automatic batching plant with printing facility (approx. 30 Cum/Hr) – to be commissioned at site.	1st Within 60 days. 2nd Within 90 days
24.4.12	2 Nos Transit Mixer (5 / 6 Cum capacity)	Within 30 days.
24.4.13	2 No Concrete Pump (20 cum/ hr min capacity & lift 70M)	Within 75 days.
24.4.14	3 nos Self Priming Dewatering Pump 5 HP (diesel / electric)	Within 30 days.
24.4.15	3 No Multi stage high lift water Pump (for curing) (lifting height shall be 175 metre). Two shall be	Within 75 days.

	working and other will be stand by.	
24.4.16	1 No Pneumatic Hammer.	As per site requirement
24.4.17	2 Nos Reinforcement Bending Machine	Within 30 days
24.4.18	2 Nos Reinforcement Cutting Machine	Within 30 days
24.4.19	1 No Compression Testing Machine (200 T Cap)	Within 60 days.
24.4.20	Civil laboratory equipments as per list attached in ANNEX `A`with temporary building one AC lab size 4.5mtrx6mtr and 1 non-AC lab 4.5 mtrx4.5 mtr	Within 60 days.
24.4.21	Power Winch – 3 T - 2 nos for structural erection.	As per requirement
24.4.22	Power Winch – 5 T - 1no for structural erection.	As per requirement
24.4.23	Power Winch – 10 T - 2 nos for structural erection	As per requirement
24.4.24	1 No Total Station	Within 20 days.
24.4.25	2 Nos Auto Level & Staff	Within 20 days.
24.4.26	2 nos DG set (suitable capacity as per requirement)	Within 80 days.
24.4.27	Concrete Cube Moulds – Adequate no.	Within 75 days
24.4.28	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 - 2 sets.	As per site requirement and discussion with BHEL
24.4.29.a	Strand Jack / winches with safety device lifting capacity 15 T	As per requirement
24.4.29.b	Hanging platforms with safety device (two nos.)	As per requirement
24.4.29.c	1 No Trailor – 20T,	Within 30 days.
24.4.30	1 No Drinking Water Tank – 1000 Lit.	Within 30 days.
24.4.31	1 No Ultra-Sonography Testing Machine for structural work.	As per requirement
24.4.32	1 No Radiography Source.	Whenever required
24.4.33	Radioset – 1 no (VHF/UHF.)	Within 120 days.
24.4.34	Portable fire extinguishers as below: Soda acid – 4 sets. Dry chemical powder – 4 sets CO2 – 2 sets. Water & sand bucket (4 buckets in one stand) – 3 sets. Fire hose with nozzle (50 M length) – 3 sets.	Within 60 days.
24.5	T&P shown in the above mentioned list are tentative and minimum requirement based on planned progress requirement. Actual Mobilisation schedule, based on front availability, drawings and material availability at site is to 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. 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
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	Automatic batching plant with printing facility (approx. 30 Cum/Hr)	Rs 50000/- per week or part thereof
24.7.12	transit mixer (5 / 6 M3 capacity)	Rs 7000/- per week or part thereof
24.7.13	Concrete Pump (20 cum/ hr min capacity & lift 70M)	Rs 20000/- per week or part thereof
24.7.14	Self Priming Dewatering Pump 5 HP (diesel/ electric)	Rs 2000/- per week or part thereof
24.7.15	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
24.7.16	Pneumatic Hammer.	Rs 500/- per week or part thereof
24.7.17	Reinforcement Bending Machine	Rs 5000/- per week or part thereof
24.7.18	Reinforcement Cutting Machine	Rs 5000/- per week or part thereof
24.7.19	Compression Testing Machine (200 T Cap)	Rs 4000/- per week or part thereof
24.7.20	Civil laboratory equipments as per list attached in ANNEX `A`with temporary building one AC lab size 4.5mtrx6mtr and 1 non AC lab 4.5 mtrx4.5 mtr	Rs 500/- per week or part thereof
24.7.21	Power Winch – 3 T	Rs 2000/- per week or part thereof
24.7.22	Power Winch – 5 T	Rs 3000/- per week or part thereof
24.7.23	Power Winch – 10 T	Rs 5000/- per week or part thereof
24.7.24	Total Station	Rs 5000/- per week or part thereof
24.7.25	Auto Level & Staff	Rs 5000/- per week or part thereof
24.7.26	2 nos DG set (suitable capacity as per requirement)	Rs 20000/- per week or part thereof
24.7.27	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
24.7.28	Strand Jack / winches with safety device lifting capacity 15 T	Rs 10000/- per week or part thereof
24.7.29.a	Hanging platforms with safety device	Rs 15000/- per week or part thereof
24.7.29.b	Trailor – 20T,	Rs 10000/- per week or part thereof
24.7.29.c	Drinking Water Tank – 3000 Lit.	Rs 5000/- per week or part thereof
24.7.30	Ultra-Sonography Testing Machine For Structural Work.	Rs 5000/- per week or part thereof
24.7.31	Radiography Source.	Rs 500/- per week or part thereof
24.7.32	Radioset – 1 no (VHF/UHF.)	Rs 500/- per week or part thereof
24.7.33	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**
	Contractor shall establish and maintain civil laboratory 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	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.
26.2	**Sl. No.** / **Activity** / **Completion time** 26.2.1 / Completion of Chimney U#1 / 9 months 26.2.2 / Completion of Chimney U#2 / 11 months 26.2.3 / Completion of Chimney U#3 / 13 months Phase gap between unit 1, 2 & 3 shall be 2 Months
26.3	Contractor shall submit structural fabricaton drawings within 15 days from the release of engineering drawings by BHEL. 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. 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.
26.4	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.
27.0	**COMPLETION PERIOD**
	The entire work under this scope shall be successfully completed within 13 (Thirteen) months from the date of Start of work. Mobilisation period is 15 days from the date of LOI / intimation by Construction Manager BHEL, North Karanpura 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 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 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 MILESTONE**
33.1.1	In case delay in achieving the Milestone as mentioned in Clause 26.2.1 above, is solely attributable to the contractor, 0.5% per week of executable contact value, limited to maximum 2% of executable contact value, will be withheld.
33.1.2	In case delay in achieving the Milestone as mentioned in Clause 26.2.2 above, is solely attributable to the contractor, 0.5% per week of executable contact value, limited to maximum 3% of executable contact value, will be withheld.
33.1.3	Amount already withheld, if any against slippage of clause 26.2.1 & 26.2.2 above, shall be released only if there is no delay attributable to contractor in achievement of Milestone as mentioned in clause 26.2.3 above.
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	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. Withheld amount, if any due to slippage of identified intermediate milestone(s) shall be adjusted against LD or released as the case may be.
33.1.6	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	**Overall Completion**

33.2.1	If the completion of work is delayed beyond the completion period referred above due to reasons attributable to the contractor, they shall pay to BHEL as penalty a sum @ 0.5 % of contract price per week of delay or part thereof subject to a maximum of 10 % of the total contract value.
33.2.2	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.
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 crosses + 50% (plus fify percent) limit during execution and obtain approval/consent of CM, BHEL for execution of further quantity for this item.
34.5	While, total price (Supply & service parts together) will be considered for evaluation, separate order will be placed for supply part & service part as per 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 (if / as & when applicable later) shall be deducted at applicable rates on gross invoice value from the running bills (RA bills). However, as on date no TDS under GST is applicable.
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 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	For all items of works, as per the the Price schedule, Vol-III, billing shall be on item rate basis. However, Interim Payment shall be limited to 95% of gross bill amount.
36.2	All admissible recovered/ adjustments etc. shall be made from the interim payable amount.
36.3	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.
36.4	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.
36.4.1	0.7 % shall be paid on compliance of housekeeping of vendor's working area and store/ office areas.
36.4.2	0.3 % shall be paid on compliance of general illumination of vendor's working area and stores, office area.
36.4.3	0.2 % shall be paid on compliance of applicable OHSAS requirement as per guidelines

	of BHEL/ PSER and as specified in the tender.
36.4.4	0.3 % shall be paid on compliance of applicable safety requirement as per guidelines of BHEL/ PSER and as specified in the tender.
36.5	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 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.
36.6	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.
36.7	Such payment as above shall be affected only on certification by BHEL against completion of each stage.
36.8	Applicable GST, which can be claimed at any point, shall be released to you upon compliance of following:
36.8.1	You declaring such Invoice in his GSTR-1
36.8.2	Receipt of Goods / services and Tax Invoice by BHEL
36.8.3	Confirmation of payment of GST thereon by you on GSTN Portal
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**
	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	**DIVISIBLE CONTRACT**
	Notwithstanding anything stated elsewhere in this tender, the contract to be awarded shall be based on supply & erection contract (divisible contract) on single source responsibility. In the mode of contracting on the basis of supply & erection, the civil & erection portion of the contract will relate to Schedule – 3 of volume-III and supply portion of the contract will relate to the Schedule – 4 of volume-III. But the two contract shall not in any way dilute the responsibility of the bidder for the successful completion of the job as per tender specification and both the contracts shall contain a cross-fall breach clause, namely that a breach in one contract shall automatically be classified as a breach on the other contract which will confer a right on BHEL to terminate the other contract at the risk and cost of the bidder. The title of the Ownership of goods to be supplied shall pass on to the NTPC on dispatch ex-works/ FOR destination. However, till the scope is completed in all respect and the plant / equipment is taken over by the NTPC the goods shall remain with the custody of the bidder.
42.0	**DESIGN OFFICE AND FABRICATION DRAWING**
42.1	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.
42.2	Contractor shall submit progress report pertaining to fabrication drawing, by 7th 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.
43.0	**FABRICATION**

43.1	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. 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.
43.2	Bidder, at his own cost, shall supply electrodes required for fabrication, erection of structural steel as per specification and approval of BHEL.
44.0	**INSURANCE**
44.1	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.
44.2	Vendor shall timely intimate dispatches to the underwriter failing which the contractor shall be held responsible for the loss/damage/theft of materials during transit The name of the underwriter and Policy No. shall be intimated in due course of time.
44.3	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.
44.4	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.
44.5	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 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.
44.6	It will be responsibility of vendor to replenish the items lost/ damaged in time without hampering the schedule of work and without waiting for settlement of insurance claim. Amount received from the underwriters on settlement of insurance claim shall be passed on to the vendor as and when available.
44.7	Other conditions of Insurance shall be as per relevant clause of GCC/SCC.
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, Cement / 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	Initial & final setting time, Consistency of cement	Vicat Apparatus with desk pot	Standard	IS 5513
2	Shrinkage of cement, Auto Clave Test	Le Chatelier's appratus Auto Clave Equipment	Standard	IS 5514
3	Abrasion value test	Los Angles Abrasion testing machine	Standard	IS 2386
4	Aggregate Impact value test	Aggregate Impact value testing machine with blow counter	Standard	IS 9377
5	Aggregate crushing value test	Crushing value apparatus	Standard	IS 2386
6	Flakiness index	Thickness gauge for measuring flakiness index	Standard	IS 2386
7	Elongation Index	Elongation guage	Standard	IS 2386
8	Bulk density, voids and bulking appratus	Measuring cylinders	3, 5,10 & 15-liters cylinders	
9	Concrete Compressive test	Digital Compressive Testing Machine with 2000 KN capacity.	2000KN capacity	IS 2505
10	Cement motor cube casting	Mortor Cube mould	70.6 x 70.6 x 70.6 mm, minimum 06 sets desired.	IS 10086
11	Concrete Cube casting	Concrete Cube Mould	150x150x150mm, minimum 20 sets desired considering TG Raft major concereting activity.	IS 10086
12	Workability of concrete	Slump cone	Standard, atleast 04 nos	IS 456
13	Specific gravity of aggregates	Pycnometer	Standard, atleast 02 nos	IS 383
14	Cement mortor cube vibrating	Motorised vibration machine for cement testing	Standard	IS 4031
15	Course agregate Sieve analysis (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	IS 383
16	Fine agregate 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, Pan and cover	IS 383
17	Seive Shaker	Motorised Sieve shaker	Mfg. Catalogue	
18	Silt content check	Sand silt content beaker	Standard	
19	Ultrasonic pulse velocity test	UPV appratus for concrete	Standard	

	Soil Testing Equipment (Levelling & Grading)			
1	Liquid limit test	Liquid limit apparatus	Standard	IS 2720
2	Core Cutter test	core cutter apparatus	Rammer, 6 nos of std 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	3 nos	600gx0.01g, 10g and 50 kg	
3	Physical balance	5 kg capacity	Weights upto 5 kg	
4	Thermometer	Temperature range 0° C to 150° C	Digital	
5	Poker Thermometer (Concrete Road)	Temperature range 0° C to 50° C & 150° C	02 nos each required	
6	Measuring jars	2 nos set of each size	100ml, 200ml, 500ml & 1000 ml	
7	Gauging trowlers	4 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	2 kg and 5 kg	
10	Vernier calipers	2 nos each	12" and 6" Sizes	
11	Digital pH meter	01 nos	.01 mm least count	
12	Digital micrometer	01 nos	0.01 mm least count	
13	Digital paint thickness meter for steel	02 nos	500-micron Range	
14	GI tray	02 nos each	600x450x50mm, 450x300x40mm, 300x250x40mm	
15	Electric morter mixer	01 nos	0.25 CUM capacity	
16	Rebound hammer test	01 nos	Digital Rebound hammer	IS 13311
17	Screw Gauge	02 nos	0.1 mm-10mm, Least count 0.05	
18	Digital paint thickness meter for masanory/concrete painting measurement	02 nos	150-micron range	

Annexure-B

LIST OF FABRICATORS FOR PREPARATION OF FABRICATION DRAWING FOR BHEL

SL.NO.	DETAILER NAME	DETAILOR ADDRESS
1.	ASSOCIATED CONSULTING ENGINEERS	K-65, SARITA VIHAR, NEW DELHI 110044
2.	CONSTRUCTION CONSULTANTS CONSULTING ENGINEERS	94, G.F. BLOCK-1 EROS GARDENS COLONY, SURAJKUND ROAD, FARIDABAD, HARYANA-121009
3.	OCTAMEC ENGINEERING LTD.	OCTAMEC ,18, SUBHASH ROAD, VILE PARLE(E), MUMBAI-400057
4.	BRIDGE & ROOF CO.(INDIA) LTD. (A GOV. OF INDIA ENTERPRISE)	427/1, GRAND TRUNK AD, HOWRAH-711101
5.	STRUCON CONSULTING PVT. LTD.	PLOT NO.-46, SECTOR-37, PACE CITY-1, GURGAON, HARYANA-122001
6.	ENGINEERING CONSULTANCY SERVICES	B-57, NEW KRISHNA PARK, DHAULI PIAO, VIKASPURI, NEW DELHI-110018
7.	DYNAMIC STRUCTURAL ENGINEERING SERVICES	B-73, DDA FLATS, PKT-3, BINDAPUR, DWARKA, NEW DELHI- 110059

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 CICO TECHNOLOGIES LIMITED FOSROC CHEMICALS (I) PVT LTD, BSF
2	PAINT AND PAINTING SYSTEM	BERGER SHALIMAR PAINTS JENSON AND NICHOLSON KANSAI NEROLAC AKZO NOBEL ASIAN PAINTS
3	STRUCTURAL STEEL	STEEL AUTHORITY OF INDIA LTD TATA IRON & STEEL CO LTD INDIAN IRON & STEEL CO LTD RASHITRYA \SPAT NIGAM LTD JSPL LTD ESSAR STEEL LTD ISPAT INDUSTRIES LTD JSW STEEL LTD LLOYDS STEEL LTD 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 ROCKWOOL INDUSTRIES, BHILAI LAPINUS, MALANPUR (MP) MINWOOLRAJANANDGAON LLOYD INSULATION, BHILAI U.P. TWIGA, BULENDSHAHAR
5	CHIMNEY ELEVATOR	MEKASTER ENGG & EQPT (P) LTD. (GUJARAT) ALIMAK, AB (SWEDEN) UNIVERSAL CONSTRUCTION MACHINARY & EQUIPMENTS (PUNE)

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.14.00	**CHIMNEY**
3.14.01	**Salient Features**
	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.
	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 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,

CLAUSE NO.	TECHNICAL REQUIREMENTS

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.

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.

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.

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.

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.

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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.14.02	**Design Concept** 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. In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail. 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. The min. thickness of web for plate girders shall be kept as 12 mm. Seismic forces on the chimney system shall be determined based on site specific seismic information provided elsewhere in this document. Wind forces on the chimney system shall be determined based on site specific wind design criteria provided elsewhere in this document. 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** 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. 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. 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. 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. 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. 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. 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

CLAUSE NO.	TECHNICAL REQUIREMENTS
	shall be twice that required from design forces. The clear cover to reinforcement shall be 50 mm. 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. 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. 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. Shell thickness between any two 10m reference levels shall not vary more than 150mm. The minimum thickness of shell/closure wall at beam support recess/ opening locations shall be 100mm. 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. 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** 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. 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. Two manholes placed diametrically opposite shall also be provided in each flue at all internal platform levels. The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained. Clean-out door shall be provided below the flue for the removal of ash.
3.14.05	**Internal Platforms** 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**
	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**
	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**
	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. 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. 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** (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. (ii) All exposed surfaces of steel wind strakes shall be painted with epoxy phenolic coating system having total 240 microns DFT. 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. 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. 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 ΔE) 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. (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. (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. 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. 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. 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

CLAUSE NO.	TECHNICAL REQUIREMENTS
	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 Employer. 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** 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. 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. All equipment supplied shall comply with relevant IS Standards. 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. 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. 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. 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. 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.. A temporary aviation obstruction lighting system shall be provided during construction of the chimney. 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. 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. 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 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. 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 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** 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

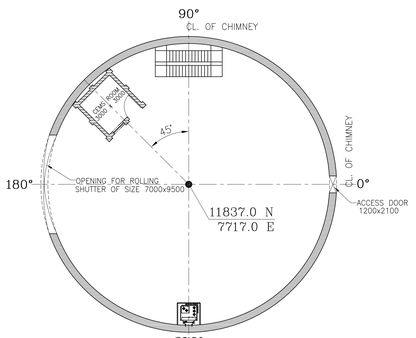
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DRAWING NO. PE-DG-441-620-C101

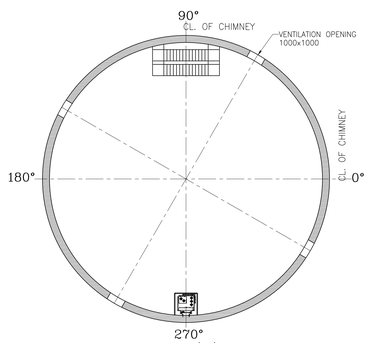
FIRST ANGLE PROJECTION | ALL DIMENSIONS ARE IN MM

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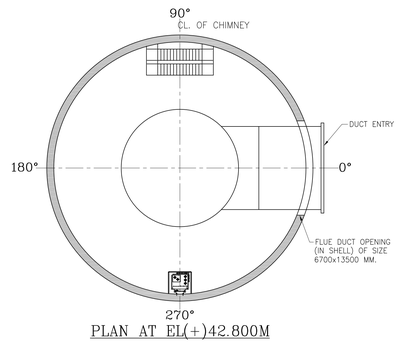
NORTH



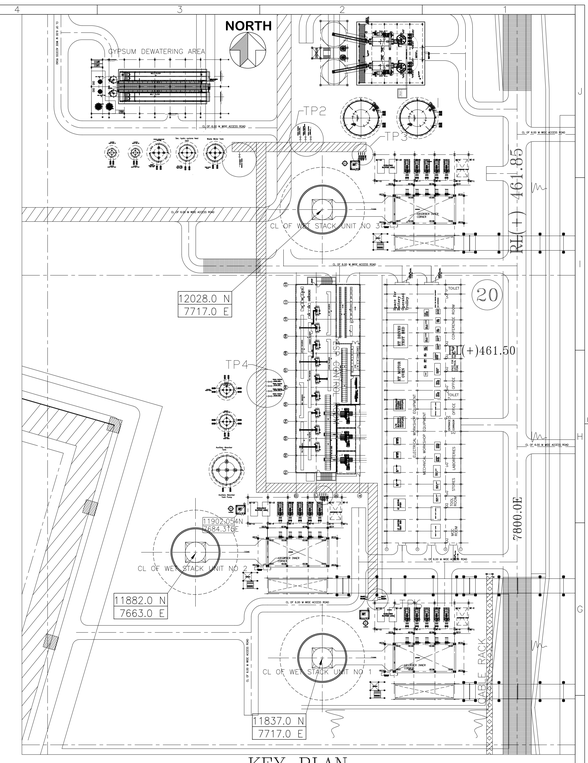
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PLAN AT EL(+)14.00M



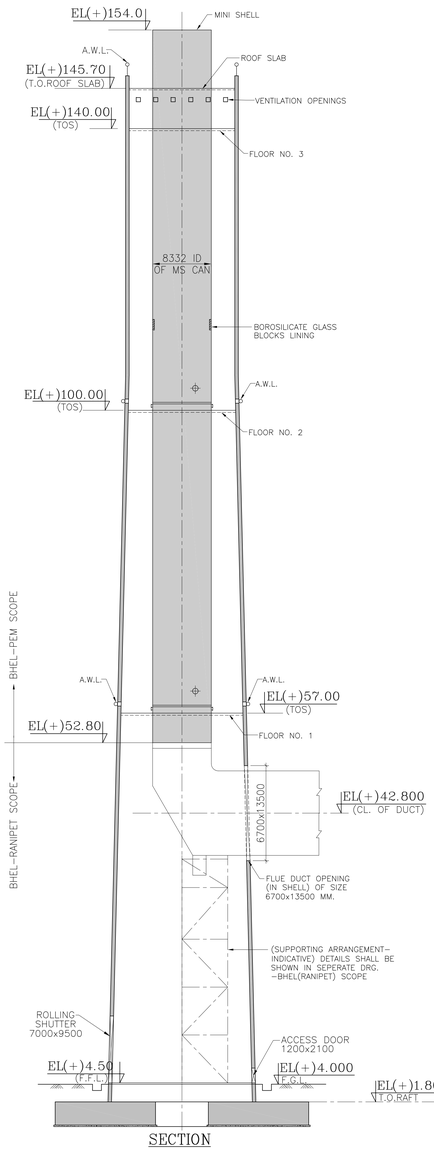
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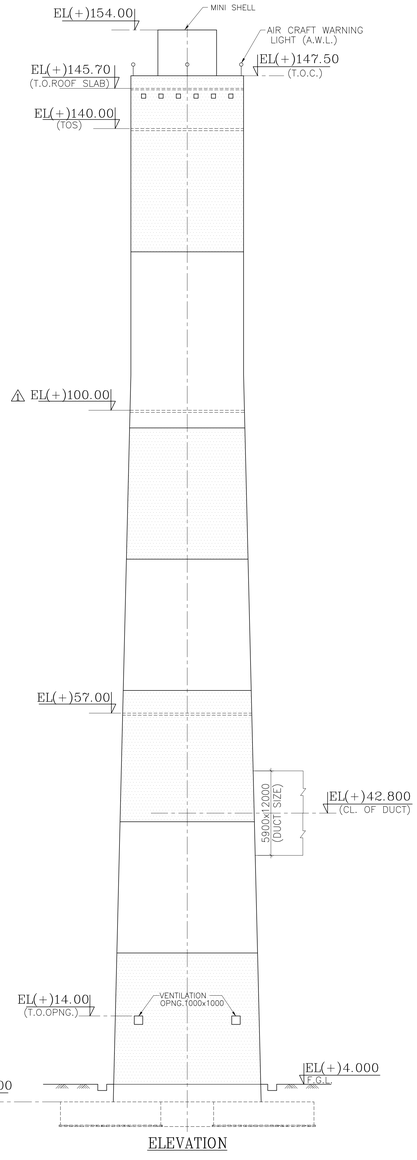
KEY PLAN

ELEVATION (M)	OUTSIDE DIAMETER OF SHELL (mm)	SHELL THK (mm)	OUTSIDE PROFILE OF SHELL (mm)
147.50	16000	500	CYLINDRICAL
145.50	16000	500	
140.00	16000	500	
135.00	16000	500	
130.00	16000	500	
125.00	16000	500	
120.00	16000	500	
115.00	16000	500	
110.00	16000	500	
105.00	16000	500	
100.00	16242	500	
95.00	16484	500	
90.00	16727	500	
85.00	16969	500	
80.00	17211	500	
75.00	17453	500	
70.00	17696	500	
65.00	17938	500	
57.00	18326	500	
52.80	18529	500	
49.55	18687	500	
45.00	18907	500	
42.80	19014	500	
40.00	19149	500	
36.05	19341	500	
30.00	19634	500	
25.00	19876	500	
20.00	20118	500	
14.00	20409	500	
10.00	20603	500	
+6.600	20767	500	
+4.500	20869	500	
+1.800	21000	500	

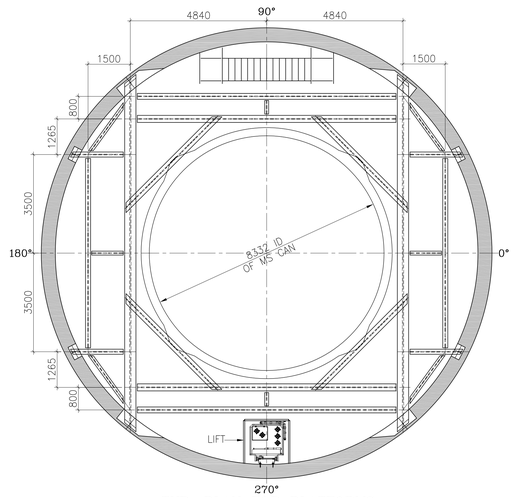
2500 : 103200 UNIFORM LINEAR TAPER



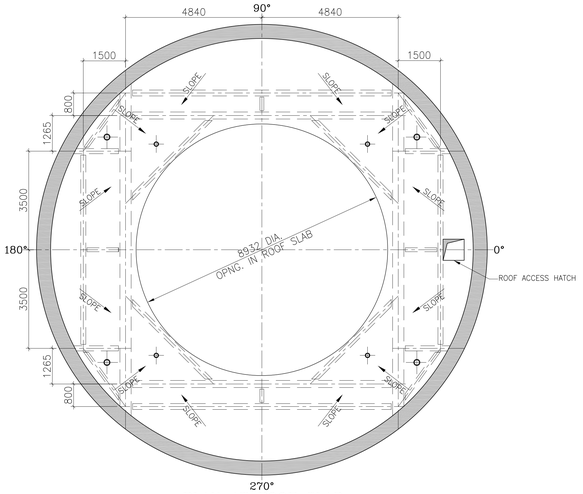
SECTION



ELEVATION



TYP. PLAN FOR PLATFORMS



PLAN AT ROOF SLAB
(T.O.C. = EL+145.700 M.)

FOR TENDER PURPOSE ONLY

NOTES: -

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
2. COMPLIANCE WITH STANDARDS SHALL RELATE TO LATEST PUBLISHED EDITIONS.
3. ALL ELEVATIONS ARE REFERRED TO THE FINISHED GROUND FLOOR LEVEL OF POWER HOUSE BUILDING AS EL(±)0.00 M WHICH CORRESPONDS TO RL(+)457.50 M. ABOVE MEAN SEA LEVEL.
4. THE OTHER COMPONENTS OF THE CHIMNEY INCLUDE ROLL UP DOORS, PERSONNEL ACCESS DOORS, HAND RAILS, HOOD HATCH, LINER TEST PORTS, NON METALLIC EXPANSION JOINTS, RAIN WATER DRAINAGE SYSTEM, VENTILATION OPENINGS, ELECTRICAL POWER SUPPLY DISTRIBUTION BOARDS, LIGHTING PANELS, SOCKET OUTLETS, POWER AND CONTROL CABLING, RACEWAY SYSTEM, STAIR AND PLATFORM LIGHTING, LIGHTNING PROTECTION & GROUNDING SYSTEM, COMMUNICATIONS SYSTEM ETC. AND SHALL BE PROVIDED AS PER TECHNICAL SPECIFICATIONS.
5. FOR STANDARD NOTES & DETAILS FOR RCC WORKS REFER APPROVED DRG. NO. PE-DG-441-600-C001.
6. FOR STRUCTURAL DETAILS, WELDING, HANDRAILING ETC. REFER APPROVED DRG. NO. PE-DG-441-600-C002.
7. AIRCRAFT WARNING LIGHT (A.W.L.) SHALL BE PROVIDED TO MEET THE REQUIREMENT OF RELEVANT STANDARD STATUTORY BODY.
8. FABRICATED FLUE CANS OF LENGTH APPROX. 5 TO 6 METERS HAS TO BE TRANSPORTED INSIDE CHIMNEY WITH DIA. OF FLUE CAN IN VERTICAL POSITION. THE FLUE CANS SHALL BE STIFFENED ACROSS DIAMETER WITH TEMPORARY STRUTS DURING TRANSPORTATION.

REV.	DATE	ALTD	CHD	APPD

JOB NO. 441

STATUS CONTRACT

DISTRIBUTION

PRINT SCALE IN METRE 0 10 20 30 40 50

NTPC DRG. NO. 4410-109-PEM-PVC-B-012

OWNER NTPC — NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT 3x660MW NORTH KARANPURA STPP (FGD PACKAGE)

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA (U.P.)

DEPT CODE		NAME	SIGN	DATE
C	DRN	SANJAY	Sd/-	19.09.2019
	DESN	LP	Sd/-	19.09.2019
	CHD	MA	Sd/-	19.09.2019
	APPD	AKS	Sd/-	19.09.2019

TITLE FGD CHIMNEY
GENERAL ARRANGEMENT

MPL	ELEC	C&I	MSE	MAX	DEPT.	SCALE 1:150	DRAWING NO.
					SIGN		PE-DG-441-620-C101
					DATE		SHEET 1 OF 1 REV.

Sep 19, 2019 - 11:30am
FORMAT SIZE A0

CAD FILE NAME: D:\PROJECTS\North Karanpura\441-620-C101 TENDER.dwg

Maharatna Company	**TITLE: - 3X660MW NORTH KARANPURA STPP FGD SYSTEM PACKAGE.** **SPECIFICATIONS FOR SINGLE FLUE RCC CHIMNEY**	SPECIFICATION NO. PE-TS-441-620-C002 VOLUME : IIB SECTION : C REV.NO. 00 SHEET

3X660MW NORTH KARANPURA STPP
FGD SYSTEM PACKAGE

VOLUME II-B

CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

SECTION – C

TECHNICAL SPECIFICATIONS

(SINGLE FLUE RCC CHIMNEY)

PE-TS-441-620-C002

Maharatna Company

Bharat Heavy Electricals Limited
Project Engineering Management
Power Sector, PPEI BUILDING
SECTOR 16A, NOIDA-201301, UP

Maharatna Company	**TITLE: - 3X660MW NORTH KARANPURA STPP FGD SYSTEM PACKAGE.** **SPECIFICATIONS FOR SINGLE FLUE RCC CHIMNEY**	SPECIFICATION NO. PE-TS-441-620-C002 VOLUME : IIB SECTION : C REV.NO. 00 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: - 3X660MW NORTH KARANPURA STPP FGD SYSTEM PACKAGE.** **SPECIFICATIONS FOR SINGLE FLUE RCC CHIMNEY**	SPECIFICATION NO. PE-TS-441-620-C002 VOLUME : IIB SECTION : C REV.NO. 00 SHEET

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Sub-section D16: Road and drainage

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Maharatna Company	**TITLE: - 3X660MW NORTH KARANPURA STPP FGD SYSTEM PACKAGE.** **SPECIFICATIONS FOR SINGLE FLUE RCC CHIMNEY**	SPECIFICATION NO. PE-TS-441-620-C002 VOLUME : IIB SECTION : C REV.NO. 00 SHEET

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Sub-section D28: Specification for electrical works.

Sub-section D29: specification for chimney elevator

Maharatna Company	**TITLE: - 3X660MW NORTH KARANPURA STPP FGD SYSTEM PACKAGE.** **SPECIFICATIONS FOR SINGLE FLUE RCC CHIMNEY**	SPECIFICATION NO. PE-TS-441-620-C002 VOLUME : IIB SECTION : C REV.NO. 00 SHEET

SECTION-C

SPECIFIC TECHNICAL REQUIREMENTS FOR CIVIL WORKS

SPECIFICATION NO. PE-TS-441-620-C002

NTPC Limited

(A Government of India Enterprise)

NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)

PART – A

TECHNICAL SPECIFICATIONS

SECTION – VI

FOR

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-4410-109-2

NTPC Limited

(A Government of India Enterprise)

NORTH KARANPURA SUPER THERMAL POWER PROJECT (3x660MW)

PART - A

TECHNICAL SPECIFICATIONS

SECTION – VI

FOR

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-4410-109-2

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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 **North Karanpura STPP (3x660 MW)**. 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, 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. AMDT 8 SL 178 PAGE 68
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. 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.
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. 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:** CLAUSE DELETED AMDT 8 SL 179 PAGE 69
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.

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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. 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: (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. (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. (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. 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** 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. Limestone storage hopper shall be of RCC with structural steel shed covered with permanently Colour coated profiled steel sheets. 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

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mm. Minimum thickness of RCC side walls shall be 600 mm at bottom and 300 mm at top.

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.

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.

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.

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:

Chemical injection grouting for inner faces (details as specified elsewhere).

Polymer modified cementitious coating on earth side face as per the following :

(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.

(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.

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.

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Plinth protection along with drains shall be provided along the Hopper complex. However, 5m wide paving shall also be provided around machinery hatches. and Truck hopper.

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.

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

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	0.9 times only, ground water table to be taken at adjoining formation level and soil wedge angle of not more than 15 degrees. 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. 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** 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. Seal plates under the conveyor galleries shall be provided in such a way that complete gallery bottom shall form a leak proof floor. 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. 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

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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

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be slide type. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements.

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.

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.

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**

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.

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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.

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.

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3.04.00	**Crusher House** 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. AMDT 8 SL 191 PAGE 73 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. 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** 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. All air - conditioned areas, shall be provided with the suspended permanently colour coated aluminium false ceiling system (details specified elsewhere) with under deck insulation. 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** 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

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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

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

Toilet with potable water line facilities shall be provided in each of the following locations:

(a.) In all M. C. C. Rooms

(b.) Control Building

3.09.00 Staircases, Gratings, Handrails

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However sheeting shall be provided at the top.

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

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.

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 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.

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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. 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. 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. 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. 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** 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. 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** 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**
AMDT NO. 14 SL NO. 51 PAGE 12	Configuration and height of chimney(s) shall be as specified in mechanical portion of technical specification. There shall be one flue (liner) for each unit. 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.
	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 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,

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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.

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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.

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The expansion joint in the flue liner shall comprise of non-metallic ~~fluoroelastomeric~~ 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 backed 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.

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 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.

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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.

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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.

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3.14.02	**Design Concept** 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. In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail. 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. The min. thickness of web for plate girders shall be kept as 12 mm. Seismic forces on the chimney system shall be determined based on site specific seismic information provided elsewhere in this document. Wind forces on the chimney system shall be determined based on site specific wind design criteria provided elsewhere in this document. 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~~.
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3.14.03	**Wind Shield** The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The ~~load calculation and~~ 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. 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. 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. 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. 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. ~~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~~. 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.
	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.
AMDT NO. 14 SL NO. 60 PAGE 16	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.
	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.
	Shell thickness between any two 10m reference levels shall not vary more than 150mm.
AMDT NO. 14 SL NO. 61 PAGE 16	The minimum thickness of shell/closure wall at beam support recess/ opening locations shall be 100mm.
	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.
upto distance of 20 times diameter at 2/3rd 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,	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**
	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.
	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.
	Two manholes placed diametrically opposite shall also be provided in each flue at all internal platform levels.
	The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained.
AMDT NO. 14 SL NO. 62 PAGE 16	~~Clean-out door shall be provided below the flue for the removal of ash.~~
3.14.05	**Internal Platforms**
	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**

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**

as per limit state method as per IS 4998

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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~~.M30

3.14.08 **Thermal insulation** (Applicable in case of Titanium / C-276 Flue Liner)

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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.

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~~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.~~

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**

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(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.

(ii) ~~All exposed surfaces of steel wind strakes shall be painted with epoxy phenolic coating system having total 240 microns DFT.~~

~~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.~~

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~~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.~~

~~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 ΔE) 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.~~

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(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.

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(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.

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.

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.

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 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 Employer. 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** 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. 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. All equipment supplied shall comply with relevant IS Standards. 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. 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. 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. 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. 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.. A temporary aviation obstruction lighting system shall be provided during construction of the chimney. 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. 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. 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 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. 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 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** 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: 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. Minimum 4 nos. down comers shall be provided in each building at corners. 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. 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. 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. 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.** 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.

For water supply, medium class galvanized mild steel pipes conforming to IS: 1239 shall be used.

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.

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.

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.

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.

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.

For design of building drainage system IS: 1742 shall be followed.

For sanitary / sewerage pipes above ground, sand cast iron pipes conforming to IS : 1729 with leak proof lead joints.

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.

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~~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

a) Wall Cladding & Roofing Material

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 **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 **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 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. **b) Metal Deck Roof Material** Troughed permanently colour coated metal decking sheets shall be **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 **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 **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. 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. 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** 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** 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. 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** 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. 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. 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. 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. 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** 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. Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS: 277 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 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. 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** 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 **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 **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 **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. 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. 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. 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** 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: 1) Application of polymerised mastic over the RCC roof to achieve smooth surface as primer coat. 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). 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. 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**
	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.
AMDT 8 SL 189 PAGE 72	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 0.6 mm 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.
	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.
	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.
	R. C. C. floors (where no brick masonry walls are provided) shall be provided with handrails all along the periphery.
For scope of area paving refer clause no. 1.00.00, Sub-section-IIID Civil works, SectionVI, Part-A of technical specification	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. Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification. 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. Lightly loaded areas such where no heavy traffic movement is envisaged shall be provided with Normal Duty paving. 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 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. Plinth level of all buildings shall be kept at least 500 mm above the finished grade / formation level. 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. 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. **GRADE SLAB OF BUILDINGS AT GROUND FLOOR** 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. 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** All brick walls shall be non - load bearing in-filled panel walls. AMDT 8 SL 197 PAGE 79 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. 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/cm2. 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%. 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. Parapets, chajjas, windows and door heads, architectural faces, fins etc. shall be provided with drip course in 1 : 4 cement sand mortar. 50 mm thick Damp proof course shall be provided at plinth level for all brick wall. 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** 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** Site leveling of gypsum storage area , lime storage area , gypsum dewatering area , truck hopper and associated areas to be levelled in one blocks as defined in the drawing no. 4410-999-POC-F-001 titled, "Layout plan of FGD System ". 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.

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	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 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 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. 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 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. 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. Filling with rock shall be done only after the written permission of the Engineer in the following manner: Filling with rock shall be done only in areas identified for laydown and preassembly . 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. Refer tender drawing no. "4410-999-POC-F-001". 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.

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.

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	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** 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. 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** 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. 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. 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

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	shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete. The finished top (crest) of all roads shall be 350 mm above the surrounding finished ground level. 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. Cutting / extending / rerouting / remaking of existing roads including associated works to maintain continuity of road system / network shall also be carried out. 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. Unless otherwise specified, all roads shall be double lane roads. The road section should be as per drawing no. 4410-999-POC-F-001.
13.00.00	**GATE ALONG BOUNDARY WALL:** The gates shall be provided at the entry and exit of truck movement road gates in Bidder's Scope are as identified in Drawing No.: 4410-999-POC-F-001. The gate shall comprise of two mild steel double panelled openable shutter of minimum 7.75 m clear width and minimum height of 3.0m from top of road. 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. All gates shall be given anti-corrosive treatment in three coats. The structural steel shall confirm to IS: 2062 (latest) and all other relevant IS codes. 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** AMDT 8 SL 184 PAGE 70 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 ~~90~~mm/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. 75 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

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	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 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. 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. 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. 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** 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. 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. 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. PUMPING STATIONS AMDT 8 SL 183 PAGE 70 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 **"Annexure-A"** and **"Annexure-B"** respectively in Civil Section, whichever is governing. 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. 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. 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.
	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 : i) Water / liquid inside and no earth outside (applicable only to such

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	structures which are liable to be filled up with water or any liquid). ii) Earth with surcharge outside and no water / liquid inside 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. 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** 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** 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. 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).
AMDT 8 SL 185 PAGE 70 **17.01.00**	Design of steel structures shall be done as per provisions of IS:800: 2007 (Limit state design) 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

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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.
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** The maximum Horizontal Deflection for various structures shall not exceed and be limited to the following:

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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.

For electric overhead cranes :

1) upto 50 t capacity : span/750

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 specifically mentioned in this specification.

b) For design and construction of steel-concrete composite members, IS: 11384 shall be followed.

c) For reinforcement detailing, IS: 5525 and SP: 34 shall be followed.

d) Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.

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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. 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. 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. 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 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.) ii) Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside. 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. iv) Base slab and piers of the pump houses shall also be designed for the

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condition of different combination of pump sumps being empty during maintenance stages with maximum ground water level.

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.

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**

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17.26.0 0 DELETED

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.

17.27.0 0 Design drawings of steel structures shall include the connection, joint & fastener details for Main columns, Beams & Bracings

Reinforcement design shall be done by working stress method as per IS:456-2000 and IS:2974 (Part-IV).

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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)**

Epoxy phenolic coating shall be applied on internal surfaces of the RCC water retaining structures, as per details specified below:

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.

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.

Coating on RCC water retaining structures (drinking water)

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

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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. 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^{o}C - 300^{o}C for one hour and later on cooled in the same oven to 100^{o} C. It shall be transferred to a holding oven maintained at 60^{o}C - 70^{o}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** 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** 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 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

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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

Thickness of thicker part at Point of welding	Welding Using: Low hydrogen electrode or submerged arc welding	Welding Using: 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

Thickness of thicker part at Point of welding	Welding Using: Low hydrogen electrode or submerged arc welding	Welding Using: 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 surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained.

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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. 2.5 m wide paving with metallic hardener around periphery of all sumps and underground tanks shall be provided. 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. 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. 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. Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec.

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22.00.00	**Statutory Requirements** 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. 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. 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. Statutory clearances and norms of State Pollution Control Board shall be followed. 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** 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. 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** 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: a) M25 - For all underground / sub-structural/ super-structure R. C. C. work. b) M30- For Block Foundation c) M35- For spring supported RCC deck and rail load bearing structure (if applicable).

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	Minimum 75 mm thick P.C.C M-7.5 shall be provided as mud mat below all foundations. For concreting of underground structures requiring water tightness, plasticizer cum water proofing admixture shall be added to the concrete mix. Both coarse and fine aggregates shall conform to IS: 383 for concrete, shotcreting etc. unless otherwise mentioned.
25.00.00	**Excavation, Backfilling, Disposal and Stacking of materials Details**
25.01.00	**Excavation in Soil** 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. 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. 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. 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. For other details, excavation clauses as given at Annexure-C of this specification, are to be referred.
25.02.00	**Excavation in Rock** 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. 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.

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	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. 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 forexcavation in rock, clauses as given at Annexure-C of this specification, are to be referred.
25.03.00	**Backfilling, Disposal and Stacking of materials** Backfilled earth shall be compacted as per “Foundation system and Geotechnical Data Chapter” given at Annexure-C of this specification. 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. 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. 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: 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. 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. 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. 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

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	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. 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** All burrs and irregular edges of the structural steel members to be galvanised shall be ground smooth before galvanising. Purity of Zinc to be used for galvanising shall be 99.5 % as per IS : 209 (latest edition). The weight of the zinc coating shall be at least 610 Gms. / m^2 unless noted otherwise.
27.00.00	**CHEMICAL INJECTION GROUTING** 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. 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. 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

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	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.
28.00.00	**POLYMER MODIFIED CEMENTITIOUS COATING**
28.01.00	**Materials** 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%). Portland cement based dry powder. Clean, fine specially prepared quartz sand approximately 0.6 mm size.
28.02.00	**Mixing** 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** It must adhere to wet surface. It should develop adequate bond strength, with the concrete surface, not less than 2 N / Sq. mm. Co - efficient of permeability shall be about $5x10^{-10}$ Cm / Sec. Water absorption after continuous soaking shall not be more than 1 %. The materials shall be permeable under water vapour. The material shall be resistant to acids and alkalies present in the soil and underground water with normal pH value between 4 and 14. The co - efficient of thermal expansion of the material shall be close to that of concrete.
28.04.00	**Application** 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.

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	(a) For Slurry Mix 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 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. The coating shall be air dried for 4 to 6 hours and, thereafter, cured for 7 days after the application of last coat. **(b) For Brush Topping Mix** 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. The Coating shall be air dried for 4 to 6 hours and thereafter cured for 7 days after the application of last coat. Rate of application of coating shall be established to achieve the required thickness.
29.00.00	**Architectural Concepts** 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. Necessary projections, fins, parapets, chajjas etc. in addition to the minimum area specified elsewhere in this specification shall be provided as required. Nothing extra shall be payable for any changes required while getting the drawings / scheme approved and for executing the same. 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.

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29.01.00	**FINISHING SCHEDULE**
29.01.01	**Flooring** 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. 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) 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:** The nominal thickness of floor finish shall be 50 mm. 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. (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. (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. (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. (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. (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. (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.

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	(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 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). (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 : (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. (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. (iii) IIIrd course of applying blown or residual bitumen applied hot at 1.7 kg. per sq.m of area. (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:** Acid / alkali resistant lining treatment shall be provided in different areas as follows: 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.

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	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. The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron). 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 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. 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. Alum solution preparation tank: 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. 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. Basket of Alum solution preparation tank: 5 mm thick epoxy lining over a coat of epoxy primer. Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks. 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. 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

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	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.
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). The internal (smooth) surface of walls shall have 12 mm thick plaster in cement sand mortar (1:6). 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 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** 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.

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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. The paint shall be of approved colour shade and make.
29.10.00	**External Wall Finish** 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, 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. Toe wall of chain link fencing shall be provided with two coats of Acrylic Smooth Exterior Paint The finish shall be of approved colour shade and make.
29.11.00	**Ceiling Finish** 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.

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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.
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). The common toilet area shall have finished floor level at 15 mm below the finished floor level of surrounding area. Following minimum fittings & fixtures together with associated plumbing works shall be provided as specified below.

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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 grade polished granite stone	1 No.
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.

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	(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 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:

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	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) 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. 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. 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 ΔE) 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. Notes: 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. 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. 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. 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

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	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.** 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. 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** 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** 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** 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.** 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. ii) The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion. 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., 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.

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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.
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. 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** 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.

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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.
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** 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:** 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

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	damper units which in turn shall be supported on girders. The girders shall be an integral part of the crusher house building. 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”.
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 : (a.) Engineering (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. (2.) Structural design of the R. C. C. top deck including preparation of General Arrangement drawings, detailed reinforcement drawings, bar - bending schedules etc. (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. (4.) Drawings showing embedments and their locations and details on the R. C. C. top deck. (5.) Drawings showing blockouts, recesses etc. on the top deck. (6.) Design of the supporting structure, including preparation of detailed drawings and bill of materials. **(b.) Supply including packing and transportation to site** (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. (2.) Frame (s) for pre-stressing of spring elements.

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(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.

(c.) Erection and Commissioning

(1.) Complete erection and commissioning of the vibration isolation system including :

(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.

(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.

(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.

(d.) Documentation

(1.) Submission of detailed design calculation, analysis (static and dynamic) and drawings for Employer's acceptance and approval.

(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.

(3.) Furnishing installation and maintenance manual indicating equipment, procedure etc., necessary for installation, maintenance of vibration isolation system.

(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.

(5.) Bill of materials of various elements such as springs, visco-dampers, with their rating, stiffness etc., included in supply.

(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.

(7.) Proposed erection strategy of the entire system.

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34.03.00	**Design Requirements for Crusher Foundation**
34.03.01	**Dynamic Analysis** 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 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. Natural frequencies upto at least 10 % above the operating speed shall be determined and these frequencies shall be checked against the design criteria. 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** The vibration isolation system shall be designed for about 90 % isolation efficiency.
34.03.03	**De-coupling** 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** The frequency criterion has already been laid down implicitly by the isolation efficiency criteria and de-coupling required. 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** Unbalance forces arising out of all the following cases shall be considered for checking the design and amplitudes. (a.) Balance quality grade Q 40 as per VDI 2060 - 1966. (b.) One hammer broken condition. The missing hammer shall be assumed to be closest to the crusher non - drive end of the crusher.

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	(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** The calculated amplitudes (mean to peak values) shall not exceed following limits under the specified conditions. 1) Operating speed of 750 RPM (a.) 150 microns for an unbalance force arising out of balance quality grade Q 40 as per VDI 2060 - 1966. (b.) 300 microns in case of a one hammer broken condition. (c.) Amplitudes need not be checked for a three hammer broken condition. 2) Operating speed of 450 RPM (a.) 200 microns for an imbalance force arising out of balance quality grade Q-40 as per VDI -2060-1966. (b.) 400 microns in case of a one hammers broken condition. (c.) Amplitude need not be checked for a three hammer broken condition. For intermediate operating speed between 450 to 750 RPM the amplitude limits can be linearly interpolated. 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** 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** 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.

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34.04.00 Strength Criteria

The following criteria shall apply for the design of top deck :

(a.) Dead loads, live loads, Seismic loads and dynamic loads shall be considered for the design. The most unfavorable combination shall considered for design.

(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

(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.

(d.) Working stress method shall be used for the design of R. C. C. deck. In survival condition, 10 % overstressing may be permitted.

(e.) The R. C. C. top deck shall be at least of M35 grade of concrete as per IS : 456.

(f.) Fatigue need not be considered for the three hammer broken condition.

(g.) For calculating unbalance forces, the heaviest hammer (plain or toothed) shall be considered.

34.05.00 Approval of Designs and Drawings

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

Latest revisions of the following Codes shall be used for the design of the crusher foundations.

(a.) IS : 456 Code of Practice for Plain and Reinforced concrete.

(b.) IS : 2974 (Part IV) Code of Practice for Design and Construction of Machine Foundations (Part IV) for rotary type machine of low frequency.

(c.) IS : 1893 (Criteria for Earthquake Resistant Design of Structures).

(d.) DIN 4024 Machine Foundations :

Flexible supporting structures for machines with rotating masses.

(e.) DIN 2089

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	Helical Compression Springs out of round wire and rod; calculation and Design. (f.) DIN 2096 Helical Compression Springs out of round wire and rod; quality requirements for hot formed compression springs. (g.) VDI 2056 - Criteria for assessing mechanical vibrations of machines. (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
35.00.00	**Packaging and Transportation.** 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** 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** 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** All tests required for all materials, quality of workmanship or any other tests as desired by the Engineer shall be at contractor's cost.

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39.00.00	**MATERIALS**
39.01.00	**For Civil, Structural and Architectural works** 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. 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.
39.02.00	**Structural steel** 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** 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. b) Pipes shall conform to IS 1161. c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240. 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** 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	Cement 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. Ordinary Portland Cement (OPC) shall necessarily be used for the following structures. a) Spring supported decks of limestone crusher b) RCC for Chimney shell. The grade of cement shall be Grade 43 for OPC conforming to IS:8112. 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 on trial mix. Mix design shall be done with varying percentage of fly ash mix with cement.

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39.04.00	**Reinforcement steel shall conform to:** a) Mild steel bars of grade I of IS: 432 Part – I or grade A of IS: 2062. 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**

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39.05.0 0 Aggregates

a) Coarse Aggregate

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.

b) Fine Aggregate

Fine aggregate shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or 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.

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 chalcedony, opal etc. The procedure laid down in IS 2430 for sampling of aggregates may be followed.

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 are not satisfactory, shall be submitted to the Engineer for his review, in a report form.

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.

In case aggregates indicate residual expansion, under repeated temperature cycle test (from 10o Celsius to 65o 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 temperature cycle. The contractor shall use aggregates free from residual expansion under repeated temperatures cycle test.

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.

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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.
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.

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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)
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.

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Annexure-A

CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

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.

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%

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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).

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.

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~~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.

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REFER ANNEXURE VIII TO AMDT

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 : 0.19g

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 moment resisting steel frames designed and detailed as per IS:800 and moment resisting RC frames designed and detailed as per IS:456 : 0.067

   b) for braced steel frames designed and detailed as per IS:800 : 0.05

   c) for moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.04

   d) for RCC Chimney :0.133

   e) For Liquid retaining tanks : 0.08

   f) for Steel chimney, Absorber tower : 0.10

   g) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below : 0.067

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 : 0.133

Note: g = Acceleration due to gravity

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.

ANNEXURE – VIII

NORTH KARANPURA 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	: 0.19g
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	: 0.067
b)	For special concentrically braced steel frames designed and detailed as per IS:800	: 0.05
c)	for moment resisting RC frames designed and detailed as per IS:456 and IS:13920	: 0.04
d)	for RCC chimney, RCC Natural Draft Cooling Tower	:0.133
e)	For Liquid retaining tanks	: 0.08
f)	for steel chimney, Absorber tower, Vessels	: 0.10
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)	: 0.067
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	: 0.133

Notes:

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.~~

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The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages

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APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for NORTH KARANPURA STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0.000	1	1	1
0.030	1	1	1
0.040	1.693	1.564	1.418
0.050	2.548	2.213	1.859
0.058	3.344	2.787	2.226
0.059	3.450	2.863	2.273
0.060	3.558	2.938	2.320
0.061	3.667	3.015	2.367
0.062	3.778	3.092	2.414
0.065	4.119	3.328	2.557
0.067	4.366	3.488	2.652
0.070	4.366	3.734	2.797
0.071	4.366	3.772	2.846
0.074	4.366	3.772	2.992
0.075	4.366	3.772	3.042
0.084	4.366	3.772	3.054
0.094	4.366	3.772	3.054
0.104	4.366	3.772	3.054
0.114	4.366	3.772	3.054
0.120	4.366	3.772	3.054
0.121	4.366	3.772	3.054
0.123	4.366	3.772	3.054
0.124	4.366	3.772	3.054
0.126	4.366	3.772	3.054
0.133	4.366	3.772	3.054
0.304	4.366	3.772	3.054
0.310	4.366	3.772	3.054
0.327	4.366	3.772	3.054
0.335	4.366	3.772	3.054
0.352	4.366	3.772	3.054
0.376	4.366	3.772	3.054
0.400	4.366	3.772	3.054
0.450	4.350	3.760	3.042
0.500	3.808	3.454	2.720
0.550	3.462	3.140	2.473
0.601	3.168	2.874	2.263
0.604	3.152	2.859	2.252
0.617	3.086	2.799	2.204
0.622	3.061	2.777	2.186
0.632	3.013	2.733	2.152
0.667	2.855	2.589	2.039

CLAUSE NO.	TECHNICAL REQUIREMENTS

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for NORTH KARANPURA STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0.767	2.482	2.252	1.773
0.867	2.196	1.992	1.569
0.967	1.969	1.786	1.406
1.067	1.784	1.619	1.275
1.167	1.632	1.480	1.165
1.267	1.503	1.363	1.073
1.367	1.393	1.263	0.995
1.467	1.298	1.177	0.927
1.567	1.215	1.102	0.868
1.667	1.142	1.036	0.816
1.767	1.078	0.977	0.770
1.867	1.020	0.925	0.728
1.967	0.968	0.878	0.691
2.067	0.921	0.836	0.658
2.167	0.879	0.797	0.628
2.267	0.840	0.762	0.600
2.367	0.804	0.730	0.575
2.467	0.772	0.700	0.551
2.567	0.742	0.673	0.530
2.667	0.714	0.648	0.510
2.767	0.688	0.624	0.492
2.867	0.664	0.602	0.474
2.967	0.642	0.582	0.458
3.067	0.621	0.563	0.443
3.167	0.601	0.545	0.429
3.267	0.583	0.529	0.416
3.367	0.565	0.513	0.404
3.467	0.549	0.498	0.392
3.544	0.537	0.487	0.384
3.559	0.535	0.485	0.382
3.666	0.519	0.471	0.371
3.765	0.506	0.459	0.361
3.865	0.493	0.447	0.352
3.965	0.480	0.436	0.343
4.006	0.475	0.431	0.339
4.017	0.474	0.430	0.339
4.056	0.469	0.426	0.335

CLAUSE NO.	TECHNICAL REQUIREMENTS

ANNEXURE-B

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

CLAUSE NO.	TECHNICAL REQUIREMENTS
	ANNEXURE-C
1.00.0	**FOUNDATION SYSTEM AND GEOTECHNICAL DATA**
1.01.0	**Soil Data**
	Owner has carried out geotechnical investigation at the project site. Few bore logs, available of vicinity to this area are enclosed at Annexure-III for Bidder's reference. The geotechnical investigation report for nearby areas will be made available for the Bidder's study at the Owner's office, if required. Onus of correct assessment/ interpretation and understanding of the existing subsoil condition / data is on the Bidder. The natural ground reduced levels (RLs) of FGD Area as per topographical survey drawing varies from RL 459.0m to 461.6m. Site levelling & grading had been carried out and achieved finished ground level (FGL) is RL (+) 460.0m i.e. there is maximum filling of 1.0m and maximum cutting of 1.6m in FGD area. However, site levelling in Hopper, Crusher House, Lime & Gypsum storage area etc. shall be done under this package and as per Topographical survey drawing existing ground levels are varying from 461.9m to 465.6m and FGL to be achieved in this area shall be as indicated in GLP. Bidder may refer topographical survey drawing for variation in existing/ natural ground level and FGL. As per borelog data, water table is varying from 1.6m to 3.8m at the time of field investigation and may fluctuate with season.
1.01.01	Since the available soil data is of vicinity, 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 1.07.00 and shall be approved by Owner before execution. Geotechnical investigation work shall be got executed by the Contractor through the agencies as mentioned in Clause No. 1.07.03. 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.
1.01.02	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.
1.01.03	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%.

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	d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.
1.02.00	**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.
102.01	**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) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards. e) The water table for design purpose shall be considered at Finished Ground Level. f) A combination of open and pile foundations shall not be permitted under the same equipment / structure / building. g) 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.
1.02.02	**Open Foundations** In case open foundations are adopted, following shall be adhered to.

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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.

e) During design the Allowable Bearing Pressure shall be adopted after approval of geotechnical investigation report. However, the maximum allowable bearing pressure shall be as per approved geotechnical report and shall be limited to the values as furnished in Table-1.

Table-1

Founding Depth/ Stratum	Net Allowable Bearing Pressure T/m2		
	Isolated and combined footings including raft for 25mm permissible settlement in case of soil and 12mm in case of rocky strata	Isolated and combined footings for 40mm permissible settlement in case of soil and 12mm in case of rocky strata	Rafts (width > 6m) for 75mm permissible settlement in case of soil and 12mm in case of rocky strata
	Width upto 6.0m		
In case of Soil			
2.0m below NGL	10	14	18
3.0m below NGL	14	18	24
In case of rocky strata			
1m into highly weathered rock*	35	35	35
2m into highly weathered rock*	45	45	45

* Highly weathered sandstone with shale bands/highly weathered fine grained fractured rock, stratum is with SPT 'N' > 100 (Refusal) and core recovery (CR) around 20% or more.

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For NGL & FGL of the proposed area GLP along with topographical survey drawing may be referred.

In case any loose/soft pockets in rocky strata is encountered at founding level, the same shall be removed completely upto the hard strata and filled up with PCC (1:4:8).

f) For open foundations, the total permissible settlement shall be governed by IS: 1904 / IS: 13063 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:

Isolated & Raft (Mill foundations/ Machine Foundations) resting on soil	25 mm
Isolated (other than Mill foundations/ Machine Foundations) resting on soil	40 mm
Raft (other than Mill foundations/ Machine Foundations) resting on soil	75 mm
Foundations in Weathered rock / rock	12 mm

Incase pile foundations are to be adopted the requirements under para "Pile Foundations" shall be adhered to.

1.02.03 Pile Foundations –

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. 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 & shall be limited to the values given below:

Pile	Dia. (mm)	Vertical compression capacity (T)
Bored cast-in-situ pile	600	140
	760	250

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The pile shall be socketed into rock strata with minimum socket length of 5 times the diameter of pile below the start of socketing horizon. Socketing horizon shall be considered as the zone wherein average core recovery is atleast than 30 %.

The uplift and lateral load capacity shall be respectively restricted to 35% and 5% of the allowable load capacity in vertical compression.

However, the pile capacities to be adopted shall be the least of the estimated design values and that obtained from the initial pile load tests.

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).

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.

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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.

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.

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 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 of the pile.

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	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.
1.03.00	**Special Requirements**
1.03.01	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.
1.04.00	**Excavation, Filling and Dewatering**
1.04.01	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.
1.04.02	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.
1.04.03	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 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.
1.04.04	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.

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1.04.05	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.
1.04.06	**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.** 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.
1.05.00	**EXCAVATION IN ROCK** 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.
1.05.01	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).
1.05.02	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. 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.
1.06.00	**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,

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	drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.
1.07.00	**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.
1.07.01.00	**Scheme of geotechnical Investigation**
1.07.02.01	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.
1.07.02.02	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.
1.07.02.03	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.
1.07.02.04	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.
	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.

CLAUSE NO.	TECHNICAL REQUIREMENTS
1.07.02.05	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.
1.07.03.00	Geotechnical investigation work shall be got executed by the Contractor through the following agencies. 1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata 2. Cengrs Geotechnica 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
1.08.00	**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 20m to 25m.	Depth of boreholes shall be as mentioned in column "Depth of Borehole" or 5m continuous
2	Crusher House	Minimum 2 Nos.	Depth of boreholes shall be 20m to 25m.	
3	Gypsum and Lime storage area	Minimum 10 Nos.	Depth of boreholes shall be 10m to 15m	

CLAUSE NO.	TECHNICAL REQUIREMENTS

4	Chimney	Minimum 2 Nos.	25 to 30 m	in rock with RQD > 50% whichever is earlier.
5	Other Structure/Facility	Minimum 2 Nos. boreholes under each area / facility	15 to 20 m	
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.

Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401	Created by : SKD	Created on : 23/12/2014	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.1

Co-ordinates E=7937 N=12065

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	6	Undisturbed (UDS)	2
Cone (Pc)		Penetrometer (SPT)	6
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 11/12/2014
Completion Date : 13/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 459.320 m.
Water Struck At :
Standing Water Level : 1.65 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
			DS-1	0.50
		3 4 6 (10)	SPT-1	1.00-1.45
			UDS-1	2.00-2.45
Stiff, yellowish brown to brownish grey, silty clay / clayey silt with decomposed rock. Obs. kankar & sand mixture.		4 4 8 (12)	SPT-2	2.45-2.90
			UDS-2	3.50-3.95
		5 6 9 (15)	SPT-3	3.95-4.40
		22 47 31 (>100) 4.0 cm Pentn. Refusal	SPT-4	5.00-5.34
		100 5.0 cm Pentn. Refusal	*SPT-5	5.55-5.60
5.75m		100 3.0 cm Pentn.	*SPT-6	5.75-5.78 5.75
Highly weathered, light greyish brown, fine grained, highly fractured shale.		NX rotary drilling from 5.75m to 32.50m	R1	CR=21% RQD=Nil 6.50
			R2	CR=29% RQD=Nil 7.25
			R3	CR=24% RQD=Nil 8.00
8.00m			R4	CR=33% RQD=Nil 8.75
Highly weathered, light greyish brown, fine grained, highly fractured shale.			R5	CR=36% RQD=Nil 9.50
8.75m			R6	CR=44% RQD=32% 10.25
Highly to moderately weathered, brownish grey, fine grained, moderately fractured sandstone.			R7	CR=53% RQD=37% 11.00
10.25m			R8	CR=52% RQD=41% 11.75
Moderately weathered, brownish grey, fine grained, moderately fractured sandstone.			R9	CR=45% RQD=31% 12.50
11.00m			R10	CR=51% RQD=47% 13.25
Moderately weathered, light greyish brown, medium to fine grained, moderately fractured sandstone.			R11	CR=57% RQD=31% 14.00
			R12	CR=53% RQD=Nil 14.75
			R13	CR=57% RQD=32% 15.50
15.50m			R14	CR=52% RQD=13% 16.25
16.30m				

BH-1/Sheet-1

Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401 | Created by : SKD | Created on : 23/12/2014 | Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.1

Co-ordinates E=7937 N=12065

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	6	Undisturbed (UDS)	2
Cone (Pc)		Penetrometer (SPT)	6
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 11/12/2014
Completion Date : 13/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 459.32 m.
Water Struck At :
Standing Water Level : 1.65 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
16.30m				
			R15	CR=55% RQD=43% 17.00
			R16	CR=67% RQD=49% 17.75
			R17	CR=69% RQD=55% 18.50
			R18	CR=74% RQD=53% 19.25
			R19	CR=68% RQD=44% 20.00
			R20	CR=81% RQD=74% 20.75
			R21	CR=83% RQD=64% 21.50
			R22	CR=81% RQD=40% 23.00
Moderately to slightly weathered / fresh, light blackish grey, fine grained, moderately to slightly fractured sandstone.			R23	CR=84% RQD=47% 24.50
			R24	CR=82% RQD=58% 26.00
			R25	CR=85% RQD=42% 27.50
			R26	CR=83% RQD=69% 29.00
			R27	CR=86% RQD=65% 30.50
			R28	CR=85% RQD=68% 32.00
N.B. – '*' means sample could not be recovered. 32.50m			R29	CR=88% RQD=84% 32.50

BH-1/Sheet-2

Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401	Created by : SKD	Created on : 23/12/2014	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.2

Co-ordinates E=7925 N=12047

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	4	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	4
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	1

Commencement Date : 08/12/2014
Completion Date : 11/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 459.70 m.
Water Struck At :
Standing Water Level : 1.65 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Stiff, yellowish brown, silty clay / clayey silt. Obs. kankar & sand mixture.		3 5 6 — 11	DS-1 SPT-1 WS-1	0.50 1.00-1.45 1.65
1.90m Hard, brownish grey, silty clay / clayey silt with mica & decomposed rock.		17 38 45 — ≥100 (10.0 cm Pentn.) 100 — Refusal (4.0 cm Penetn.) 100 — Refusal (3.0 cm Penetn.)	*UDS-1 SPT-2 *SPT-3 *SPT-4	2.00-2.10 2.10-2.50 2.70-2.74 2.90-2.93
2.90m NX rotary drilling from 2.90m to 30.00m Highly to moderately weathered, brownish grey, medium to fine grained, moderately fractured, alternation of sandstone & shale.			R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14 R15 R16 R17 R18	2.90 CR=28% RQD=Nil — 3.50 CR=36% RQD=32% — 4.25 CR=35% RQD=Nil — 5.00 CR=39% RQD=Nil — 5.75 CR=40% RQD=20% — 6.50 CR=41% RQD=Nil — 7.25 CR=43% RQD=23% — 8.00 CR=45% RQD=Nil — 8.75 CR=47% RQD=20% — 9.50 CR=51% RQD=27% — 10.25 CR=44% RQD=28% — 11.00 CR=51% RQD=20% — 11.75 CR=55% RQD=13% — 12.50 CR=57% RQD=Nil — 13.25 CR=52% RQD=13% — 14.00 CR=64% RQD=49% — 14.75 CR=69% RQD=55% — 15.50 CR=61% RQD=31% — 16.25
9.50m Moderately to slightly weathered, brownish grey, medium to fine grained, moderately fractured alternation of sandstone & shale.				
16.30m				

BH-2/Sheet-1

Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401	Created by : SKD	Created on : 23/12/2014	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.9

Co-ordinates E=7939 N=11986

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	4	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	4
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 11/12/2014
Completion Date : 13/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 460.398 m.
Water Struck At :
Standing Water Level : 2.30 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Hard, brownish grey, silty clay / clayey silt with mica & decomposed rock.		12 20 24 — 44	SPT-1	1.00-1.45
		22 43 35 — >100 (4.0 cm Pentn.)	*UDS-1	2.10-2.20
			SPT-2	2.20-2.54
		100 (5.0 cm Pentn.) Refusal	*SPT-3	3.00-3.05
3.25m		100 (4.0 cm Pentn.) Refusal	*SPT-4	3.25-3.29
Highly to moderately weathered, brownish grey, fine grained, highly to moderately fractured, alternation of sandstone & shale.		NX rotary drilling from 3.25m to 25.00m	R1 CR=29% RQD=Nil	3.25 – 4.00
			R2 CR=39% RQD=Nil	4.00 – 4.75
			R3 CR=32% RQD=19%	4.75 – 5.50
			R4 CR=35% RQD=28%	5.50 – 6.25
			R5 CR=44% RQD=31%	6.25 – 7.00
			R6 CR=49% RQD=39%	7.00 – 7.75
			R7 CR=47% RQD=20%	7.75 – 8.50
			R8 CR=48% RQD=Nil	8.50 – 9.25
10.00m			R9 CR=50% RQD=Nil	9.25 – 10.00
Moderately to slightly weathered, brownish grey, fine grained, highly to moderately fractured, alternation of sandstone & shale.			R10 CR=53% RQD=37%	10.00 – 10.75
			R11 CR=63% RQD=55%	10.75 – 11.50
12.25m			R12 CR=61% RQD=43%	11.50 – 12.25
Moderately to slightly weathered, light brownish grey, fine grained, moderately fractured alternation of sandstone & shale.			R13 CR=64% RQD=59%	12.25 – 13.00
13.75m			R14 CR=56% RQD=32%	13.00 – 13.75
Moderately to slightly weathered / fresh, brownish grey to light blackish grey, fine grained, medium to slightly fractured, alternation of sandstone & shale.			R15 CR=60% RQD=13%	13.75 – 14.50
			R16 CR=63% RQD=Nil	14.50 – 15.25
16.30m			R17 CR=61% RQD=Nil	15.25 – 16.00

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Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401	Created by : SKD	Created on : 23/12/2014	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.9

Co-ordinates E=7939 N=11986

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	4	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	4
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 11/12/2014
Completion Date : 13/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 460.398 m.
Water Struck At :
Standing Water Level : 2.30 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
16.30m.			R18	CR=64% RQD=13% — 16.75
			R19	CR=66% RQD=55% — 17.50
			R20	CR=64% RQD=33% — 18.25
			R21	CR=69% RQD=35% — 19.00
			R22	CR=73% RQD=16% — 19.75
Moderately to slightly weathered / fresh, brownish grey to light blackish grey, fine grained, medium to slightly fractured, alternation of sandstone & shale.			R23	CR=81% RQD=44% — 20.50
			R24	CR=84% RQD=80% — 21.25
			R25	CR=83% RQD=72% — 22.75
			R26	CR=85% RQD=69% — 24.25
			R27	CR=88% RQD=75% — 25.00
25.00m.				

N.B. — '*' means sample could not be recovered.

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Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401 | **Created by : SKD** | **Created on : 23/12/2014** | **Sheet No:**

BORE LOG DATA SHEET — BORE HOLE NO.13 — Co-ordinates E=7937 N=11932

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	5	Undisturbed (UDS)	2
Cone (Pc)		Penetrometer (SPT)	5
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 05/12/2014
Completion Date : 10/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 460.287 m.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Medium, brownish grey, silty clay / clayey silt. Obs. mica, kankar & sand mixture.		3 3 5 (8)	DS-1	0.50
			SPT-1	1.00-1.45
2.45m			UDS-1	2.00-2.45
Stiff, brownish grey, silty clay with decomposed rock & mica.		4 6 8 (14)	SPT-2	2.45-2.90
		29 71 for 5.0 cm Pentn. (≥100)	*UDS-2	3.50-3.60
			SPT-3	3.60-3.80
			*SPT-4	3.90-3.95
4.05m		100 for 5.0 cm Pentn. Refusal	*SPT-5	4.05-4.08
Highly weathered, greyish brown, fine grained, highly fractured alternation of sandstone & shale.		100 for 3.0 cm Pentn. Refusal	R1	CR=24% RQD=Nil 4.05-4.75
		NX rotary drilling from 4.05m to 31.50m	R2	CR=28% RQD=Nil 4.75-5.50
5.50m			R3	CR=41% RQD=23% 5.50-6.25
Highly to moderately weathered, brownish grey, fine grained, moderately fractured, alternation of sandstone & shale.			R4	CR=35% RQD=20% 6.25-7.00
			R5	CR=39% RQD=32% 7.00-7.75
			R6	CR=35% RQD=17% 7.75-8.50
			R7	CR=41% RQD=Nil 8.50-9.25
			R8	CR=44% RQD=Nil 9.25-10.00
			R9	CR=48% RQD=26% 10.00-10.75
			R10	CR=52% RQD=13% 10.75-11.50
12.25m			R11	CR=49% RQD=Nil 11.50-12.25
Moderately to slightly weathered, brownish grey, fine grained, moderately fractured, alternation of sandstone & shale.			R12	CR=55% RQD=32% 12.25-13.00
			R13	CR=51% RQD=24% 13.00-13.75
			R14	CR=59% RQD=47% 13.75-14.50
			R15	CR=61% RQD=37% 14.50-15.25
			R16	CR=60% RQD=17% 15.25-16.00
16.30m				

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Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401	Created by : SKD	Created on : 23/12/2014	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.13

Co-ordinates E=7937 N=11932

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	5	Undisturbed (UDS)	2
Cone (Pc)		Penetrometer (SPT)	5
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 05/12/2014
Completion Date : 10/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 460.287 m.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
16.30m. Moderately to slightly weathered, brownish grey, fine grained, moderately fractured, alternation of sandstone & shale.			R17 CR=55% RQD=24%	16.75
			R18 CR=61% RQD=37%	17.50
			R19 CR=72% RQD=56%	18.25
18.25m. Slightly weathered, light greyish brown, fine grained, moderately fractured alternation of sandstone & shale.			R20 CR=67% RQD=45%	19.00
			R21 CR=64% RQD=25%	19.75
			R22 CR=62% RQD=23%	20.50
20.50m. Slightly weathered, light blackish grey, fine grained, moderately to slightly fractured, alternation of sandstone & shale.			R23 CR=67% RQD=53%	21.25
			R24 CR=64% RQD=33%	22.00
			R25 CR=70% RQD=48%	22.75
			R26 CR=71% RQD=65%	23.50
			R27 CR=73% RQD=72%	24.25
			R28 CR=70% RQD=36%	25.00
			R29 CR=73% RQD=27%	25.75
			R30 CR=75% RQD=15%	26.50
			R31 CR=73% RQD=69%	27.25
			R32 CR=76% RQD=71%	28.00
28.00m. Fresh, light blackish grey, fine grained, moderately fractured alternation of sandstone & shale.			R33 CR=81% RQD=78%	28.75
			R34 CR=84% RQD=73%	29.50
			R35 CR=86% RQD=58%	
			R36 CR=92% RQD=52%	31.00
31.50m. N.B. – '*' means sample could not be recovered.				31.50

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Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

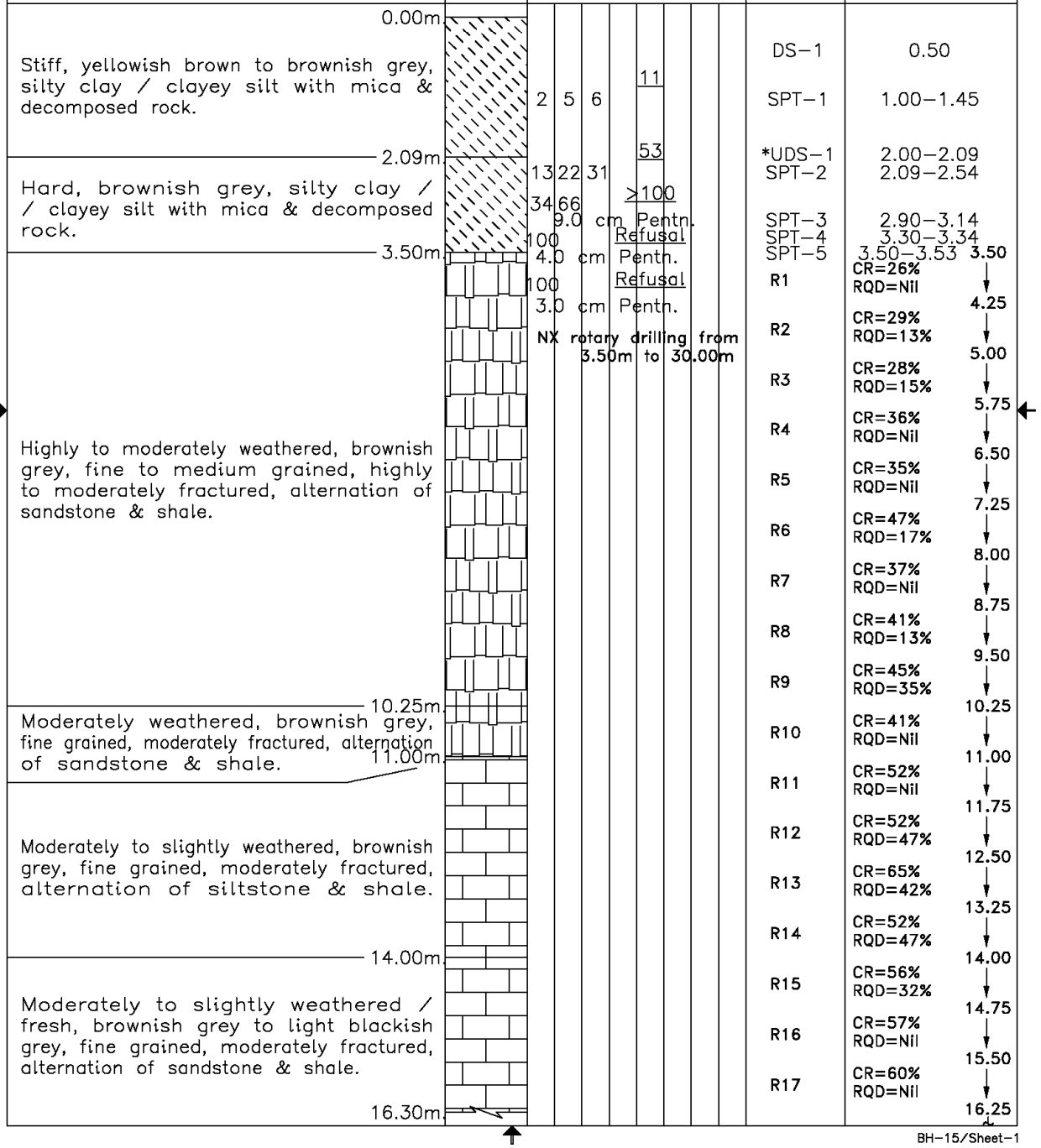
Job No : 3401	Created by : SKD	Created on : 23/12/2014	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.15

Co-ordinates E=7925 N=11914

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	5	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	5
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 10/12/2014
Completion Date : 13/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 460.141 m.
Water Struck At :
Standing Water Level : 3.10 m.



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Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401	Created by : SKD	Created on : 23/12/2014	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.15

Co-ordinates E=7925 N=11914

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	5	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	5
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 10/12/2014
Completion Date : 13/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 460.141 m.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
16.30m.				
			R18	CR=61% RQD=35% 17.00
			R19	CR=64% RQD=44% 17.75
			R20	CR=63% RQD=Nil 18.50
			R21	CR=60% RQD=33% 19.25
			R22	CR=67% RQD=40% 20.00
			R23	CR=64% RQD=24% 20.75
			R24	CR=68% RQD=56% 21.50
			R25	CR=73% RQD=65% 22.25
Moderately to slightly weathered / fresh, brownish grey to light blackish grey, fine grained, moderately fractured, alternation of sandstone & shale.			R26	CR=70% RQD=32% 23.00
			R27	CR=80% RQD=24% 23.75
			R28	CR=83% RQD=Nil 24.50
			R29	CR=85% RQD=36% 26.00
			R30	CR=82% RQD=15% 27.50
			R31	CR=84% RQD=13% 28.50
			R32	CR=87% RQD=56% 30.00
30.00m.				

N.B. – '*' means sample could not be recovered.

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Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401	Created by : SKD	Created on : 23/12/2014	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.18 — Co-ordinates E=7939 N=11853

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	6	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	6
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 14/12/2014
Completion Date : 15/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 458.447 m.
Water Struck At :
Standing Water Level : 3.40 m.

DESCRIPTION	SYMBOL	N–VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Stiff, yellowish brown, silty clay / clayey silt. Observed kankar.		4 6 8 — 14	DS–1	0.50
			SPT–1	1.00–1.45
			UDS–1	2.00–2.45
		4 5 9 — 14	SPT–2	2.45–2.90
2.90m				
Hard, brownish grey, silty clay / clayey silt with decomposed rock & mica.		7 15 28 — 43	SPT–3	3.30–3.75
		31 69 — >100 (5.0 cm Pentn.)	SPT–4	4.00–4.20
		100 — Refusal (5.0 cm Pentn.)	*SPT–5	4.30–4.35
4.45m			*SPT–6	4.45–4.48
Highly weathered, brownish grey, medium grained, highly fractured, alternation of sandstone & shale. 5.00m		100 — Refusal (3.0 cm Pentn.)	R1	CR=23% RQD=Nil
		NX rotary drilling from 4.45m to 25.00m	R2	CR=28% RQD=Nil
Highly to moderately weathered, brownish grey to light blackish grey, medium to fine grained, highly to moderately fractured, alternation of sandstone & shale.			R3	CR=29% RQD=16%
			R4	CR=24% RQD=Nil
			R5	CR=30% RQD=16%
			R6	CR=34% RQD=22%
			R7	CR=38% RQD=16%
			R8	CR=40% RQD=Nil
			R9	CR=45% RQD=Nil
			R10	CR=48% RQD=20%
			R11	CR=44% RQD=32%
			R12	CR=52% RQD=16%
			R13	CR=48% RQD=Nil
14.00m				
Moderately weathered, brownish grey to light blackish grey, medium to fine grained, highly to moderately fractured, alternation of sandstone & shale.			R14	CR=58% RQD=49%
			R15	CR=52% RQD=32%
15.50m			R16	CR=50% RQD=45%
16.30m				

5.00 5.75 6.50 7.25 8.00 8.75 9.50 10.25 11.00 11.75 12.50 13.25 14.00 14.75 15.50 16.25

BH–18/Sheet–1

Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401	Created by : SKD	Created on : 23/12/2014	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.18

Co-ordinates E=7939 N=11853

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	6	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	6
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 14/12/2014
Completion Date : 15/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 458.447 m.
Water Struck At :
Standing Water Level : 3.40 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
16.30m. Moderately weathered, brownish grey to light blackish grey, medium to fine grained, highly to moderately fractured, alternation of sandstone & shale. 17.75m.			R17	CR=52% RQD=Nil 17.00
			R18	CR=50% RQD=Nil 17.75
			R19	CR=52% RQD=17% 18.50
			R20	CR=50% RQD=32% 19.25
			R21	CR=52% RQD=13% 20.00
			R22	CR=57% RQD=Nil 20.75
Moderately to slightly weathered, light blackish grey, fine grained, moderately fractured, alternation of sandstone & shale.			R23	CR=56% RQD=13% 21.50
			R24	CR=62% RQD=25% 22.25
			R25	CR=65% RQD=25% 23.00
			R26	CR=67% RQD=21% 23.75
			R27	CR=66% RQD=24% 24.50
			R28	CR=68% RQD=29% 25.00
25.00m.				

N.B. – '*' means sample could not be recovered.

BH-18/Sheet-2

Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401 | Created by : SKD | Created on : 17/12/2014 | Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.22

Co-ordinates E=7937 N=11798

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	5	Undisturbed (UDS)	2
Cone (Pc)		Penetrometer (SPT)	5
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 01/12/2014
Completion Date : 05/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 457.457 m.
Water Struck At :
Standing Water Level : 2.3 m.

DESCRIPTION	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	Depth (m)
0.00m Stiff, yellowish brown, silty clay / clayey silt. Observed kankar & sand mixture.	3 4 5 — 9	DS-1	0.50
		SPT-1	1.00-1.45
	3 5 6 — 11	UDS-1	2.00-2.45
		SPT-2	2.45-2.90
3.70m Hard, brownish grey, silty clay / clayey silt with decomposed rock.	24 76 — >100 11.0 cm Pentn. Refusal	*UDS-2 SPT-3	3.60-3.70 3.70-3.96
	100 — 5.0 cm Pentn. Refusal	*SPT-4	4.60-4.65
5.00m Highly weathered, brownish grey, fine grained, highly fractured sand stone.	100 — 3.0 cm Pentn. NX rotary drilling from 5.00m to 29.50m	*SPT-5 R1	5.00-5.03 5.00 CR=40% RQD=Nil
		R2	5.75 CR=32% RQD=Nil
		R3	6.50 CR=27% RQD=Nil
7.25m Completely to highly weathered, brownish grey, fine grained sand stone.		R4	7.25 CR=23% RQD=Nil
		R5	8.00 CR=25% RQD=Nil
		R6	8.75 CR=20% RQD=Nil
9.50m Highly weathered, brownish grey, fine grained sand stone.		R7	9.50 CR=34% RQD=Nil
10.25m Highly weathered, light grey, fine grained, highly fractured sand stone.		R8	10.25 CR=33% RQD=Nil
		R9	11.00 CR=35% RQD=Nil
		R10	11.75 CR=40% RQD=Nil
12.50m Moderately weathered, light blackish grey, fine grained, moderately fractured alternation of sandstone & shale. 13.25m		R11	12.50 CR=49% RQD=32%
		R12	13.25 CR=51% RQD=28%
Moderately to slightly weathered to fresh, light blackish grey, fine grained, medium to slightly fractured alternation of sandstone & shale. 15.10m		R13	14.00 CR=59% RQD=49% 14.75

BH-22/Sheet-1

Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401	Created by : SKD	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.22

Co-ordinates E=7937 N=11798

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	5	Undisturbed (UDS)	2
Cone (Pc)		Penetrometer (SPT)	5
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 01/12/2014
Completion Date : 05/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 457.457 m.
Water Struck At :
Standing Water Level : 2.3 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
15.10m.				
			R14	CR=57% RQD=44% 15.50
			R15	CR=59% RQD=47% 16.25
			R16	CR=61% RQD=16% 17.00
			R17	CR=63% RQD=19% 17.75
			R18	CR=67% RQD=31% 18.50
			R19	CR=65% RQD=51% 19.25
			R20	CR=60% RQD=16% 20.00
			R21	CR=69% RQD=48% 20.75
			R22	CR=73% RQD=35% 21.50
Moderately to slightly weathered / fresh, light blackish grey, fine grained, medium to slightly fractured alternation of sandstone & shale.			R23	CR=68% RQD=17% 22.25
			R24	CR=74% RQD=23% 23.00
			R25	CR=75% RQD=32% 23.75
			R26	CR=72% RQD=40% 24.50
			R27	CR=76% RQD=52% 25.25
			R28	CR=69% RQD=57% 26.00
			R29	CR=64% RQD=54% 26.75
			R30	CR=73% RQD=50% 27.50
			R31	CR=85% RQD=58% 28.25
			R32	CR=88% RQD=56% 29.00
			R33	CR=87% RQD=62% 29.50
29.50m.				
N.B. – '*' means sample could not be recovered.				

BH-22/Sheet-2

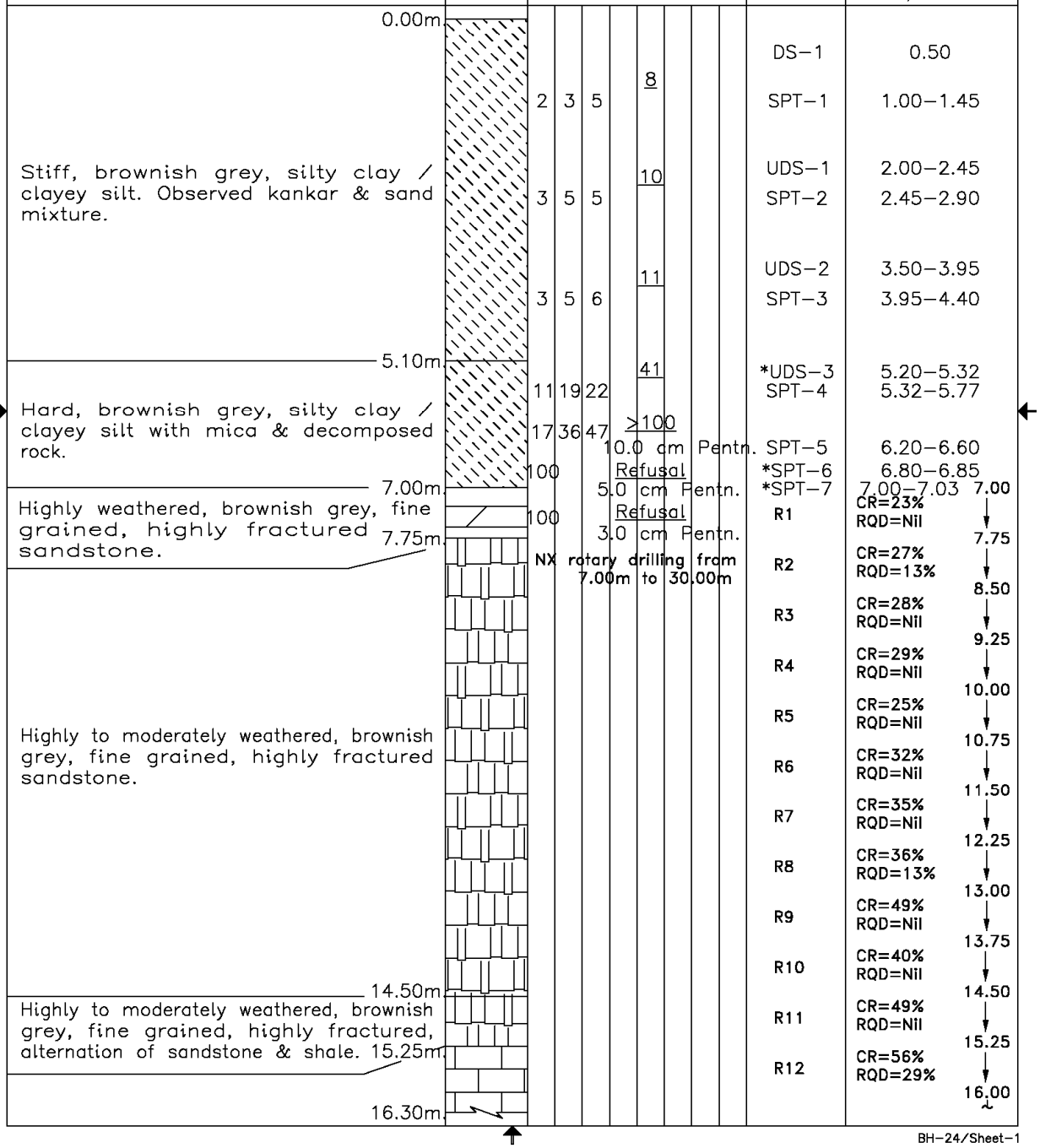
Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401 | Created by : SKD | Created on : 23/12/2014 | Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.24 — Co-ordinates E=7925 N=11783

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	7	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	7
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 06/12/2014
Completion Date : 10/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 457.219 m.
Water Struck At :
Standing Water Level : 2.40 m.



BH-24/Sheet-1

Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401	Created by : SKD	Created on : 23/12/2014	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.24

Co-ordinates E=7925 N=11783

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	7	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	7
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 06/12/2014
Completion Date : 10/12/2014
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 457.219 m.
Water Struck At :
Standing Water Level : 2.40 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
16.30m				
			R13	CR=63% RQD=43% 16.75
			R14	CR=67% RQD=51% 17.50
			R15	CR=69% RQD=65% 18.25
			R16	CR=65% RQD=16% 19.00
			R17	CR=71% RQD=48% 19.75
			R18	CR=65% RQD=16% 20.50
			R19	CR=69% RQD=Nil 21.25
			R20	CR=72% RQD=Nil 22.00
			R21	CR=76% RQD=Nil 22.75
Moderately to slightly weathered to fresh, light blackish grey, fine grained, moderately fractured, alternation of sandstone & shale.			R22	CR=80% RQD=45% 23.50
			R23	CR=76% RQD=50% 24.25
			R24	CR=78% RQD=46% 25.00
			R25	CR=77% RQD=29% 25.75
			R26	CR=80% RQD=37% 26.50
			R27	CR=81% RQD=20% 27.25
			R28	CR=79% RQD=22% 28.00
			R29	CR=82% RQD=34% 28.75
			R30	CR=81% RQD=40%
30.00m				30.00

N.B. – '*' means sample could not be recovered.

BH-24/Sheet-2

Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401	Created by : SKD	Created on : 31/01/2015	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.105

Co-ordinates E=7774 N=11928

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	5	Undisturbed (UDS)	2
Cone (Pc)		Penetrometer (SPT)	5
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 10/01/2015
Completion Date : 11/01/2015
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 461.519 m.
Water Struck At :
Standing Water Level : 3.0 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Very stiff, yellowish brown, silty clay. Observed kankar & sand mixture.		4 6 11 (17) 5 8 13 (21)	DS-1 SPT-1 UDS-1 SPT-2	0.50 1.00-1.45 2.00-2.45 2.45-2.90
3.20m Hard, brownish grey, silty clay / clayey silt. Obs. decomposed rock.		25 52 23 (≥100) 4.0 cm Pentn. 100 Refusal 5.0 cm Pentn.	*UDS-2 SPT-3 *SPT-4 *SPT-5	3.50-3.60 3.60-3.94 4.20-4.25 4.50-4.53
4.50m Highly weathered, greyish brown, fine grained, highly fractured alternation of sandstone & shale. 5.25m		100 Refusal 3.0 cm Pentn. NX rotary drilling from 4.50m to 20.00m	R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14 R15 R16 R17 R18 R19 R20 R21	4.50 CR=25% RQD=Nil 5.25 CR=26% RQD=Nil 6.00 CR=29% RQD=14% 6.75 CR=28% RQD=13% 7.50 CR=35% RQD=Nil 8.25 CR=32% RQD=Nil 9.00 CR=32% RQD=19% 9.75 CR=31% RQD=14% 10.50 CR=30% RQD=Nil 11.25 CR=38% RQD=16% 12.00 CR=40% RQD=28% 12.75 CR=38% RQD=Nil 13.50 CR=40% RQD=Nil 14.25 CR=42% RQD=Nil 15.00 CR=44% RQD=Nil 15.75 CR=41% RQD=Nil 16.50 CR=42% RQD=20% 17.25 CR=44% RQD=Nil 18.00 CR=37% RQD=Nil 18.75 CR=42% RQD=Nil 19.50 CR=48% RQD=14% 20.00
15.75m Highly to moderately weathered, greyish brown, fine grained, highly fractured alternation of sandstone & shale.				
Moderately weathered, brownish grey, fine grained, highly fractured alternation of sandstone & shale.				
N.B. – '*' means sample could not be recovered. 20.00m				

BH-105/Sheet-1

Project : G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No : 3401	Created by : SKD	Created on : 31/01/2015	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.109

Co-ordinates E=7763 N=12110

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	5	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	5
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 08/01/2015
Completion Date : 09/01/2015
Bore Hole Diameter : 150mm / NX.
Level Of Ground : 460.577 m.
Water Struck At :
Standing Water Level : 3.0 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Stiff, yellowish brown, silty clay. Observed kankar.		3 4 7 (11)	DS-1 SPT-1	0.50 1.00-1.45
1.90m Stiff, yellowish brown, silty clay / clayey silt with sand mixture & mica. Obs. decomposed rock.		3 6 8 (14)	UDS-1 SPT-2	2.00-2.45 2.45-2.90
		31 67 for 13.0 cm Penetn. (≥100)	SPT-3	3.20-3.48
3.75m Highly weathered, brownish grey, fine grained, highly fractured sandstone.		100 for 5.0 cm Penetn. (Refusal)	*SPT-4 *SPT-5	3.60-3.65 3.75-3.78
4.50m		100 for 3.0 cm Penetn. (Refusal) NX rotary drilling from 3.75m to 15.00m	R1	CR=25% RQD=Nil 3.75-4.50
Highly weathered, brownish grey to light blackish grey, fine grained, highly fractured alternation of sandstone & shale.			R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14 R15	CR=28% RQD=Nil 4.50-5.25 CR=31% RQD=Nil 5.25-6.00 CR=27% RQD=Nil 6.00-6.75 CR=28% RQD=Nil 6.75-7.50 CR=27% RQD=Nil 7.50-8.25 CR=30% RQD=Nil 8.25-9.00 CR=33% RQD=Nil 9.00-9.75 CR=35% RQD=Nil 9.75-10.50 CR=36% RQD=Nil 10.50-11.25 CR=38% RQD=Nil 11.25-12.00 CR=41% RQD=Nil 12.00-12.75 CR=45% RQD=Nil 12.75-13.50 CR=47% RQD=18% 13.50-14.25 CR=48% RQD=14% 14.25-15.00
11.25m Highly weathered, brownish grey to light blackish grey, fine grained, highly fractured sandstone.				
12.00m Moderately weathered, greyish brown, fine grained, highly fractured sandstone.				
15.00m				

N.B. – '*' means sample could not be recovered.

BH-109/Sheet-1

Project: G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No.: 3401 | **Sheet No.**

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Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results Pc/Pm kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	Atter. Limits LL %	PL %	SL %	IS Classi fication	Grain Size Gravel %	Sand %	Silt %	Clay %	Test Method
BH01	UDS01	2.00	Brownish grey, silty clay with traces of kankars.	2.00	1.63	2.67	23 T 24 C	0.630	TR:SH-UU 3.0 2.0 1.0	0.669 0.537 0.514	0.57	0				CI*		3	88	9	**See the Note
BH01	UDS02	3.50	Brownish grey, silty clay with traces of sand mixtures & kankars	2.16	1.87	2.69	16 S 16 T		UNCONFD 0.0 0.0 0.0 REMOULD 0.0 0.0 0.0	1.024 1.395 1.465 0.966 0.902 0.978	1.30 0.95	0 0	42	20	12	CI		20	76	4	Do
BH01	SPT04	5.00	Yellowish grey, silty clay with traces of fine sand mixture.										42	22		CI*		6	94	(Silt+Clay)	Do
BH02	SPT01	1.00	Yellowish grey, silty clay.													CI					Do
BH02	SPT02	2.10	Brownish grey, silty clay / clayey silt with sand mixtures.													CI*		35	65	(Silt+Clay)	Do
BH03	UDS01	1.90	Brownish grey, silty clay / clayey silt with traces of rusty spots.	1.94	1.62	2.73	19 S 20 T 20 C	0.650	TR:SH-UU 3.0 2.0 1.0	1.840 1.725 1.508	1.16	8	40	25	25	CI		23	75	2	Do
BH04	SPT04	5.22	Brownish grey, silty clay / clayey silt with sand mixture.													CI*		28	72	(Silt+Clay)	Do
BH05	SPT02	2.13	Brownish grey, silty clay with decomposed rock.													CI*		26	74	(Silt+Clay)	Do
BH06	SPT02	2.12	Brownish grey, silty clay / clayey silt with decomposed rock.													CI*		29	71	(Silt+Clay)	Do
BH07	SPT02	2.13	Brownish grey, silty clay with decomposed rock.										38	15		CI					Do

Project: G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No.: 3401 | **Sheet No.**

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn. kg/sqcm	Frictn. Deg.	Atter. Limits LL %	PL %	SL %	IS Classi fication	Grain Size Gravel %	Sand %	Silt %	Clay %	Test Method
BH12	UDS01	2.00	Brownish grey, silty clay / clayey silt with traces of kankars.	1.94	1.55	2.63	26 S 26 T		UNCONFD 0.0 0.0 0.0 REMOULD 0.0 0.0 0.0	0.17 0.179 0.155 0.163 0.11 0.112 0.101 0.104	0.17	0	39	20	19	CI		22	73	5	Do
BH14	SPT02	2.10	Brownish grey, silty clay with sandmixtures.													CI*		35	65 (Silt+Clay)		Do
BH15	SPT02	2.09	Brownish grey, silty clay with sandmixture & mica.													CI*		21	79 (Silt+Clay)		Do
BH16	UDS01	2.00	Brownish grey, silty clay / clayey silt with traces of sandmixture.	1.96	1.68	2.70	16 S 16 T 17 C	0.495	TRSH-UU 3.0 2.0 1.0	0.498 0.428 0.380	0.44	0	30	17	17	CL		37	62	1	Do
BH17	UDS01	2.00	Yellowish brown, silty clay / clayey silt with traces of kankars.	1.97	1.58	2.64	26 S 25 T		TRSH-UU 3.0 2.0 1.0	1.694 1.528 1.346	1.52	0				CI*		33	64	3	Do
BH18	UDS01	2.00	Yellowish brown, silty clay / clayey silt with traces of kankars.	1.68	1.41	2.69	19 S 19 T		UNCONFD 0.0 0.0 0.0 REMOULD 0.0 0.0 0.0	0.342 0.433 0.440 0.244 0.313 0.301	0.41 0.29	0 0	43	19	14	CI		21	77	2	Do
BH19	UDS01	2.00	Brownish grey, silty clay with traces of kankars.	2.12	1.85	2.65	13 S 15 T		UNCONFD 0.0 0.0 0.0 REMOULD 0.0 0.0 0.0	1.416 2.100 1.653 1.406 1.302 1.186	1.72 1.30	0 0	38	18		CI		8	81	11	Do

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Project: G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No. : 3401 | **Sheet No.**

Res-340101 / Page 3

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	Atter Limits LL %	PL %	SL %	IS Classification	Grain Size Gravl %	Sand %	Silt %	Clay %	Test Method
BH19	SPT06	6.00	Brownish grey, silty clay / clayey silt with sand mixtures.													CI*		38	62 (Silt+Clay)		Do
BH20	UDS01	2.00	Yellowish grey, silty clay / clayey silt with traces of sand mixtures.	2.01	1.71	2.70	18 S 18 T		UNCONFD 0.0 0.0 0.0 REMOULD 0.0 0.0 0.0	1.217 0.858 0.884 0.649 0.646 0.641	0.99 0.64	0	35	19	18	CI		23	71	6	Do
BH21	UDS01	2.00	Yellowish grey, silty clay / clayey silt with traces of sand mixtures.	2.11	1.75	2.50	21 S 21 T		UNCONFD 0.0 0.0 0.0 REMOULD 0.0 0.0 0.0	0.527 0.531 0.475 0.362 0.357 0.328	0.51 0.35	0 0	38	17	12	CI		30	66	4	Do
BH22	UDS01	2.00	Brownish grey, silty clay with traces of sand mixture.	2.06	1.78	2.64	16 S 16 T 17 C	0.534	TR:SH-UU 3.0 2.0 1.0 UNCONFD 0.0 0.0 0.0 REMOULD 0.0 0.0 0.0	1.617 1.594 1.104 1.013 1.058 0.905 0.694 0.674 0.612	0.71 0.99 0.66	12 0 0	30	16	17	CL		37	60	3	Do
BH22	SPT03	3.70	Brownish grey, clayey silt with sand mixture & mica.													CI*		36	64 (Silt+Clay)		Do
BH23	UDS01	2.00	Brownish grey clayey silt/ silty clay with traces of kankars.	2.11	1.84	2.72	14 S 15 T 18 C	0.542	TR:SH-UU 3.0 2.0 1.0	1.911 1.831 1.774	1.84	0	40	16	14	CI		15	80	5	Do

Project: G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No.: 3401 | **Sheet No.**

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Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Fricn Deg.	Atter Limits LL %	PL %	SL %	IS Classification	Grain Size Gravl %	Sand %	Silt %	Clay %	Test Method
BH23	UDS02	3.50	Brownish grey clayey silt/ silty clay with traces of kankars.	2.16	1.89	2.70	15 S		UNCONFD		1.55	0	50	20	18	CH		12	86	2	Do
									0.0	1.767											
									0.0	1.306											
									0.0	1.577											
									REMOULD		1.09	0									
									0.0	1.207											
									0.0	1.075											
									0.0	0.998											
BH23	SPT05	5.60	Brownish grey, clayey silt with sand mixtures & traces of mica.													CI*		42	58 (Silt+Clay)		Do
BH24	UDS01	2.00	Yellowish grey, silty clay / clayey silt with traces of sand mixtures.	2.15	1.85	2.66	16 S	0.384	TRSH-UU		2.35	7	38	17	13	CI		20	70	10	Do
							16 T		3.0	3.126											
							15 C		2.0	2.913											
									1.0	2.833											
BH24	UDS02	3.50	Brownish grey, silty clay / clayey silt.				19 S		UNCONFD		0.52	0	38	16	12	CI					Do
									0.0	0.499											
									0.0	0.555											
									0.0	0.498											
									REMOULD		0.35	0									
									0.0	0.337											
									0.0	0.385											
									0.0	0.317											
BH24	SPT04	5.32	Brownish grey, silty clay / clayey silt with sand mixtures.													CI*		34	66 (Silt+Clay)		Do
BH25	UDS01	2.00	Brownish grey, silty clay with traces of kankars.	2.01	1.67	2.67	20 S	0.550	TRSH-UU		0.62	9	47	21	11	CI		6	80	14	Do
							20 T		3.0	1.345											
							22 C		2.0	1.054											
									1.0	0.988											
BH25	SPT03	3.62	Brownish grey, silty clay / clayey silt with sand mixtures and mica.			2.69										CI*		32	62	6	Do
BH26	UDS01	2.00	Brownish grey, silty clay with traces of rusty spots & kankars.	2.06	1.66	2.66	23 S		UNCONFD		0.65	0	48	21	16	CI		17	70	13	Do
							24 T		0.0	0.626											
									0.0	0.693											
									0.0	0.633											
									REMOULD		0.48	0									
									0.0	0.451											
									0.0	0.510											
									0.0	0.471											

Project: G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No.: 3401 | **Sheet No.**

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results: Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	Atter. Limits: LL %	PL %	SL %	IS Classification	Grain Size: Gravl %	Sand %	Silt %	Clay %	Test Method
BH103	UDS01	2.00	Yellowish brown, silty clay with decomposed rock and mica.	2.03	1.74	2.68	17 S 17 T		UNCONFD 0.0 0.0 0.0 REMOULD 0.0 0.0 0.0	0.86 0.883 0.874 0.853 0.58 0.603 0.566 0.557	0.86 0.58	0 0				CI*		37	57	6	Do
BH105	SPT03	3.60	Light grey, silty clay with fine sand mixture & mica.										37	24		CI					Do
BH106	SPT01	1.00	Yellowish grey, silty clay.										44	23		CI					Do
BH106	SPT02	2.30	Light grey, silty clay / clayey silt with fine sand mixture & mica.													CI*		21	79	(Silt+Clay)	Do
BH107	UDS01	2.00	Yellowish brown, silty clay / clayey silt with traces of kankars.	2.04	1.64	2.67	24 S 24 T						43	19	13	CI		13	80	7	Do
BH107	SPT03	3.62	Brownish grey, silty clay / clayey silt with sand mixture & mica.													CI*		39	61	(Silt+Clay)	Do
BH108	UDS01	2.00	Brownish grey, silty clay / clayey silt with traces of kankars.	2.02	1.73		17 T		UNCONFD 0.0 0.0 0.0 REMOULD 0.0 0.0 0.0	1.817 1.849 1.839 1.242 1.286 1.268	1.84 1.26	0 0				CI*					Do
BH109	SPT02	2.45	Greyish brown, silty clay.																		Do
BH110	SPT03	3.40	Greyish brown, silty clay / clayey silt with mica.													SM		64	36	(Silt+Clay)	Do

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Project: G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No.: 3401 | **Sheet No.**

LABORATORY ROCK TEST RESULTS

BH No.	Run No.	Depth (M)	Density (gm/cc) Bulk	Density (gm/cc) Dry	Water Content (%)	Porosity %	Specific Gravity	Unconfined Compressive strength (kg/sqcm) In-situ	Unconfined Compressive strength (kg/sqcm) Saturated	Coefficient of softening	Point Load Strength Index (kg/sqcm)	Slake Durability Index (%)	Hardness (based on Mohr Scale)	Soundness (%) Loss	Deformability (kg/sqcm)	Test Method
1	1	5.75-6.00	1.983	1.911	3.743	7.155	2.748	102	20	0.196	0.83 0.90	24.72 45.48	2.50-3.00 3.00-3.50	8.25	5883	**See the Notes Do
10	10	12.50-13.25	2.001	1.950	2.630	5.129	2.713				0.88		3.00-3.50	2.48		Do
2	3	4.25-5.00	2.117	2.045	3.560	7.278	2.605	27			0.90	29.43			1995	Do
3	5	6.00-6.75	1.817	1.804	0.724	1.307					0.94	63.28		4.90		Do
4	2	6.75-7.50	2.285	2.239	2.053	4.598	2.347	186	30	0.269	1.21		3.50-4.00	1.25	5778	Do
4	12	14.25-15.00										11.11		10.00		
5	8	9.00-9.75									0.84		3.00-3.50	4.75		
6	2	4.50-5.25										0.00		17.29		
6	8	9.00-9.75	2.222	2.185	1.693	4.021	2.619	100	17	0.170	1.00	2.25	3.00-3.50		4752	Do
7	15	14.25-15.00	2.259	2.223	1.596	3.548	2.673	122	87	0.714	3.25	61.48	3.50-4.00	8.29	6020	Do
8	22	19.00-19.75	2.252	2.171	3.748	8.136	2.363	176	24	0.136		63.96	3.00-3.50			Do
9	19	16.75-17.50	2.013	1.972	2.081	4.105	2.057				1.25			11.25		Do
10	1	3.00-3.75							15			0.00	2.50-3.00	13.49		
11	3	5.50-6.25	2.167	2.092	3.611	7.533	2.568	75	40	0.533	1.75	44.47		9.96	2726	Do
12	11	11.50-12.25	2.242	2.193	2.228	4.885	2.305				0.97		3.00-3.50			Do
13	7	8.50-9.25	2.196	2.147	2.303	4.944	2.480	120	102	0.846	4.33	92.48	3.50-4.00	5.75	5183	Do
14	30	25.00-25.75	2.225	2.156	3.179	6.855	2.610				2.15			4.29		Do
15	16	14.75-15.50	2.254	2.183	3.248	7.092	2.580		38		1.00	70.00			4433	Do
16	14	14.50-15.25	2.257	2.215	1.905	4.221	2.499				9.57	66.67	3.00-3.50	10.00		Do
17	15	14.00-14.75	2.398	2.383	0.627	1.495	2.420				0.94		3.00-3.50			Do
18	4	6.50-7.25														

Project: G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CETEST

Job No. : 3401 | **Sheet No.**

BH No.	Run No.	Depth (M)	Density (gm/cc)		Water Content	Porosity %	Specific Gravity	Unconfined Compressive strength (kg/sqcm)		Coefficient of softening	Point Load Strength Index (kg/sqcm)	Slake Durability Index (%)	Hardness (based on Mohr Scale)	Soundness (%) Loss	Deformability (kg/sqcm)	Test Method
			Bulk	Dry	(%)			In-situ	Saturated							
18	20	18.25-19.25	2.250	2.214	1.627	3.601	2.498	147	39		4.65	72.48	3.00-3.50	11.21	4705	Do
19	19	20.50-21.25	2.165	2.094	3.367	7.052	2.675	106	41	0.386				10.63	4290	Do
20	2	5.75-6.50									0.81	11.92	2.00-2.50			Do
21	15	15.00-15.75	2.343	2.283	2.627	5.998	2.428	335			5.46	86.48	3.00-3.50	4.29	12325	Do
22	2	5.75-6.50	2.165	2.123	1.996	4.238	2.630				0.95	3.69		11.92		Do
23	15	16.50-17.25	2.449	2.409	1.660	3.259	2.692	254	142		4.42	82.36	3.50-4.00		11543	
24	8	12.25-13.00	1.949	1.882	3.561	6.701	2.017	52				39.63			1344	Do
25	8	11.25-12.00	2.159	2.114	2.143	4.531	2.680	59	25		1.00	64.44	3.00-3.50	11.25	3353	Do
26	15	16.25-17.00	2.225	2.163	2.853	6.172	2.306		47		3.21			4.82	3149	Do
27	17	15.25-16.00	2.150	2.091	2.797	5.850	2.221	86	42	0.488		31.92	3.00-3.50		2895	Do
28	3	5.50-6.50	2.068	2.041	1.346	2.747	2.098				0.84			3.36		Do
29	26	28.75-29.25	2.334	2.298	1.591	3.656	2.385	243	196	0.810	10.49	91.11	3.00-3.50	4.83	13423	Do
30	1	7.25-8.00	1.885	1.847	2.048	3.783	2.649				0.82		3.00-3.50			Do
30	8	12.50-13.25	2.169	2.132	1.713	3.652	2.213	151	27	0.179		41.48			5078	Do
31	4	6.25-7.00	1.985	1.944	2.090	4.063	2.027				0.94	49.73		3.63		Do
32	20	25.75-27.25	2.333	2.304	1.241	2.859	2.372	335	100	0.298		58.99	3.00-3.50		11441	Do
33	11	11.50-12.25	2.143	2.087	2.715	5.665	2.482				1.25	44.47	3.00-3.50	4.92		Do
34	13	12.75-13.50	2.112	2.045	3.247	6.641	2.191	102	25	0.245	1.00		3.50-4.00		3001	Do
35	3	4.75-5.50	2.110	2.078	1.565	3.252	2.419				0.94	11.43	2.50-3.0	12.00		Do
36	30	24.75-25.50	2.290	2.260	1.343	3.035	2.330	264	138	0.533		72.49	3.00-3.50		15501	Do
37	28	25.25-26.00	2.351	2.314	1.588	3.674	2.402	242	140	0.579	4.82	63.48	3.00-3.50	7.63	7559	Do
38	17	14.75-15.50	2.324	2.277	2.046	4.658	2.388	172	48	0.279					7815	Do

CLAUSE NO.	TECHNICAL REQUIREMENTS

Project: G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand. CET

Job No. : 3401 | **Sheet No.**

BH No.	Run No.	Depth (Mt)	Density (gm/cc)		Water Content	Porosity %	Specific Gravity	Unconfined Compressive strength (kg/sqcm)		Coefficient of softening	Point Load Strength Index (kg/sqcm)	Slake Durability Index (%)	Hardness (based on Mohr Scale)	Soundness (%) Loss	Deformability (kg/sqcm)	Test Method
			Bulk	Dry	(%)			In-situ	Saturated							
89	21	19.00-20.00	2.390	2.337	2.241	5.237	2.751		31		0.93	74.85	3.00-3.50		5757	Do
90	22	18.25-19.00	2.163	2.146	0.762	1.637	2.336	183	75	0.410					2597	Do
91	3	5.50-6.25									0.90	0.00	2.50-3.00	15.29		Do
96	6	9.25-10.00									0.92	5.00	2.50-3.00	8.29		Do
98	2	4.25-5.00										0.00		13.00		Do
99	2	5.25-6.00	2.144	2.087	2.731	6.444	2.444				0.82	7.25	3.00-3.50	7.76		Do
100	2	4.00-4.75										0.00	3.00-3.50	14.50		Do
100	7	7.75-8.50									0.82	44.48		7.72		Do
109	1	3.75-4.50									0.82		2.00-2.30			Do
109	6	7.50-8.25										0.00	3.00-3.50	12.25		Do
111	9	10.00-10.75	2.171	2.133	1.818	3.877	2.660	184			0.82	63.56	3.00-3.50		6593	Do
112	26	27.50-28.30	2.290	2.261	1.304	2.947	2.639	349	87	0.248			3.50-4.00		7346	Do
113	22	18.75-19.50	2.103	1.922	9.382	18.036	2.345				0.92	63.91		4.30		Do
114	23	19.50-20.25	2.274	2.220	2.463	5.466	2.348	166	49	0.295	1.33		3.50-4.00		6902	Do
115	16	14.25-15.00	1.693	1.639	3.290	5.391					1.04	42.36		5.33		Do
116	20	17.00-17.75	2.241	2.166	3.445	7.462	2.341	144	9	0.063	1.25		3.00-3.50		407	Do
117	18	17.50-18.25	2.278	2.233	1.988	4.439	2.543	120	38	0.317		55.69	3.00-3.50	2.36	5633	Do
119	10	9.75-10.30	2.126	2.064	3.024	6.241	2.201				1.04	42.57		1.00		Do

Project: G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand CETEST

Job No. : 3401 | Sheet No.

APPARENT RESISTIVITY VALUES

ERT No. 01

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	32.14	33.53	31.76	32.08	32.38
2	2.0	25.89	30.67	28.79	26.52	27.97
3	3.0	22.63	31.87	29.43	23.20	26.78
4	4.0	25.64	33.94	27.91	28.16	28.91
5	5.0	22.63	34.89	31.74	28.29	29.39
6	7.0	23.76	36.08	32.56	19.80	28.05
7	10.0	27.03	39.60	37.09	20.12	30.96

Mean Resistivity at ERT-01 is 29.21 m.

ERT No. 02

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	47.18	49.82	43.72	45.29	46.50
2	2.0	42.86	36.70	21.62	26.40	31.90
3	3.0	28.67	20.76	36.40	19.43	26.32
4	4.0	30.67	31.93	26.40	24.64	28.41
5	5.0	30.80	28.29	30.49	28.29	29.47
6	7.0	35.64	29.48	30.36	30.80	31.57
7	10.0	37.72	32.06	28.82	33.32	32.98

Mean Resistivity at ERT-02 is 32.45 m.

ERT No. 03

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	35.16	16.10	33.34	32.70	29.33
2	2.0	30.42	27.65	35.20	27.65	30.23
3	3.0	35.46	26.03	47.15	26.40	33.76
4	4.0	32.43	27.65	41.73	41.48	35.82
5	5.0	37.72	19.17	40.23	40.86	34.50
6	7.0	29.92	24.64	61.16	42.68	39.60
7	10.0	32.69	19.49	62.23	21.37	33.95

Mean Resistivity at ERT-03 is 33.88 m.

ERT No. 04

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	23.96	26.17	21.07	21.70	23.23
2	2.0	24.51	24.51	23.00	23.88	23.98
3	3.0	26.40	26.78	26.97	27.72	26.97
4	4.0	28.91	30.67	28.66	28.16	29.10
5	5.0	29.86	40.23	33.32	29.23	33.16
6	7.0	30.36	41.36	34.76	38.72	36.30
7	10.0	31.43	39.60	37.09	40.23	37.09

Mean Resistivity at ERT-04 is 29.97 m.

CLAUSE NO.	TECHNICAL REQUIREMENTS

Project: G/I for 3x660MW North Karanpura Super Thermal Power Project, Jharkhand CETEST

Job No. : 3401 | Sheet No.

ERT No. 05

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	21.83	21.57	23.71	20.25	21.84
2	2.0	20.74	18.60	18.60	18.23	19.04
3	3.0	17.92	16.79	18.11	18.67	17.87
4	4.0	20.11	19.86	19.36	19.36	19.67
5	5.0	21.06	20.74	19.80	18.54	20.04
6	7.0	24.64	22.88	22.88	21.12	22.88
7	10.0	23.89	23.89	27.66	24.52	24.99

Mean Resistivity at ERT-05 is 20.90 m.

ERT No. 06

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	16.17	16.23	19.00	16.23	16.91
2	2.0	16.47	16.59	17.10	17.22	16.85
3	3.0	17.54	21.50	22.63	36.59	24.57
4	4.0	21.12	26.15	23.13	20.87	22.82
5	5.0	24.83	27.66	23.26	20.74	24.12
6	7.0	27.28	30.36	26.40	27.28	27.83
7	10.0	29.54	28.29	30.80	29.54	29.54

Mean Resistivity at ERT-06 is 23.23 m.

ERT No. 07

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	18.81	19.18	20.76	19.81	19.64
2	2.0	22.75	20.87	23.00	23.63	22.56
3	3.0	24.90	26.03	25.46	25.84	25.56
4	4.0	25.14	22.63	26.65	44.50	29.73
5	5.0	26.09	26.72	28.60	29.23	27.66
6	7.0	32.56	22.44	26.40	27.72	27.28
7	10.0	33.94	30.17	33.32	32.69	32.53

Mean Resistivity at ERT-07 is 26.42 m.

ERT No. 08

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	38.43	36.92	32.27	36.48	36.03
2	2.0	23.13	14.83	15.84	15.46	17.32
3	3.0	21.50	21.12	18.48	21.50	20.65
4	4.0	19.86	21.12	18.60	25.14	21.18
5	5.0	15.40	20.74	21.37	26.40	20.98
6	7.0	20.24	26.40	25.08	28.16	24.97
7	10.0	23.89	26.40	34.57	25.14	27.50

Mean Resistivity at ERT-08 is 24.09 m.

SUB-SECTION-V-Q

QUALITY ASSURANCE

MECHANICAL SYSTEM

SUB-SECTION-V-QM1

FLUE GAS DESULPHURISATIN SYSTEM

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION
1.00.0	**FLUE GAS DESULPHURISATION SYSTEM**
1.01.0	**Mills:**
1.01.01	Raw material for shaft, coupling, gears and pinions, Mill Heads ,top and bottom races and other rotating components shall be subjected to UT & Base frame for MPI. MPI/LPI shall be carried out to check surface soundness. Rubber wear lining of Mill Shell shall be checked for shore hardness. For Central driven ball mill shall be run tested (without grinding media) for 30 min at shop to check unusual noise and vibration.
1.01.02	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.
1.01.03	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.

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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 (water fill test, NDT and Vacuum box test) 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.

1.07.0 **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:

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	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
1.10.0	**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

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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 **Oxidation Blower**

- Physical and chemical property of the shaft, gears, impeller to be checked.
- Rotor assembly to be dynamically balanced.
- Performance test of the blower to be carried out at shop.
- Vibration, noise, bearing temperature check, visual and dimensional check of the blower.

1.15.0 **Rubber and Flake Lining at Site:**

- The surface shall be properly blast cleaned to the Standard SA 2 ½ or better / Technical specification.
- Check DFT or thickness of coating and perform adhesion test.
- Perform Spark test shall be carried.
- Necessary field checked shall be carried out as per NTPC Tech specification/ relevant procedure.

1.16.0 **Rubber Lining of Pipe :**

The lining shall be checked for adhesion test , Shore hardness, thickness of coating etc. Spark test. Sample rubber compound shall be tested for Tensile, Elongation, Resistance to Bleeding.

1.17.0 **OTHER CRITICAL EQUIPMENTS:**

Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.

SUB-SECTION-V-QM2

LIME STONE & GYPSUM HANDLING

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION

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 alongwith 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.

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(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

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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.

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(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

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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 becarried out in accordance with ISO:1217/Eq. The test shall also include

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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 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 Specialities

Refer 1.08.02 above

1.09.02.1 Pipes and Fittings

Refer 1.08.03 above

1.09.03 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.

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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	**Bucket Elevator**
1.15.01	All plates equal to or above 25 mm thickness shall be ultrasonically tested.
1.15.02	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.
1.15.03	Machined and hardfaced 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.
1.15.04	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.
1.15.05	For other items like drive system, motor, pulley, belt etc relevant portion of specification shall be applicable.
1.16.00	**Elevators (Rack and Pinion Type)** 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 part of the quality assurance plan to be agreed with the owner.
1.16.01	All forgings shall be subjected to ultrasonic test to ensure free from internal defects in addition to check for chemical and mechanical properties.
1.16.02	10% of the welds selected at random shall be subject to DP test.
1.16.03	All forged components shall be subjected to DPI/MPI after machining.
1.16.04	Gear Reducer shall be checked for gear ratio, backlash, contact pattern. No load shop trial run shall be conducted on gear boxes to check for oil leakage, temperature rise, noise and vibration.
1.16.05	Buffer springs shall be subjected to load test as per relevant specifications. Material certificates for springs shall also be furnished.

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1.16.06	All components prior to assembly shall be checked for dimensions.
1.16.07	Function test of Elevator assembly shall be carried out.
1.16.08	All electrical equipments shall be of proven quality.
1.16.09	Galvanized components/parts shall be checked for weight of Zn coating, thickness of coating, uniformity of coating and adhesion test and visual examination as per IS 2633 and IS 2629.
1.17.00	**Steel Structure**
1.17.01	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.
1.17.02	Visual inspection of all welds shall be performed in accordance with AWS D.1.1.
1.17.03	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.
1.17.04	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.

SUB-SECTION-V-QM3

AIR CONDITIONING & VENTILATION SYSTEM

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION

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

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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. 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.

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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-QM4

EQUIPMENT COOLING WATER SYSTEM

CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC

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 50 mm or above.

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 as specified in Technical Specification..

11 Pipes, Valves and RE Joints shall be tested as per relevant standard/ Technical specification requirements.

ELECTRICAL SYSTEM

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

LT SWITCHGEARS & BUSDUCTS

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							

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-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. 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

LT CONTROL CABLES

Control 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	Lay length & Sequence	Armour coverage, cross over,	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after ageing on outer sheath & insulation	Thermal stability	Anti termite coating on	Constructional requirements feature as per NTPC	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 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.	----

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

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION	एनटीपीसी NTPC

MODULE NO. SQE-16

CABLING, EARTHING, LIGHTNING PROTECTION

ATTRIBUTES / CHARACTERISTICS 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

ELECTRICAL ACTUATOR WITH INTEGRAL STARTERS

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION

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-QE7

STATION LIGHTING

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION	एनटीपीसी NTPC

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.

SUB-SECTION-V-QE8

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-QE9

DG SET

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-QE10

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-QE11

HT CABLES

MV (3.3 kV / 6.6. kV / 11 kV / 33 kV) 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 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 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 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-QE12

HT SWITCHGEARS

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-QE13

MEDIUM VOLTAGE BUSDUCT

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-QE14

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.

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 IS/IEC
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.

CONTROL AND INSTRUMENTATION SYSTEM

SUB-SECTION-V-QC1

MEASURING INSTRUMENT

(PRIMARY AND SECONDARY)

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION	एनटीपीसी NTPC

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) 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.

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) 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 AND PIPING

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION	एनटीपीसी NTPC

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

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION	एनटीपीसी NTPC

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) 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	एनटीपीसी NTPC

POWER SUPPLY FOR C&I SYSTEMS (UPS/BATTERY/BATTERY CHARGER/ACDB/DCDB)

TESTS / ITEMS	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) 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.

CIVIL WORKS

SUB-SECTION-V-QD1

CIVIL WORKS

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:-

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A. Evaluation of Aggregates:

I. To carry out different tests on coarse aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material; soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 2386.

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.

III. To prepare evaluation report based on test results of I) and ii) above and to advise regarding suitability of fine and coarse aggregates.

B. Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity:

Evaluation for Potential Alkali-Aggregate reactivity as per following scope of work:

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.

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.

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

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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: 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), Electrosteel steel Ltd. (for Reinforcement steel/TMT bars) and Monnet Ispat and Energy Ltd. (for long products/Rolled sections and Reinforcement steel/TMT bars). Subsequently, 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.

The contractor shall furnish complete QA & QC programme (QAP) for the work envisaged which may include the following:-

- The organisation structure for the management and implementation of the proposed Quality Assurance Programme.
- Documentation Control System
- The procedure for procurement of materials and source inspection.
- System for site controls including process controls.
- Control of non-conforming items and systems for corrective action
- Inspection and test procedures for site activities
- System for indication and appraisal of inspection status
- System for maintenance of records
- System for handling, storage and delivery.
- Quality Plan detailing out quality practices and procedures, relevant standards and acceptance levels for all types of work under the scope of this contract.

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.

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	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. 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 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. 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. 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. 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. 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.

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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 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. 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. All welding/brazing procedures shall be submitted to the NTPC or its authorized representative for approval prior to carrying out the welding/brazing. 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. 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. 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 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

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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.

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 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 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) ± 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) 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

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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.

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

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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.

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

TOLERANCES				
Description of Item/ Structural Element			**Max (mm)**	**Min (mm)**
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 • Riser • Tread		 +1.5 +3.0	 -1.5 -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 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

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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 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

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SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD
	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 (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. Wherever RT is not feasible UT to be carried out with the approval of the engineer)	100% RT on butt welds of tension flange (bottom flange) of crane girders 10% RT weld length of each welder on butt welds,
	Ultrasonic testing on full penetration welds (other than butt welds)	100% UT on the web to flange joint of crane girder 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

Clause No	QUALITY ASSURANCE PROGRAMME

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

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.

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.

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.

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

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

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.

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.

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2.11.0 PILING WORK (If Applicable)

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 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.

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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.

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 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.
2. Concrete mix for Pre cast members shall conform to IS-456-2000.
3. All relevant QA requirements pertaining to cast insitu concrete shall be applicable.
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.

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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 withstand ability 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.

2.16.0 SLIPFORM SHUTTERING

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.

2. Manning of each shift shall be done by at least two experienced operators and a foreman particularly in night shift.

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.

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

5. Shuttering plates to be used for slip form shall be new and the grade of steel shall conform to the specification requirements.

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.

एनटीपीसी NTPC	PROJECT: North Karanpura STPP (3X660)	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 FOR CHIMNEY						
9	NON-METALLIC EXPANSION JOINT						
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

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.

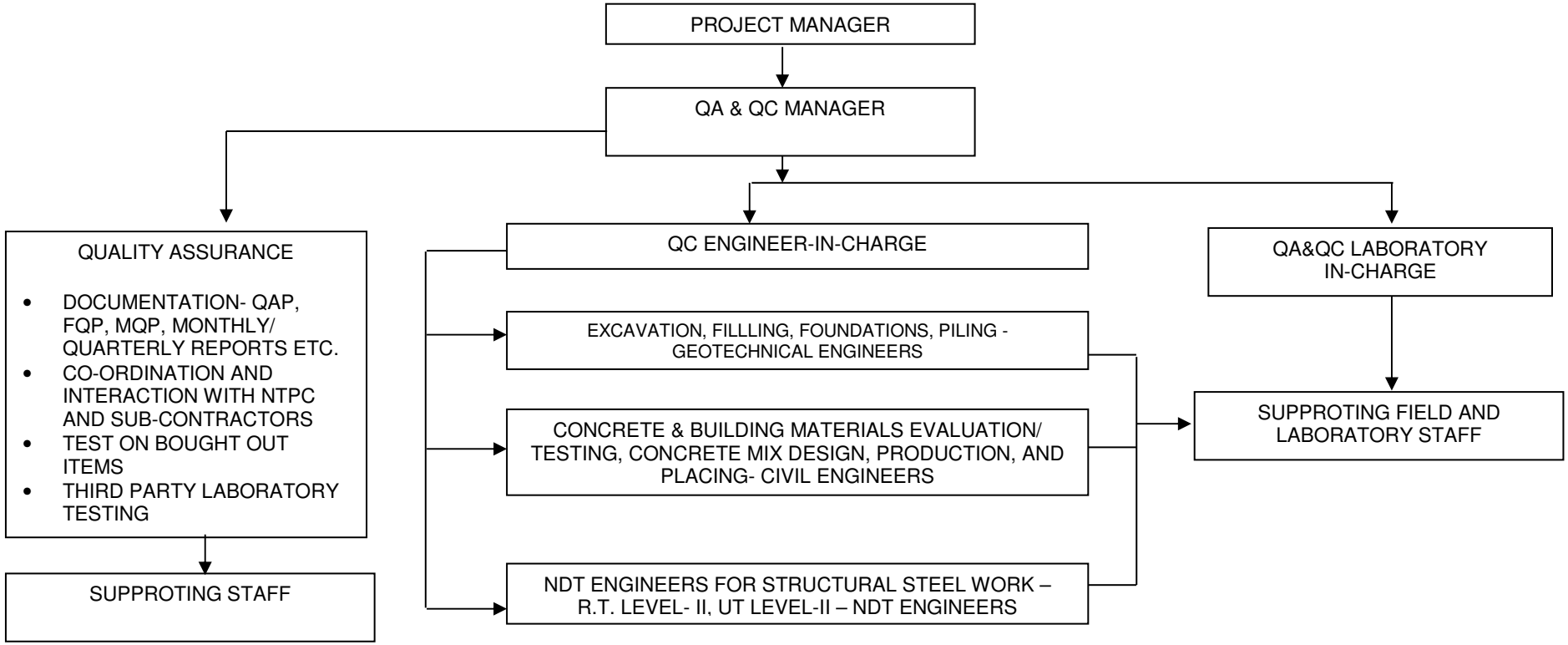
Clause No	QUALITY ASSURANCE PROGRAMME

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 SUB-SYSTEM : Foundations, Excavation & Fill, Concrete, Building, Masonry Etc.		QP NO. : REV. NO .: DATE : PAGE :		1 0	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	North Karanpura STPP (3X660) 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 ---- OR---- 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	√	

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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		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

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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

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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		

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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			√	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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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										

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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**										

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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	√	

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Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
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ii		Testing of Joints	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings		SR		
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		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		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

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Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
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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.
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.:			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)** **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:	North Karanpura STPP (3X660)			
				REV. NO .:		0	PACKAGE:	FLUE GAS DESULPHURISATION SYSTEM 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
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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:	North Karanpura STPP (3X660)			
				REV. NO .:	0	PACKAGE:	FLUE GAS DESULPHURISATION SYSTEM 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	D*	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 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 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 5% spot RT on butt welds / at inaccessible locations UT on butt welds- For coal bunker bins 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. 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)**										

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					ANNEXURE- V				
		ITEM : STRUCTURAL STEEL WORK		QP NO. :		2	PROJECT:	North Karanpura STPP (3X660)			
				REV. NO .:		0	PACKAGE:	FLUE GAS DESULPHURISATION SYSTEM 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
5.03.01		Ultrasonic Testing (UT)	As required/ agreed	A	Physical	100% UT on the web to flange joint of crane girder 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.
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)
		Foundation Bolts (materials)	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	Foundation bolts shall conform to IS:5624 and property class shall be 4.6 as per IS:1367 (Part-3).
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	√	

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN						ANNEXURE- V			
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				REV. NO .:		0	PACKAGE:	FLUE GAS DESULPHURISATION SYSTEM 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
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		
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	√	All bolts for connections shall be conforming to IS: 12427 and of property class 5.6 as per IS:1367 (Part 3). Nuts shall conform to IS:1363 (Part 3) of property class 5
11.02		Contact surfaces before bolting	As agreed / required	B	Physical	Random before asembly for bolting	Tech Specs and Const. Drawings, IS 4000		SR		

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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
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
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 documentation.	For Owner USE	**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)** **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**			
Signature		This document shall be read in conjunction with Owner Tech. Specifications, BOQ, Drawings		**REVIEWED BY**	**APPROVED BY** / **APPROVAL SEAL**

SUB-SECTION-VI

PRE-COMMISSIONING

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

1.00.00 GENERAL

1.01.00 The pre-commissioning and commissioning activities including Guarantee tests, checks and initial operations of the equipment furnished and installed by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such operations.

1.02.00 It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment systems which are installed by him. The Contractor shall also be responsible for flushing & initial filling of all oils & lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications & documents.

1.03.00 The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the facilities ready for sustained safe, reliable and efficient operation. All pre-commissioning/ commissioning activities considered essential for such readiness of the facilities including those mutually agreed and included in the Contractors quality assurance program as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Contractor.

2.00.00 TESTING / COMMISSIONING PROCEDURES

The contractor shall submit his testing / commissioning check lists and procedures for various equipments / systems covered under the contract at least 10 months before the actual commissioning of the equipments / systems for review and approval of employer.

The testing / commissioning procedures are to be of a standard format in order to maintain consistency of presentation, content and reporting. The list of commissioning check lists and procedures to be submitted and their content details shall be agreed upon during preaward discussions.

An indicative list of Testing / Commissioning procedures and Standard Checklists and the details regarding the contents are enclosed as annexure at the end of this

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

sub-section of section-VI, Part B. The actual list of such equipments / systems shall depend on the equipments / systems being supplied by the contractor.

i) Annexure-I : Standard Checklist of items

ii) Annexure-II : Testing / Commissioning Procedure

iii) Annexure-III : Commissioning procedures requiring approval of Employer.

iv) Annexure – IV : Brief write up on Contents of Testing / Commissioning Procedures

3.00.00 PRECOMMISSIONING & COMMISSIONING ACTIVITIES

3.01.00 **General**

The pre-commissioning activities including some of the important checks & tests for certain major equipment/ systems (as a minimum) are described below, although it is the Contractor's responsibility to draw up a detailed sequential & systematic list of checks / tests and various activities / procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.

3.02.00 **PRE-COMMISSIONING ACTIVITIES/TESTS:**

3.02.01 **Air and Gas Tightness Test**

After completion of installation of Booster fans (if required), ducts, absorber, GGH and before commencement of application of thermal insulation a test shall be performed on the FGD system by the contractor to prove or to establish the tightness of the erected equipments within the Terminal points. The procedure adopted for such tests shall have the prior approval of the Employer. Normally physical leak detection method by pressurizing the section under test by running Temporary blower is adopted. The contractor may adopt any other better method of testing.

All equipments including any temporary blanking, if required, for the above test shall be provided by the Contractor.

The Contractor's air and gas tightness test procedure shall be such that it shall enable conductance of air/gas tightness test on the ducts in segmented manner (as and when these duct segments are ready), so that these duct segments can be immediately released for application of insulation after their gas tightness tests. Contractor shall made all necessary arrangement for conducting tests in this

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

manner. Any blanking etc. on the duct side required for testing of duct segments shall be provided by Contractor. Contractor shall bring fan / blower (s) of adequate size / capacity and other necessary instruments so that these tests can be conducted. The above equipment shall be brought to site by the Contractor on temporary basis and shall be taken back after successful completion of air / gas tightness test.

3.02.03 All pre-commissioning tests & activities as indicated in Annexure-I, II & III and elsewhere in the technical specification shall be performed by the Contractor.

3.03.00 **COMMISSIONING OF FACILITIES**

General

Upon completion of pre-commissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities.

Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.

The Contractor shall finalize the protocol of check lists, after erection of the system and equipment, as per International Codes/Standard with the Employer.

The Contractor shall furnish requisite no. of copies of procedures and list of start up, pre-commissioning, commissioning and initial operation tests for Employer's approval.

The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment or prior to that as the case may be.

Other tests shall be conducted, if required by the Employer, to establish that the plant equipments are in accordance with requirements of the specifications.

3.03.01 The Commissioning tests/checks shall specifically include but will not be limited to following:

(a) Checks on the operation of all controls of isolating gas and air dampers

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

(b) Checks on operation of fans to ascertain level of noise and vibration

(c) Test running of all pumps, blowers/compressors

(d) Checks on operation of all GGH and adjustment of seals

(e) Checks on operation of all soot blowers and retraction gear and the sequences control.

(f) Checks on operation of all rotating equipments to ascertain level of noise and vibration

(g) Standard commissioning tests and procedures as per Contractor's practice for FGD plant

(h) Checks on operation of all individual control loops in the FGD control loops in the FGD control system.

(i) Checks on inter-relation between each control loop in the FGD control system.

(j) Calibration tests of orifice, flow nozzles, instruments and control equipment to the extent included in these specifications.

(k) Checks on operation of all static equipments to ascertain level of noise and vibration

(l) Tests on Control & Instrumentation (C&I) Equipments

The Contractor shall finalise the protocol of check lists, after erection of the system and equipment, as per International Codes/Standard with the Employer.

The Contractor shall furnish requisite no. of copies of procedures and list of start up, precommissioning, commissioning and initial operation tests for Employer's approval.

The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment or prior to that as the case may be.

Other tests shall be conducted, if required by the Employer, to establish that the plant equipments are in accordance with requirements of the specifications.

3.03.02 **Balance equipment & systems**

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS
	All pre-commissioning tests &activities as required for successful running of the equipment or as mentioned in the technical specification elsewhere shall be performed by the contractor.
4.00.00	**INITIAL OPERATION**
	Upon completion of system checking/tests and as a part of commissioning of facilities, complete FGD plant/facilities shall be put on initial operation for a period of thirty (30) days or 720 hours as stipulated in General Technical Requirements.
5.00.00	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical & C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied & installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).
6.00.00	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical & C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied & installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).
7.00.00	**COMMISSIONING SPARES**
7.01.00	It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However, such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.
7.02.00	These spare will be received and stored by the Contractor at least 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilized as and when required. The unutilized spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

ANNEXURE-I

STANDARD CHECKLIST

This is an indicative list of items. The actual list shall depend on the Equipment / System being supplied by the contractor.

MECHANICAL

VALVES

1. Manually Operated Valve
2. Electrically Operated Valve
3. Pneumatically Actuated Valve
4. Hydraulically Actuated Valve
5. Safety Valve
6. Electromatic Relief Valve
7. Steam Trap
8. Non Return Valve (including Hydraulic/ Pneumatic QCNRVS)
9. Control Valve
10. Relief Valve
11. Differential Pressure Regulating Valve
12. Pinch valve

TANKS & PRESSURE VESSELS

1. Limestone silos
2. Gypsum storage silos
3. Limestone slurry tanks
4. Filtrate tank
5. Waste water tank
6. Secondary hydrocyclone feed tank
7. Lime dosing tank
8. Process water tank
9. Absorber
10. Auxiliary absorbent tank

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

11. Mill circuit tank
12. Any other tank not covered above
13. Vacuum tanks
14. Air Receiver(if any)

PUMPS

1. Slurry recirculation pumps
2. Gypsum bleed pumps
3. Limestone slurry pumps
4. Process water pumps
5. All other slurry pumps
6. Vacuum pumps
7. Sump pumps

PIPE WORK SYSTEM

1. Steam services
2. Water services
3. Slurry services
4. Air services
5. Constant load support
6. Spring supports
7. Hangers and other Supports

STRAINER AND FILTER

1. Strainer / Filter Basket Type
2. Strainer Rotary (Low Pressure)
3. Filter & Strainers Centrifugal Separators
4. Filter & Strainer Y-Type
5. Filter & Strainer (Plate Type)
6. Purifier
7. Filter – Compressed Air Line

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

FANS & COMPRESSORS

1. Booster Fans (if provided) – Axial Flow pressure Lubricated
2. Oxidation Blowers/Compressors-General

DAMPERS & GATES

1. Manually Operated Damper
2. Pneumatically Operated Damper
3. Electrically Operated Damper
4. Manually Operated Gates
5. Pneumatically Operated Gate
6. Electrically Operated Gate

DUCT WORK

1. Flue Gas Ducting
2. Expansion Joints
3. Observation & Access Door

CRANES AND ELEVATORS

1. Crane
2. Hoists
3. Passenger cum goods elevator

POWER TRANSMISSION

1. Power Transmission Gear Box
2. Bearings
3. Couplings

FGD & AUX.SYSTEM

1. Agitators
2. Air Motor
3. Process trestle

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

4. Limestone feeder
5. Vacuum belt filter
6. Limestone ball mill
7. Limestone Hydrocyclones
8. Primary Hydrocyclones
9. Secondary Hydrocyclones
10. Absorber internals
11. Absorber Auxiliaries

ELELCTRICAL

1. D.C. Motor
2. HV Squirrel Cage Induction Motor
3. 415 V Squirrel Cage Induction Motor
4. Motor Operated Actuators
5. Transformers
6. Aux. Control and Relay Panel Desk
7. HT & LT SWITCHGEARS/MCC
   - (I.) STANDARD CHECLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM
   - (II.) PT CARRIAGE AND CUBICLES
   - (III.) CABLE/BUS DUCT/BUS BARS
   - (IV.) CONTRACTOR MODULE
   - (V.) SWITCH FUSE MODULE
   - (VI.) MASTER PANEL OF LUBE OIL PANEL
   - (VII.) FEEDER PANEL OF LUBE OIL PANEL
   - (VIII.) SPACE HEATER AND CABLE MODULE
   - (IX.) HT CIRCUIT BREAKER
   - (X.) 415 V CIRCUIT BREAKER
8. POWER CABLE
9. AUXILIARY CABLE
10. D.C. CABLE
11. EXPLOSION PROOF ELECTRICAL EQUIPMENT

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

12. JUNCTION BOX
13. CONTROL TRANSFORMER MODULE
14. BRUSH GEAR ASSEMBLY
15. AUX. CONTROL AND RELAY PANEL DESK
16. INDICATING INSTRUMENT
17. RECORDING INSTRUMENT
18. INTEGRATING INSTRUMENT
19. D.G SET
20. STATION LIGHTING

CONTROL & INSTRUMENTATION

1. Conductivity Measuring Equipment Including Test Procedures
2. pH Analyser Including Test procedure
3. Silica Analyser
4. Level Switch (Float Actuated)
5. Level Switch (Electrode Type)
6. Level Switch (Displacer Actuated)
7. Transmitter (Float Operated Pneumatic Output including Testing procedures
8. Level indicator (Float/Pulley Type)
9. Local Temperature Indicator Including Test Procedure
10. Resistance Thermometer Element Including Test procedure
11. Thermocouple Element and Connecting Cable
12. Thermocouple and Resistance Thermometer Convertor/Transmitter Including Test Procedures
13. Temperature Switch Including Test Procedure
14. Cold Junction Boxes
15. 0_2Analyser
16. SO2 analyzer
17. 0_2 in Hydrogen including Test procedures
18. Pressure and Vacuum Gauge
19. Pressure and Vacuum Switch Including Test procedures
20. Differential Pressure Transmitter including Test Procedures

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

21. Differential pressure switch including Test procedures
22. Flow indicator (Variable Area)
23. Orifice plate
24. Flow Switch
25. Nozzle
26. Flow Integrator (pneumatic input) including test procedure
27. Flow indicator (Float Operated) Including Test Procedure
28. Venturi (Fluid)
29. Flow Switch (Magnetic Type)
30. Limit Switches
31. Turbine Supervisory Measuring System
32. Position Measurement & Indication Including Test procedures
33. Vibration Measurement
34. Digital Indicator
35. Moving Coil Indicator Including Test Procedures
36. Recorder Including Test procedure
37. Flame Scanner
38. Electrical Auto Manual Control Station
39. Push Button Module
40. Test Procedure for Electronic Modules of DDCMIS
41. Alarm Annunciator Equipment Including Test Procedure
42. Test procedure for Adjustment of Modulating Controller-PID Term
43. Test Procedure Indicating Controller-Electrical Input & Pneumatic Output
44. Density monitors
45.

AIR CONDITIONING & VENTILATION SYSTEM

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

ANNEXURE-II

TESTING / COMMISSIONING PROCEDURES

Following is an indicative list of equipments / systems for which Testing / Commissioning procedures are to be submitted. The actual list will depend on the equipment / system being supplied by the Contractor.

S. No	DESCRIPTION
	FGD
1.	Booster Fan (if provided)
2.	Absorber System
3.	Limestone grinding system
4.	Absorber system
5.	Gypsum dewatering system

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

ANNEXURE-III

COMMISSIONING PROCEDURES REQUIRING APPROVAL OF EMPLOYER

S.NO.	DESCRIPTION
1.	AIR & GAS TIGHTNESS TEST
2.	OIL FLUSHING OF LUB OIL SYSTEM OF ROTARY EQUIPMENTS
3.	LIMESTONE GRINDING SYSTEM
4.	GYPSUM DEWATERING SYSTEM

CLAUSE NO.	PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS

ANNEXURE-IV

BRIEF WRITE UP ON THE CONTENTS OF TESTING / COMMISSIONING PROCEDURE

Testing / Commissioning Procedure is required to be of a standard format in order to maintain consistency of presentation, content and reporting. These should contain the following sections to make the document a self contained one.

1. Plant Details / Design data
2. Objective
3. Proposal
4. Services Required
5. Safety Precautions
6. Emergency Procedures
7. State of the Plant (Status in respect of erection completion of Mech, Elect and C&I items)
8. Method
9. Completion / Acceptance Criteria
10. Appendix
    - Result
    - Log sheet
    - Drawing etc.

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 of Flue Gas Desulphurisation (FGD) System Package for Northkaranpura Super Thermal Power Project (3 x 660 MW) 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;

b) Detailed design of all the equipment and system(s) including civil, structure steel works included in bidder's scope.

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.

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	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. 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.

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	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 2X 800 MW unit, 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 Absorber for each unit with Slurry re-circulation pumps & Oxidation blowers, common Limestone Grinding system, common Gypsum dewatering 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.
1.03.03	All motors, HT & LT Switchgears, DC System, Transformers, Electrical Actuators, HT & LT power & control cables, DG set (if applicable), cabling, lighting etc.
1.03.03	Associated Control & Instrumentation (C&I) equipments.
1.03.04	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 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

CLAUSE NO.	INTENT OF SPECIFICATION

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:

(A) LAYOUT & CIVIL DRAWINGS

(1) Layout Plan of FGD System : Drg No.: 4410-999-POC-F-001

(2) Equipment layout Plan : Drg No. : 4410-999-POM-F-001

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(B) SCHEMES

Sl. No	Drawings Title	Drawings No.	Rev. No.	No. of Sheets
1)	Scheme of Absorber system	4410-109-POM-A-005	A	1
2)	Scheme of Limestone Milling system	4410-109-POM-A-006	A	1
3)	Scheme of Gypsum De-watering system	4410-109-POM-A-007	A	1

(C) 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 Enclosure, purging scheme, DP transmitter	0000-999-POI-A-036	1
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

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(D) ELECTRICAL

(1)	Electrical single line diagram for FGD Package	:	Drg No. 4410-109-POE-J-004
(2)	Ladder type Cable Tray	:	Drg No. 0000-211-POE-A-001
(3)	Perforated type Cable Tray	:	Drg No. 0000-211-POE-A-002
(4)	Cable tray details Horizontal TEE	:	Drg No. 0000-211-POE-A-004
(5)	Cable tray 90 bends	:	Drg No. 0000-211-POE-A-005
(6)	Cable Tray 90 Vertical elbow (outside) 90 vertical elbow (inside)	:	Drg No. 0000-211-POE-A-006
(7)	Cable tray details cross	:	Drg No. 0000-211-POE-A-008
(8)	C1 & C2 Channel, Cable Tray Support System	:	Drg No. 0000-211-POE-A-013
(9)	Typical Details of Cable Tray Support System	:	Drg No. 0000-211-POE-A-014
(10)	Typical Details of Cable Tray Support System	:	Drg No. 0000-211-POE-A-015
(11)	Cantilever Arms	:	Drg No. 0000-211-POE-A-016
(12)	Typical Details of Cable Tray Support System	:	Drg No. 0000-211-POE-A-017
(13)	Typical Details of Cable Tray Support System	:	Drg No. 0000-211-POE-A-018
(14)	Fixing of Channel in Trench Wall	:	Drg No. 0000-211-POE-A-019
(15)	Bracket Floor Plate Light Duty	:	Drg No. 0000-211-POE-A-020
(16)	Bracket Floor Plate Heavy Duty	:	Drg No. 0000-211-POE-A-021
(17)	Bracket C1 Channel Clamp Heavy Duty & Bracket C2 Channel	:	Drg No. 0000-211-POE-A-022
(18)	Fixing of channel for trestle and trestle Bracket	:	Drg No. 0000-211-POE-A-022A
(19)	Bracket Right Angle & Bracket Right Angle Heavy Duty	:	Drg No. 0000-211-POE-A-023
(20)	Beam Clamp	:	Drg No. 0000-211-POE-A-024

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(21)	Bracket C1 Channel Clamp	:	Drg No. 0000-211-POE-A-025
(22)	Bracket Beam Clamp	:	Drg No. 0000-211-POE-A-026
(23)	Standard cable support assembly	:	Drg No. 0000-211-POE-A-030
(24)	Standard cable support assembly	:	Drg No. 0000-211-POE-A-031
(25)	Standard cable support assembly	:	Drg No. 0000-211-POE-A-032
(26)	Standard cable support assembly	:	Drg No. 0000-211-POE-A-033
(27)	Standard cable support assembly	:	Drg No. 0000-211-POE-A-034
(28)	Standard cable support assembly	:	Drg No. 0000-211-POE-A-035
(29)	Typical interconnection details between two perpendicular trestles	:	Drg No. 0000-211-POE-A-035A
(30)	Typical details of structure for testing:		Drg No. 0000-211-POE-A-036
(31)	Typical details of structure for testing:		Drg No. 0000-211-POE-A-037
(32)	Typical details of structure for testing:		Drg No. 0000-211-POE-A-039
(33)	Typical drawing for junction box	:	Drg No. 0000-211-POE-A-040
(34)	Earthing details	:	Drg No. 0000-211-POE-A-041
(35)	Earthing details	:	Drg No. 0000-211-POE-A-042
(36)	Earthing details	:	Drg No. 0000-211-POE-A-043
(37)	Earthing details	:	Drg No. 0000-211-POE-A-044
(38)	Earthing details	:	Drg No. 0000-211-POE-A-045
(39)	Lightning Protection details	:	Drg No. 0000-211-POE-A-047
(40)	Lightning Protection details	:	Drg No. 0000-211-POE-A-048
(41)	Adaptor box for LT cables	:	Drg No. 0000-211-POE-A-048A
(42)	Buried cable trench details for lighitng:		Drg No. 0000-211-POE-A-049
(43)	Buried cable trenches for HT and LT cables	:	Drg No. 0000-211-POE-A-050
(44)	Typical Section of Cable Tray Arrangement in Trestle	:	Drg No. 9591-999-POE-J-004
(45)	MV busduct support structure types	:	Drg No. 0000-000-207-E-002
(46)	Interfacing of Actuators	:	Drg No. 0000-999-POI-A-063

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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

4.01.01 **Provennesscriteria 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:

4.01.02 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:

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

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Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating
(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

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.

The provenness criteria for equipment (Booster Fans) stipulated at Sl. No. 4.01.02(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.

4.01.03 In case the Bidder or the proposed sub-vendor is not manufacturer of proven Booster Fans as per clause 1.2(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

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	equipment in India with such manufacturer who meet the requirements stipulated at clause 4.01.02(a) above for the Booster Fans.
4.01.04	A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.01.02 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 4.01.02 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). However, in this case, the proposed JV / Subsidiary Company before resorting to design, engineering, manufacturing of such proven equipment(s) listed at clause no. 4.01.02 above by himself should have sourced / shall source such proven equipment(s) for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units 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. In addition, the Bidder along with the Indian Joint Venture Company/ Subsidiary Company, qualified equipment manufacturers and its holding/ subsidiary Company, as applicable, 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 a particular equipment. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 1.5 Million (Indian Rupees One and Half Million only) for each equipment.
4.01.05	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Oxidation Blowers as per clause 4.01.02(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 4.01.02(c) above for the Oxidation Blowers. However, in this case, Bidder or the proposed sub-vendor before resorting to design, engineering, manufacturing of such proven equipment by himself should have sourced / shall source such proven equipment for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units 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.

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	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 Oxidation Blowers. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 1.5 Million (Indian Rupees One and Half Million only).
4.01.06	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Wet limestone Grinding mills as per clause 4.01.02(d) above but is a manufacturer 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 4.01.02(d) above for the Wet limestone Grinding mills. However, in this case, Bidder or the proposed sub-vendor before resorting to design, engineering, manufacturing of such proven equipment by himself should have sourced / shall source such proven equipment for at least the first660 MW unit completely from such qualified manufacturer. For subsequent units 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 Bidderalong 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 1.5 Million (Indian Rupees One and Half Million only).
4.01.07	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Agitators as per clause 4.01.02(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 4.01.02(f) above for the Agitators. However, in this case, Bidder or the proposed sub-vendor before resorting to design, engineering, manufacturing of such proven equipment by himself should have sourced / shall source such proven equipment for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units 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 Bidderalong with the qualified equipment manufacturer shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the

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	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 Agitators. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 1.5 Million (Indian Rupees One and Half Million only).
4.01.08	In case the Bidder or the proposed sub-vendor is a manufacturer of Slurry Pumps who meets the requirements stipulated at clause 4.01.02(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 4.01.02(e) above for the Slurry Recirculation Pumps. However, in this case, Bidder or the proposed sub-vendor before resorting to design, engineering, manufacturing of such proven equipment by himself should have sourced / shall source such proven equipment for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units 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. In addition, the Bidderalong 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 Slurry Recirculation Pumps. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 1.5 Million (Indian Rupees One and Half Million only).
4.01.09	Before taking up the manufacturing of such equipment(s) as per clause 4.01.03, 4.01.04,4.01.05,4.01.06, 4.01.07 & 4.01.08 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.
4.01.10	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.
4.01.11	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.

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	Note to clause 4.01.02 (1) Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown 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.
4.02.03	For Chimney, Bidder or its agency should have in the past built atleast one (1) reinforced concrete chimney of minimum 100m height.
4.02.04	In case Bidder or its agency do not meet the requirements at 2.1 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. 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: (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. (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. (iii) Machine foundations such as Mill foundations/ Block foundations.

CLAUSE NO.	INTENT OF SPECIFICATION
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. 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**
4.03.01.1	**BOOSTER FAN MOTOR** 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.
4.03.02	**LT SWITCHGEAR**
4.03.02.1	**ROUTE 1**
4.03.02.1(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.
4.03.02.1(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.
4.03.02.2	**ROUTE 2**
4.03.02.2(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

CLAUSE NO.	INTENT OF SPECIFICATION
	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.
4.03.02.2(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.
4.03.02.2(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 furnish an on-demand Bank Guarantee for **INR** 1 **Million** (Indian Rupees One Million only). 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** **Route 1**
4.03.03.1	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.
4.03.03.2	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.

CLAUSE NO.	INTENT OF SPECIFICATION
4.03.03.3	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. **Route 2** Bidder/ Sub Vendor based on technological support of its Associate or Collaborator, can also participate provided
4.03.03.4	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.
4.03.03.5	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.
4.03.03.6	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.
4.03.03.7	Bidder's/ Sub Vendor's Associate or Collaborator meets the qualifying requirement stipulated at 4.03.03.2 & 4.03.03.3 stipulated under Route 1.
4.03.03.8	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). **Note:** Equipment designed by the Bidder itself or through its Collaborator/Associate for reference plant, shall also be considered meeting the requirement of design.

CLAUSE NO.	INTENT OF SPECIFICATION
4.03.04	**NUMERICAL RELAYS & NETWORKING**
4.03.04.1	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.
4.03.04.2	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**
4.03.05.1	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. **And**
4.03.05.2	Bidder/ Sub-Vendor should have his own facilities for conducting all routine and type tests as per IS: 2026 (except short circuit test). **And**
4.03.05.3	16 MVA, 11 KV Class or higher rated oil filled transformer manufactured by Bidder/ Sub-Vendor should have been successfully short circuit tested. **Note**: i) Two different installations mean two different project sites or two different contracts. 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	**Balance equipments/ systems** The Bidder at his option can source the balance of plant equipment/systems not covered in clause 4.01.00 & 4.02.00 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.

CLAUSE NO.	INTENT OF SPECIFICATION
4.05.00	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.
4.06.00	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

CLAUSE NO.	PROJECT INFORMATION

1.00.00 **BACKGROUND**

North Karanpura Super Thermal Power Project (3x660 MW), a pit head coal based thermal power project, is located in Hazaribagh and Chatra districts of Jharkhand State. Basic inputs i.e. coal, water and land have already been tied up. The project is proposed for the States & Union Territories of Northern, Western and Eastern Regions and the State of Jharkhand.

The capacity of the project is 1980 MW comprising of three (3) units of 660 MW each.

1.01.00 **Location and Approach**

The power project is proposed to be located near Tandwa town in Chatra districts in the state of Jharkhand on Hazaribagh-Chatra State highway at a distance of about 50 kms from Hazaribagh city. The nearest commercial airport is Ranchi at a distance of 100 kms from project site. The nearest railhead Khalari Railway Station on Ranchi-Garhwa section of Eastern Railways is about 25 kms from project site.

Major rail/road distances from the project site are as under:

City		Distance Approx. (kms)
Ranchi	:	80
Khalari	:	25

The site is located near Tandwa town having latitude and longitude of about 23^0 50' N to 23º 52' N and 84^0 59' E to 85º 2' E respectively. The Vicinity Plan of the project is placed at **Annexure-I.**

Further to the information given in this sub-section, Bidders are also advised to visit the project site and collect data on local site conditions.

1.02.00 **Land**

The plant layout was readjusted and total land requirement was reduced from 2330 acres to about 970 acres. Out of 2277 acres of land the plant, ash dyke and transit camp is being suitably adjusted. No additional land is envisaged to be acquired in plant area. About 15 acres of land is envisaged to be acquired in Hazaribagh city for Township. Commissioner, Chatra vide dated 25.05.1999 and 14.06.2000 has given in-principle clearance for NKSTPP.

1.03.00 **Water**

Make up water requirement for this project would be about 20 cusec. Make up water requirement shall be met by raw water reservoir. Intake water pumps shall pump water to reservoir during the rainy season only from Garhi barrage.

1.04.00 **Fuel (Coal)**

1.04.01 **Coal Requirement, Availability and Linkage**

Coal requirement for the project is estimated as 10.60 Million Tonne/Annum (MTPA), considering a GCV of 3800 kcal/kg. Ministry of Coal vide letter dated 21.10.99 accorded inprinciple coal linkage of 10.00 MTPA subject to ratification by Standing Linkage Committee-Long Term (SLC (LT)), of MOC. SLC (LT) in its meeting held on 15.12.2000 firmed up the

coal linkage of 10.24 MTPA for the project. Subsequently, the coal linkage was withdrawn by SLC (LT) in its meeting held on 22/23.10.08.

Cabinet Committee on Investment (GOI) in its meeting on 20.02.13 decided in-principle to restore the original coal linkage granted to NKSTPP (i.e. from Magadh Coal Block) with the stipulation that the coal supply will commence during the 13th Five Year Plan. Ministry of Power has already taken up the matter of coal linkage restoration with Ministry of Coal vide dated 12.04.2013.

1.04.02 **Coal Transportation**

Coal from Magadh block of North Karanpura Coalfields is proposed to be transported to the project site through conveyor belt system. Parallel double stream Conventional troughed conveyors of 3000 MTPH rated capacity are envisaged for external coal handling plant. It is proposed to have one internal coal handling plant of 3000 MTPH rated capacity.

1.05.00 **Meteorological Data**

Important meteorological data from nearest observatory at Hazaribag is placed at Annexure-II**.**

1.06.00 **Plant Water Scheme**

The Plant water scheme is described below.

1.06.01 **Equipment Cooling Water (ECW) System (Unit Auxiliaries)**

All plant auxiliaries shall be cooled by De-mineralized water (DM) in a closed circuit. The primary circuit DM water shall be cooled through heat exchangers by Circulating Water tapped from CW system in a closed secondary circuit. The hot secondary circuit cooling water shall be cooled in the cooling towers and shall be returned back to the system.

1.06.02 **Ash Water System**

It is proposed to have HCSD (High concentration Slurry Disposal) system for combined fly ash and bottom ash. No recirculation of ash water from ash disposal area is envisaged.

1.06.03 **Other Miscellaneous Water Systems**

(a) The service water shall be taken from clarified water tank of Pretreatment plant. Service water (wash water) collected from various areas shall be treated using oil water separators, tube settlers, coal settling pits etc. as per requirement and treated water from liquid effluent treatment plant shall be recycled back to the service water system for re-use.

(b) The drinking water requirement of the plant shall be provided from water treatment plant.

(c) Steam Cycle make-up water, makeup to the primary circuit of ECW (unit auxiliaries) system, boiler fill water and makeup to the hydrogen generation plant shall be provided from Demineralising plant.

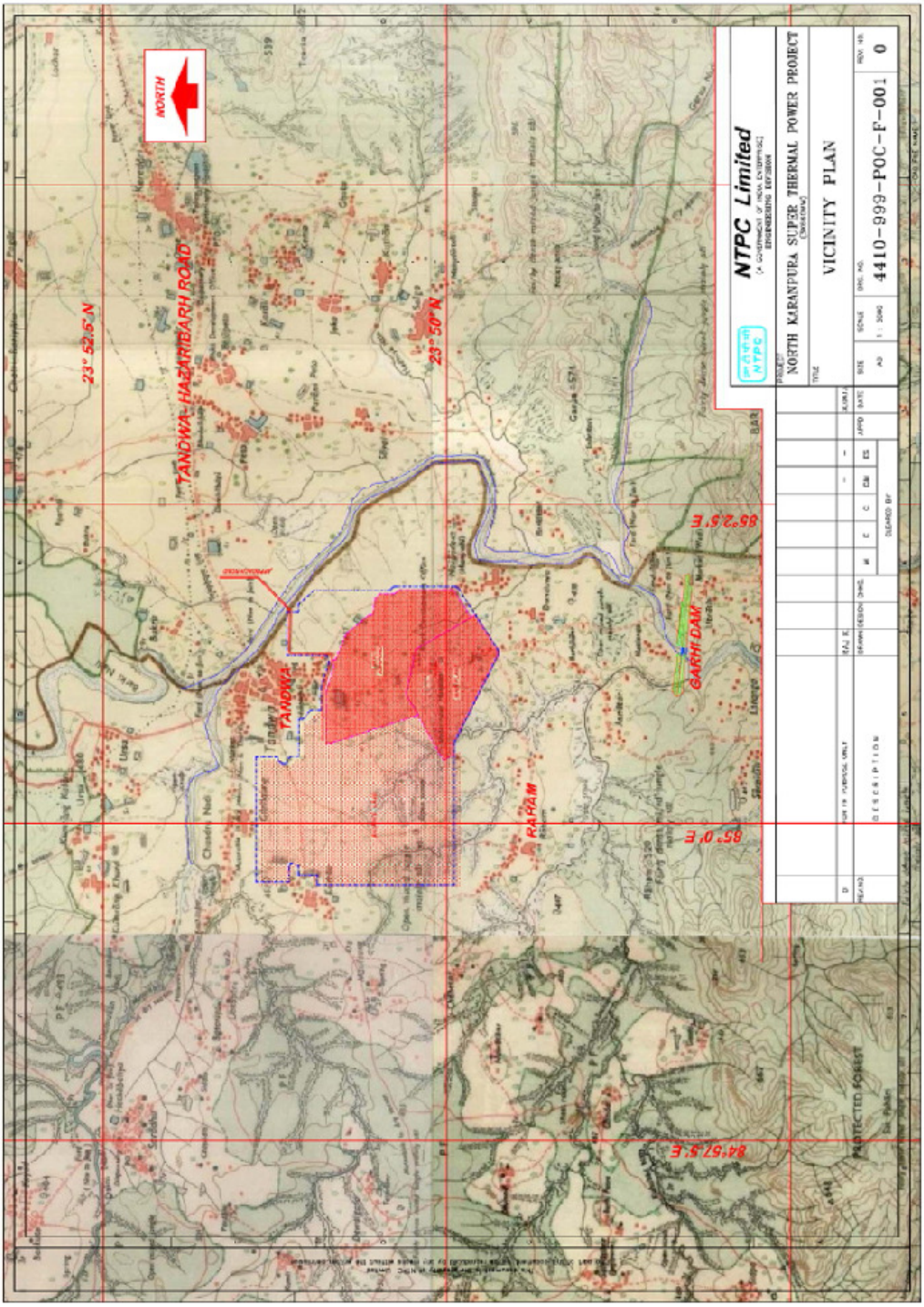
(d) The quality of Raw water is enclosed with this sub-section as Annexure-III.

CLAUSE NO.	PROJECT INFORMATION
1.07.00	**Criteria for Earthquake Resistant Design of Structures and Equipment** All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed for seismic forces as given in the Part - B of this section.
1.08.00	**Criteria for Wind Resistant Design of Structures and Equipment** All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in Part B of this section.

CLAUSE NO.	PROJECT INFORMATION

ANNEXURE – I

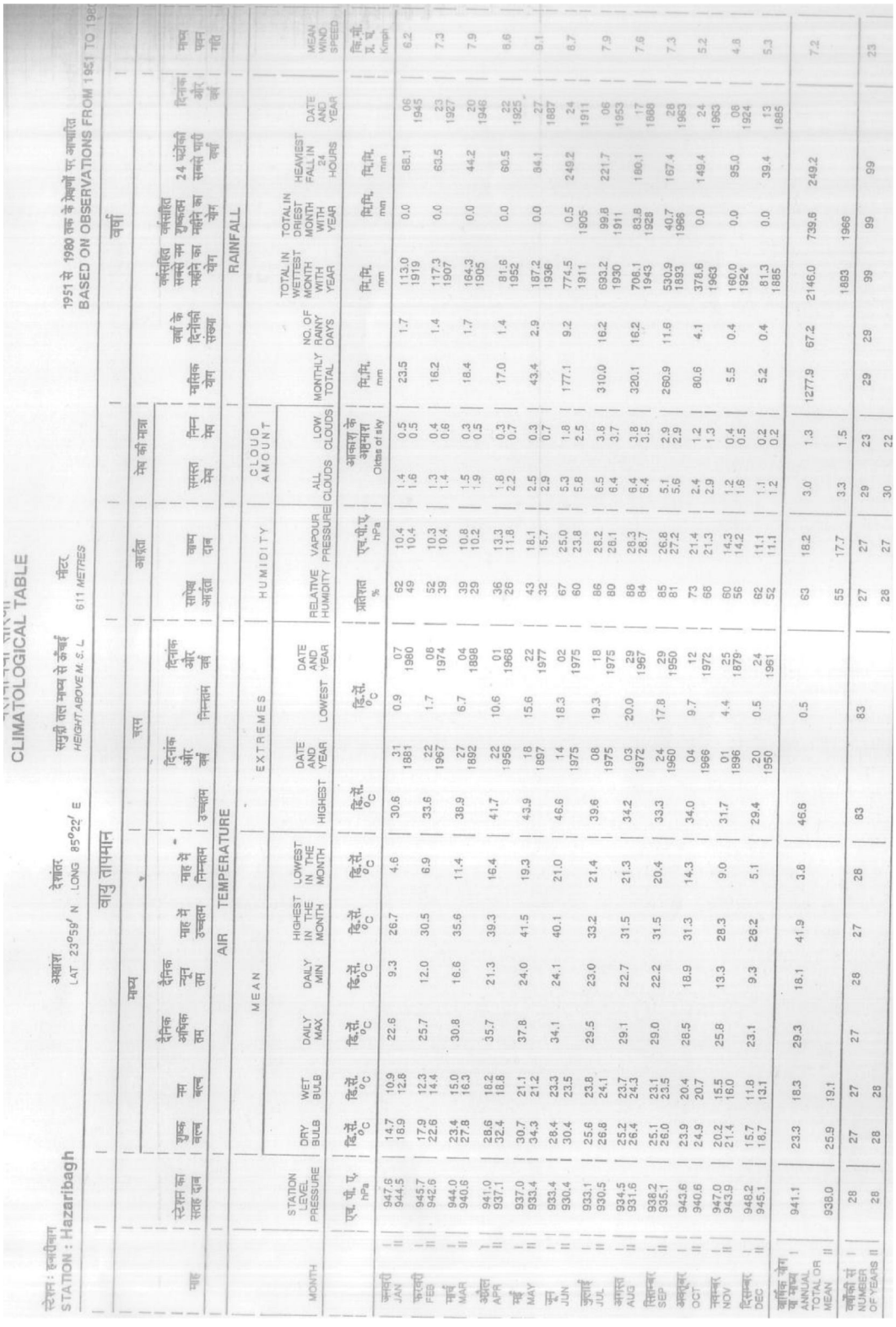
VICINITY PLAN



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ANNEXURE – II

CLIMATOLOGICAL TABLE



CLIMATOLOGICAL TABLE

स्टेशन : हजारीबाग STATION : Hazaribagh

अक्षांश LAT 23°59′ N देशांतर LONG 85°22′ E समुद्री तल सतह से ऊँचाई HEIGHT ABOVE M. S. L 611 METRES मीटर.

1951 से 1980 तक के रेकार्डों पर आधारित BASED ON OBSERVATIONS FROM 1951 TO 1980

माह MONTH		स्टेशन का सतह दाब STATION LEVEL PRESSURE	वायु तापमान AIR TEMPERATURE																				वर्षा RAINFALL						
			शुष्क बल्ब DRY BULB	नम बल्ब WET BULB	माध्य दैनिक अधिकतम MEAN DAILY MAX	माध्य दैनिक न्यूनतम MEAN DAILY MIN	माह में उच्चतम HIGHEST IN THE MONTH	माह में निम्नतम LOWEST IN THE MONTH	चरम EXTREMES उच्चतम HIGHEST	दिनांक और वर्ष DATE AND YEAR	चरम EXTREMES निम्नतम LOWEST	दिनांक और वर्ष DATE AND YEAR	आर्द्रता HUMIDITY सापेक्ष आर्द्रता RELATIVE HUMIDITY	वाष्प दाब VAPOUR PRESSURE	मेघ की मात्रा CLOUD AMOUNT समस्त मेघ ALL CLOUDS	निम्न मेघ LOW CLOUDS	मासिक योग MONTHLY TOTAL	वर्षा के दिनों की संख्या NO. OF RAINY DAYS	वर्षित सबसे नम महीने का योग TOTAL IN WETTEST MONTH WITH YEAR	वर्षित सबसे शुष्कतम महीने का योग TOTAL IN DRIEST MONTH WITH YEAR	24 घंटों की सबसे भारी वर्षा HEAVIEST FALL IN 24 HOURS	दिनांक और वर्ष DATE AND YEAR	माध्य वायु गति MEAN WIND SPEED
		एच. पी. ए. hPa	कि.से. °C	कि.से. °C	कि.से. °C	कि.से. °C	कि.से. °C	कि.से. °C	कि.से. °C		कि.से. °C		प्रतिशत %	एच.पी.ए. hPa	आकाश के अष्टमांश Oktas of sky		मि.मि. mm		मि.मि. mm	मि.मि. mm	मि.मि. mm		कि.मी. प्र. घं. Kmph	
जनवरी JAN	I	947.6	14.7	10.9	22.6	9.3	26.7	4.6	30.6	31 1881	0.9	07 1980	62	10.4	1.4	0.5	23.5	1.7	113.0 1919	0.0	68.1	06 1945	6.2	
	II	944.5	18.9	12.8									49	10.4	1.6	0.5								
फरवरी FEB	I	945.7	17.9	12.3	25.7	12.0	30.5	6.9	33.6	22 1967	1.7	06 1974	52	10.3	1.3	0.4	16.2	1.4	117.3 1907	0.0	63.5	23 1927	7.3	
	II	942.6	22.6	14.4									39	10.4	1.4	0.6								
मार्च MAR	I	944.0	23.4	15.0	30.8	16.6	35.6	11.4	38.9	27 1892	6.7	04 1898	39	10.8	1.5	0.3	18.4	1.7	164.3 1905	0.0	44.2	20 1946	7.9	
	II	940.6	27.8	16.3									29	10.2	1.9	0.5								
अप्रैल APR	I	941.0	28.6	18.2	35.7	21.3	39.3	16.4	41.7	22 1956	10.6	01 1968	36	13.3	1.8	0.3	17.0	1.4	81.6 1952	0.0	60.5	22 1925	8.6	
	II	937.1	32.4	18.8									26	11.8	2.2	0.7								
मई MAY	I	937.0	30.7	21.1	37.8	24.0	41.5	19.3	43.9	18 1897	15.6	22 1977	43	18.1	2.5	0.3	43.4	2.9	187.2 1936	0.0	84.1	27 1887	9.1	
	II	933.4	34.3	21.2									32	15.7	2.9	0.7								
जून JUN	I	933.4	28.4	23.3	34.1	24.1	40.1	21.0	46.6	14 1975	18.3	02 1975	67	25.0	5.3	1.8	177.1	9.2	774.5 1911	0.5 1905	249.2	24 1911	8.7	
	II	930.4	30.4	23.5									60	23.8	5.8	2.5								
जुलाई JUL	I	933.1	25.6	23.8	29.5	23.0	33.2	21.4	39.6	08 1975	19.3	18 1975	86	28.2	6.5	3.8	310.0	16.2	693.2 1930	99.8 1911	221.7	06 1953	7.9	
	II	930.5	26.8	24.1									80	28.1	6.4	3.7								
अगस्त AUG	I	934.5	25.2	23.7	29.1	22.7	31.5	21.3	34.2	03 1972	20.0	29 1967	88	28.3	6.4	3.8	320.1	16.2	706.1 1943	83.8 1928	190.1	17 1888	7.6	
	II	931.6	26.4	24.3									84	28.7	6.4	3.5								
सितम्बर SEP	I	938.2	25.1	23.1	29.0	22.2	31.5	20.4	33.3	24 1960	17.8	29 1950	85	26.8	5.1	2.9	260.9	11.6	530.9 1893	40.7 1966	167.4	28 1963	7.3	
	II	935.1	26.0	23.5									81	27.2	5.6	2.9								
अक्तूबर OCT	I	943.6	23.9	20.4	28.5	18.9	31.3	14.3	34.0	04 1966	9.7	12 1972	73	21.4	2.4	1.2	80.6	4.1	378.6 1963	0.0	149.4	24 1963	5.2	
	II	940.6	24.9	20.7									68	21.3	2.9	1.3								
नवम्बर NOV	I	947.0	20.2	15.5	25.8	13.3	28.3	9.0	31.7	01 1896	4.4	25 1879	60	14.3	1.2	0.4	5.5	0.4	160.0 1924	0.0	95.0	06 1924	4.8	
	II	943.9	21.4	16.0									56	14.2	1.6	0.5								
दिसम्बर DEC	I	948.2	15.7	11.8	23.1	9.3	28.2	5.1	29.4	20 1950	0.5	24 1961	82	11.1	1.1	0.2	5.2	0.4	81.3 1885	0.0	39.4	13 1885	5.3	
	II	945.1	18.7	13.1									52	11.1	1.2	0.2								
वार्षिक जोड़ या वार्षिक माध्य ANNUAL TOTAL OR MEAN	I	941.1	23.3	18.3	29.3	18.1	41.9	3.8	46.6		0.5		63	18.2	3.0	1.3	1277.9	67.2	2146.0	739.6	249.2		7.2	
	II	938.0	25.9	19.1									55	17.7	3.3	1.5			1893	1966				
वर्षों की संख्या NUMBER OF YEARS	I	28	27	27	27	28	27	28	83		83		27	27	29	23	29	29	99	99	99		23	
	II	28	28	28									28	27	30	22								

CLAUSE NO.	PROJECT INFORMATION	एनटीपीसी NTPC

ANNEXURE-III

RAW WATER ANALYSIS

Sl. No.	Constituent	as	mg per litre
1.	Calcium	CaCO3	65
2.	Magnesium	CaCO3	41
3.	Sodium	CaCO3	98
4.	Potassium	CaCO3	5
5.	Total Cations	CaCO3	209
6.	Total Alkalinity	CaCO3	150
7.	Chloride	CaCO3	25
8.	Sulphate	CaCO3	34
9.	Total Anions	CaCO3	209
9.	Silica (Reactive)	SiO2	9
11.	Iron	Fe	1.2
12.	pH Value	-	7.6-8.2
13.	Turbidity	NTU	200
14.	Organics(As per $KMnO_4$ method)	Number	2

CLARIFIED WATER ANALYSIS

Sl. No.	Constituent	Value	Unit
1	Iron	<0.3	mg/L as Fe
2	Turbidity	<10	NTU
3	Organics (as per $KMnO_4$ method)	<0.05	mg/L
4	Gravity Filter Outlet (Effluent Turbidity)	<2	NTU
5	Gravity Filter Inlet (Turbidity)	10	NTU

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ANNEXURE-IV-1

TABLE-1
LIGHT DIESEL OIL CHARACTERISTICS
(AS PER IS 15770-2008)

	Characteristics	LDO
1.	Pour Point (max)	21 ℃ & 12℃ for Summer and Winter respectively
2.	Kinematic viscosity in centistokes at 40 deg.C	2.5 to 15.0
3.	Sediment percent by mass (max)	0.10
4.	Total sulphur percent by mass (max)	1.5
5.	Ash percentage by mass (max)	0.02
6.	Carbon residue (Rams bottom) percent by pass (max.)	1.50
7.	Acidity inorganic	Nil
8.	Flash point (Min.) -Pensky Martens	66 deg.C
9.	Copper strip corrosion for 3 hours at 100℃	Not worse than No. 2
10.	Water content, % by volume (max)	0.25
11.	GCV(kcal/kg)	10,000

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TABLE-2 **ANNEXURE-IV-2**

HIGH SPEED DIESEL OIL CHARACTERISTICS

[AS PER IS **1460-2005 (BS-II)**]

S. No.	Particulars	Unit	Value
1.	PHYSICAL PROPERTIES		
	a. Distillation volume recovery @ 350^0C	% vol. (min)	85
	b. Distillation volume recovery @ 370^0C	% vol. (min)	95
	c. Kinematic Viscosity @ 40 Degree C	cSt	2.0 – 5.0
	d. Density @ 15 Degree C	kg/m^3	820 – 860
	e. Pour Point		
	- Summer	Degree C (max)	15
	- Winter	Degree C (max)	03
	f. Cold Filter Plugging Point		
	- Summer	Degree C (max)	18
	- Winter	Degree C (max)	06
	g. Flash Point (Abal)	Degree C (max)	35
	h. Lubricity WSD 1.4 @ 60 Degree C	Microns (max)	460
2.	HEATING VALUE		
	a. Higher Heating Value (HHV)	Kcal/Kg	11,000
	b. Lower Heating Value (LHV)	Kcal/Kg	10,300
3.	ACIDITY		
	a. Inorganic	mg KOH/g	Nil
	b. Total	mg KOH/g	0.2 (max.)
4.	Copper Strip Corrosion 3 hours @100^0C	No.	1 (max)
5.	RCR on 10% residue	% wt.	0.3 (max)
6.	CONTAMINANTS		
	a. Ash	ppm (wt.)	100 (max)
	b. Sediments	% wt	0.05 (max)
	c. Total Sulphur	% wt	0.05 (max)
	d. Water Content	% volume	0.05 (max)
	e. Trace Metals		
	- Na + K	ppm (wt)	0.30 (max)
	- Vanadium	ppm (wt)	0.50 (max)
	- Lead	ppm (wt)	0.50 (max)
	- Calcium	ppm (wt)	2.0
	- Ni + Zn	ppm (wt)	Nil
7.	Nitrogen content (FBN)	% wt.	0.015

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TABLE-3

ANNEXURE-IV-3

PROPOSED COAL CHARACTERISTICS FOR NORTH KARANPURA STPP (3 x 660 MW)

S.No.	Characteristics (as received basis)	Range of 95 % coal supplies			Range of 5 % coal supplies
		Column - 1	Column - 2	Column - 3	
1.0	PROXIMATE ANALYSIS	Design	Worst	Best	
1.1	Total Moisture (%)	15	18	12	12-18
1.2	Ash (%)	40	46	36	33-46
1.3	Volatile Matter (%)	19	18	22	23-18
1.4	Fixed Carbon (%)	26	18	30	31-18
1.5	Total (%)	100	100	100	
2.0	ULTIMATE ANALYSIS				
2.1	Carbon (%)	29.73	23.08	37.32	40.62-23.08
2.2	Hydrogen (%)	3.7	3.54	3.92	4.02-3.54
2.3	Sulphur (%)	0.5	0.6	0.4	0.4-0.6
2.4	Nitrogen(%)	1.8	1.45	1.6	1.4-1.45
2.5	Oxygen(%)(By difference)	8.66	6.7	8.32	8.12-6.7
2.6	Carbonates (%)	0.58	0.6	0.4	0.4-0.6
2.7	Phosphorous(%)	0.03	0.03	0.04	0.04-0.03
2.8	Total Moisture (%)	15	18	12	12-18
2.9	Ash (%)	40	46	36	33-46
	Total	100	100	100	
2.10	GCV (Kcal/Kg)	3300	2800	4000	4300-2800
2.11	Hard Grove Index	55	50	60	50-65
3.0	ASH ANALYSIS				
3.1	Silica (%)	59.79	61.3	56.7	62-56
3.2	Alumina(%)	25.36	28	23.5	28-23
3.3	Iron Oxide (%)	7.2	6	10	6-10
3.4	Titania	1.2	1	1.5	1-1.7
3.5	Phophoric Anhydride (%)	2.6	1.5	3	1-3
3.6	Lime (%)	0.88	0.5	1.5	0.5-1.7
3.7	Magnesia (%)	0.55	0.4	1	0.4-1.1
3.8	Sulphuric Anhydride (%)	1.2	0.5	1.4	0.5-1.7
3.9	Alkalies (by difference)	1.22	0.8	1.4	0.6-1.8
	Total	100	100	100	
4.0	ASH FUSION RANGE				
	REDUCING ATMOSPHERE				
4.1	Initial Deformation Temp.(oC	1100	1100	1100	1100-1150
4.2	Hemispherical Temp. (oC)	1300	1250	1350	1250-1400
4.3	Fusion Temperature (oC)	1400	1400	1400	1400-1450

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ANNEXURE-IV-4

TABLE – 4

TYPICAL IMPORTED COAL AND ASH CHARACTERISTICS

Sl.No.	Characteristics (as received basis)	Imported Coal	
		Worst	Best
1.0	**Proximate Analysis**		
1.1	Total Moisture (%)	20	16
1.2	Ash (%)	10	10
1.3	Volatile Matter (%)	30	45
1.4	Fixed Carbon (%)	40	29
1.5	Total (%)	100	100
2.0	**Ultimate Analysis**		
2.1	Carbon (%)	56.4	62.4
2.2	Hydrogen (%)	4.5	4.9
2.3	Sulphur (%)	0.9	0.8
2.4	Nitrogen (%)	0.9	0.5
2.5	Oxygen (%) (By difference)	7.3	5.4
2.6	Carbonates (%)	0	0
2.7	Phosphorous (%)	0	0
2.8	Total Moisture (%)	20	16
2.9	Ash (%)	10	10
	Total	100	100
2.10	GCV (Kcal/Kg)	5800	6500
2.11	Hard Grove Index	45	60
2.12	YGP (mg/kg)	100	70
3.0	**Ash Analysis**		
3.1	Silica (SiO_2) (%)	32.74	34.94
3.2	Alumina(Al_2O_3) (%)	30.5	28.43
3.3	Iron Oxides(Fe_2O_3) (%)	18.2	15.2
3.4	Titania (TiO_2)	1.56	1.76
3.5	Phosphoric Anhydride(P_2O_5) (%)	0.44	0.54
3.6	Lime (CaO) (%)	6.12	7.62
3.7	Magnesia (MgO) (%)	1.83	1.93
3.8	Sulphuric Anhydride (%)	6.95	7.65
3.9	Sodium Oxide (Na_2O) (%)	0.3	0.4
3.10	Balance alkalies (by difference)	1.36	1.56
	Total	100	100
4.0	**Ash Fusion Temperature reducing temperature**		
4.1	Initial deformation Temp (°C)	1100	1250
4.2	Hemispherical Temp. (°C)	1300	1350
4.3	Flow Temp. (°C)	1400	1400

SUB-SECTION-III

SCOPE OF SUPPLY & SERVICES

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES

1.00.00 **SCOPE OF SUPPLY AND SERVICES**

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.

Sub-Section

III A	-	Mechanical equipment and associated systems
III B	-	Electrical Systems
III C	-	C&I systems
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**

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**

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. (ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns. (iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns. (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** 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.
1.07.00	**Guarantee Tests** 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** 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** 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 of such spars shall be deemed to be included in the contract price. The Bidder shall

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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** 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. 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

SUB-SECTION-III-A1	**FLUE GAS DESULPHURISATION SYSTEM**
SUB-SECTION-III-A2	**LIME STONE & GYPSUM HANDLING SYSTEM**
SUB-SECTION-III-A3	**PLANT UTILITIES**
SUB-SECTION-III-A4	**ECW SYSTEM**

SUB-SECTION-III-A1

FLUE GAS DESULPHURISATION SYSTEM

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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 three (3) number steam generators of 660 MW, as detailed in this specification. Steam generator (in Employer's scope) shall be super-critical, balance draft, dry bottom, pulverised coal fired type with steaming capacity of 2220 TPH at 100% BMCR. 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 and two (2) nos of Booster fans each unit shall be provided in downstream of ID fans capable of handling the pressure drop in the FGD system, ducting, Selective Catalytic Reactor (SCR) (in Employer's Scope) and maintain required chimney inlet pressure. Contractor shall provide a common limestone milling systems for the three (03) units and common gypsum dewatering system for the three (03) units. The contractor shall also supply an auxiliary absorbent tank, common for the three (03) 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 4410-109-POM-A-005/0006/007 (3 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.
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. Each FGD system shall be provided with separate Low height wet Stack.
2.02.00	Flue Gas from Boiler shall be tapped off to FGD system after ID fan outlet duct (terminal point indicated in the tender drawing). Bidder shall make opening in the existing duct at ID Fan outlet duct at the terminal point and connect to the booster fan inlet ducting. Flue gas from ID fan discharge to absorber inlet shall be taken through booster fan. Treated gas from absorber outlet duct shall be led to wet Stack. In the absorber, SO_2 in flue gas shall be removed by a spray of recirculating slurry,

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	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 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 stack through three stage mist eliminators. Treated flue gas from the absorber shall be discharged through a 150 m Low height wet stack in contractor's scope as envisaged in the specification. Provision shall be made for facilitating operation of unit with FGD bypass like bypass damper etc., This shall also facilitate the online maintenance of absorber system and associated equipments. Provision shall be made for isolation of the flue gas flow through the absorber and also for bypass of the absorber, to allow maintenance of the absorber with the unit in operation.
2.05.00	Limestone to the absorbers of the three (03) units shall be supplied by a wet limestone grinding system, common for the three (03) units. Limestone conveyor shall feed the Limestone day silos which in turn shall feed the Limestone wet ball mill through a gravimetric feeder. The classified limestone slurry from the mills shall be stored in two (02 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 three (03) absorbers 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. 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.
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 THREE (3) UNITS)**
3.01.00	The contractors scope shall include a common limestone grinding system for the Three (03) units and shall comprise of:
3.01.01	2X100% Limestone storage silos each having minimum 24 hours storage capacity equivalent to the requirements of 3x660MW. 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

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	total limestone requirement of three (03) 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 two units at Design point, complete with all accessories and Agitator(s).
3.01.04	2x100% limestone slurry pumps for each absorber connected to each of the limestone slurry tank (total 6 nos. of pumps for 3x660 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: i. A bunker outlet gate ii. A gravimetric limestone feeder along with its drive and all other auxiliaries iii. 1 no. separator tank with agitator(s). iv. 2x100% Mill circuit pump. v. 1 set of hydro-cyclone vi. A peripheral/central drive system with motor, speed reducer gearbox and other auxiliaries. vii. An auxiliary motor for inching operation with speed reducer. 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). 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

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	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.
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. (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. In such a case additional pressure drop (if required) shall be considered in the sizing of the two (2) nos. of Booster fans, which shall be provided by the Contractor downstream of the ID fans, for each unit, capable of handling the pressure drop in the FGD system & ducting & SCR (in employer scope) and maintain required chimney inlet pressure)
4.01.03	Complete Ducting System for FGD plant from the terminal points in the flue gas duct after ID fan discharge to Booster fan inlet to absorber tower & from absorber tower to ducts connecting to wet Stack. Guillotine gates shall be provided at the inlet & outlet of the each Booster fan. One (1) no FGD by pass gate shall be provided in the existing duct connecting to existing 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 / Compressors shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. All pumps & Oxidation blowers / Compressors 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 the two (2) units.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
	The common dewatering system shall receive the gypsum slurry from each absorber through slurry feed pipes and shall comprise of two (2) sets of dewatering equipments.
5.02.00	Each set (suitable for handling /dewatering of one unit) of dewatering equipment (01 working set + 01 standby set) shall comprise of the following items as a minimum requirement: i. One set of primary hydro-cyclones ii. One vacuum belt filter iii. One no. vacuum receiver iv. One no. vacuum pump v. One set of secondary hydro-cyclones vi. Complete piping and valves for the system along with wash water line.
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 3x660 MW units operating simultaneously at 100% BMCR, with any coal fired from the specified range of coals (whichever gives the maximum gypsum flow). 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 overflow from the primary set of hydro-cyclone shall be taken to a common Secondary hydrocyclone feed tank. 2x100% Secondary hydrocyclone 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.
5.06.01	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.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
6.00.00	**AUXILIARY ABSORBENT TANK**
6.01.00	The contractor shall provide a common auxiliary absorbent tank, common for the three (03) 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	**SUMP & SUMP PUMPS**
7.01.00	The contractor shall provide sumps of adequate capacity in each of the following area: A. Each Absorber Area B. Limestone Grinding system C. Gypsum dewatering system 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.
7.01.02	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.
8.00.00	**Elevator**
8.01.00	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.
8.02.00	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.
8.03.00	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.
8.04.00	Complete erection, testing and commissioning including all testing and commissioning materials, consumables and other tools and tackles required for erection.
8.05.00	To obtain necessary local administration permits / approvals and make arrangements for inspection and tests required thereby.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
9.00.00	**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.
AMDT 14 SL 17 PAGE 4 10.00.00	**Buildings**
10.01.00	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.
containerised room (portable cabin)/ analyser room for analysers.	
10.02.00	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.
11.00.00	Contractor shall provide Corrosion protection painting for structures & equipments as described in the specification
12.00.00	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.
13.00.00	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.
14.00.00	The scope of civil works shall be as per Sub-Section-III D.
15.00.00	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.
16.00.00	**Booster Fan & Isolation Gates**
16.01.00	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 (1) 2x100% oil pumps each with motor, coupling and coupling guard. (2) 2x100% oil coolers. (3) 2x100% filters, differential pressure switches, etc. (4) One (1) oil storage tank. (5) Instrumentation, vibration monitoring, inter connected piping, valves and fittings including pressure relief valves and non return valves.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
	(6) Electrical actuator with accessories etc. 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. At least two (02) nos. of duplex thermocouples or duplex platinum RTDs (100 ohm at 0°C) and one no. of temperature indicators shall be provided for bearing metal temperature measurement, control and monitoring. Booster fans shall be suitable for the type of foundation being provided.
16.02.00	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.
17.00.00	Contractor shall provide separate air receivers of adequate capacity for meeting the instrument and service air requirements. In case higher pressure/flow requirements are envisaged for instrument & service air Contractor shall make its own arrangement.
18.00.00	**Wet Stack Condensate Collection System**
18.00.01	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.
18.00.02	Drain piping shall be of suitable material from corrosion point of view.
18.00.03	All Stack liquid collection shall be easily accessible for O&M.
18.00.04	The design of the stack condensate collection system shall be provided by the bidders in its bid.
18.00.05	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.
18.00.06	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

LIME STONE & GYPSUM HANDLING SYSTEM

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES

1.00.00 SYSTEM DESCRIPTION

1.01.00 LIMESTONE HANDLING PLANT

This shall be read in conjunction with Limestone Flow Diagram and the Limestone layout enclosed elsewhere in the specification.

ROM Limestone of (-) 250 mm size shall be delivered to North Karanpura power plant by trucks. The Limestone shall be unloaded in underground RCC hoppers by means of self-tippling trucks and shall be conveyed though a series of conveyors for further crushing, conveying/storage etc. Alternatively, Bidder may provide complete Truck unloading system comprising of of Bulk material receiving unit and Surface feeder.

(i) Two (2) no. Truck Hoppers (TH-1 &2) each having 60 Ton capacity along with apron feeders (AF-1 & AF-2) shall be provided to unload limestone from self tippling trucks. Apron feeders receiving Limestone from TH-1, TH-2, shall drop coal on to conveyors 1 A/B .Each Apron feeder shall be of 75 MTPH rated capacity. The rated capacity of conveyor 1A/B shall be 150 MTPH.

Alternatively two numbers bulk receiving unit along with surface feeders etc. each rated for 75TPH capacity shall be provided. The feeders shall feed to conveyor 1A/B located at ground level.

(ii) Conveyors 1 A/B shall feed to Limestone to Crusher house via Pent House (if applicable). Suspended magnets (SM-A, SM-B) shall be provided on Conveyors 1 A/B at Pent House for removal of tramp Iron pieces. Metal detectors MD-1 and MD-2 shall be provided on Conveyors 1A/1B to detect non-magnetic metallic materials present in the “as received” limestone. Two (2) numbers Belt Scale (BS-1& BS-2) shall also be provided, one on each Conveyor 1A and 1B for measurement of Limestone flow rate. Inline magnetic separators (ILMS-1 & ILMS-2) shall be mounted at the discharge end of Conveyor 1A/1B to remove tramp iron pieces. Limestone sampling unit (LSU) shall be provided to sample the limestone of (-) 250mm size. Further, a passenger cum goods elevator (EL) as specified elsewhere shall also be provided.

(iii) In Crusher house, Limestone from incoming Conveyor 1A will pass through dedicated Vibrating Feeder (VF-1) and dedicated Crushers (CR-1). Similarly Limestone from incoming Conveyor 2B will pass through dedicated Vibrating Screening Feeders (VF-2) and dedicated Crushers (CR-2) respectively. Each dedicated stream shall have a set of Rod gate and Rack & Pinion Gate before Vibrating Feeder. The dedicated Limestone flow stream shall permit maintenance of equipment, hoppers and chutes in one stream without affecting the operation of other stream.

(iv) Each Vibrating Feeder shall be of 150TPH rated capacity. Each crusher shall be of 150 MTPH rated capacity which shall crush limestone to (-) 20mm size.

Crushed limestone shall drop on Conveyor 2A/B.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
	(v) Conveyor 2A shall feed limestone to Stacking conveyor 3A or Conveyor 5A at Junction House (JH-1). Conveyor 2B shall feed limestone to Stacking conveyor 3B or Conveyor 5B at Junction House (JH-1). (i) Stacking Conveyor 3A/B will drop limestone to overground storage hopper provided within a shed via travelling trippers. One (1) number Traveling Tripper is mounted on each of the Stacking Conveyor 3A/B. The storage Capacity of Limestone Storage hopper shall be sufficient to store Limestone for minimum 10 days consumption considering all units at full load. (vi) Two (2) number paddle feeders (PF-1, PF-2), each of 150 MTPH rated capacity shall be installed below ground to reclaim the stored limestone and feed to underground conveyors 4A/B. Conveyor 4A/B shall drop limestone on to Conveyor 5A/B at Crusher house. (vii) Conveyors 5A/B shall drop limestone in to Limestone Silos of FGD System through fixed Tripper on the first silo in the path. Alternatively diverter Plough is also acceptable in place of fixed tripper.
1.02.00	**GYPSUM HANDLING PLANT** (ii) Dewatered Gypsum discharged from the vacuum belt filter shall be taken by Conveyor 6A/B to the storage shed. The storage shed shall be sufficient to store gypsum equivalent to gypsum generation of minimum 7 days (Generation of all three units to be considered). (iii) One number of motorized travelling tripper on each of conveyor 6A/B shall drop the gypsum to the storage shed. (iv) A truck loading bay shall be provided for loading the Gypsum to user's truck by employer.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
2.00.00	**DETAILED SCOPE**
2.01.00	**LIMESTONE HANDLING PLANT**
2.01.01	Two (2) numbers Truck unloading system for unloading of limestone from trucks complete with drives, accessories all mechanical, electrical civil & structural works, including enclosure for dust containment during unloading. The truck unloading system shall comprise of either of the following (a) Two number underground RCC Truck hoppers (TH1 & TH2), each of 60 ton capacity, along with access ramp for trucks, grating, dust enclosure etc. Clear access shall be provided for movement of pay loaders/ bulldozers on the paved area and on the hopper grating in order to remove the oversized limestone. Gratings with 300mm X 300mm clear openings over unloading hopper shall be placed and designed accordingly. (b) Two number bulk receiving units for ROM Limestone of size (-)250 mm each rated for 75TPH along with access ramp as required, receiving hoppers/box feeder/surface feeder, dust enclosure etc. The units shall be complete with drives, accessories all mechanical, electrical civil & structural works
2.01.02	Two (2) nos. Apron Feeders along with dribble conveyor complete with drives including all accessories, electricals, supporting structures, approach/ maintenance platform and associated civil & structural works etc. (Apron Feeders along with Dribble conveyors shall not be applicable in case Bidder opts Option b above)
2.01.03	Conveyor 1A/B complete with tunnel, pent house, conveyor galleries, conveyor 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 and zero speed switches, electro-hydraulic thruster brakes, all electrical etc. including all civil, structural and architectural works for conveyor gallery, gallery supporting trestles and their associated foundations. (Tunnels along with Pent house shall not be applicable in case Bidder opts Option b, however scope shall include seal plates for conveyors and all civil, structural and architectural works for conveyor gallery, gallery supporting trestles and their associated foundations.)
2.01.04	Conveyors 2A/B complete with conveyor supporting structures, short supports, stringers, deck plates, conveyor foundations, drive motors, drive units, pulleys, idlers, take-ups, take-up structure, internal and external belt cleaners, pull chord switches, belt sway and zero speed switches, electro-hydraulic thruster brakes, all electrical, etc. including all civil, structural architectural works and their associated foundations.
2.01.05	Stacking conveyors 3A/B complete with conveyor supporting structures, short supports, stringers, deck plates, conveyor foundations, drive motors, drive units, pulleys, idlers, take-ups, take-up structure, internal and external belt cleaners, pull chord switches, belt sway and zero speed switches, electro-hydraulic thruster brakes, all electrical, etc. including all civil, structural architectural works and their associated foundations.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
2.01.06	Reclaim Conveyors 4A/B complete with tunnel, pent house, 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 and 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.
2.01.07	Conveyor 5A/B complete with tunnel, pent house, conveyor galleries, conveyor 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 and zero speed switches, electro-hydraulic thruster brakes, fixed tripper or diverter ploughs, all electrical etc. including all civil, structural and architectural works for conveyor gallery, gallery supporting trestles and their associated foundations.
2.01.08	Junction House JH-1 complete with all civil, structural, architectural and electrical works including chutes, monorails, hoists/chain pulley blocks, hoist maintenance platforms, external staircases, dust debris chutes etc. JH-1 shall be provided with removable chequered plate covers over openings in machinery hatches for handling under ground equipment.
2.01.09	One (1) number Lime stone crusher house (CH) complete with all civil, structural, architectural and electrical works etc accommodating two numbers crushers and associated Vibrating Screening 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 equipments such as sampling unit, dust extraction system etc. as specified elsewhere.
2.01.10	Two (2) numbers of vibrating feeders of 150TPH rated capacity in limestone crusher house to feed the limestone to crushers with drives, dust hoods, all mechanical, electrical accessories and supporting structures etc.
2.01.11	Two (2) numbers of hammer mills of 150TPH rated capacity each for crushing limestone 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.
2.01.12	Two (2) sets of gates each comprising of one number of rod gate and one number of actuator operated rack and pinion gate at inlet of each of the vibrating screen feeder feeding limestone to crushers complete with drive, all mechanical, electrical, structural works, etc.
2.01.13	Complete chute work along with chute block switches and actuator operated flap gates in all junction houses and crusher house between various conveyors.
2.01.14	Two (2) numbers motorized travelling trippers each of 150TPH rated capacity on conveyor 3A/B for feeding the crushed limestone to the overground storage hopper. 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.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
2.01.15	Crushed limestone overground storage hopper along with machinery hatches at each of end of limestone storage shed, reclaim conveyor tunnel and pent house, complete with civil, structural, architectural and electrical 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, other equipment such as DE system, ventilation system, drinking water system, drainage system etc. as specified elsewhere in the specification.
2.01.16	One number of covered storage shed for crushed limestone storage hopper including civil, structural, architectural & electrical works.
2.01.17	Two (2) numbers paddle feeders each of 150TPH rated capacity complete with all electricals, rails, supporting structures, end stops, cable reeling drums, trailing cables, and necessary arrangement for cabling below the limestone storage hopper along with all accessories for reclaiming the limestone from storage hopper.
2.01.18	Two numbers limestone sampling units one each for conveyors 1A/B & 5A/B for sampling of as received limestone and crushed limestone being fed to the FGD System complete with all accessories and electrical, civil, structural works, supporting structures, approach/maintenance platforms etc.
2.01.19	Minimum four (4) Nos. sump pumps in limestone storage shed, and two (2) Nos. sump pumps in JH-1 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.
2.01.20	Complete ventilation system comprising of Supply and exhaust fans along with required ducting for ventilating the below ground portion of various buildings, tunnels of Conveyors, and limestone bunker bays complete with accessories all mechanical, electrical, civil and structural works and associated foundations. Exhaust fans shall be provided for all battery rooms and all toilets complete with electrical, civil & structural works etc...
2.01.21	Pressurized Ventilation system for all Switchgear rooms, MCC rooms complete with all mechanical, electrical, accessories, civil and structural works.
2.01.22	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 limestone crusher house.
2.01.23	Two (2) numbers of in line magnetic separators on conveyors 1A/B and two (2) number of suspended magnets on each conveyor 1A/B complete with handling arrangement, reject chutes, reject trolleys, supporting arrangement and all mechanical, electrical, civil, structural works and accessories.
2.01.24	Two (2) numbers of metal detectors on conveyors 1A/B complete with all mechanical, electrical, civil, structural works and accessories.
2.01.25	Four (4) numbers of electronic type belt scales on conveyors 1A/B & 5A/B for continuous weighing, complete with all mechanical, electrical, civil, structural works and accessories.
2.01.26	Complete dust extraction system for control of fugitive dust in limestone storage shed, junction towers, crusher house complete with fans, drives, bag filters, hoppers,

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
	hoisting arrangements, ducting, piping, valves etc. electrical, accessories, civil, structural and architectural works.
2.01.27	Service water, cooling water and potable water system for complete limestone handling plant including Pumps ,drives, sumps, piping etc and all mechanical, electrical and civil works.
2.01.28	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.
2.01.29	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 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 unused 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	Preservative shop coating, final painting of all structures and equipment.
2.01.34	All inserts, anchor bolts, foundation bolts for Contractor's equipment, platforms etc. in the entire LHP.
2.01.35	All necessary grouting & finishing of the floor after welding at all such pockets & elsewhere is in Contractor's scope.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES

3.00.00 DETAILED SCOPE

3.01.00 GYPSUM HANDLING PLANT

a. Gypsum shall be conveyed from the vacuum belt filter discharge to the storage shed through conveyors 6A/B of 150 TPH rated capacity.

b. One number of covered storage shed for gypsum complete with all mechanical, electrical & civil works including floors for tripper and at ground level and truck bay

c. Conveyors 6A/B complete with conveyor supporting structures, short supports, stringers, deck plates, conveyor foundations, drive motors, drive units, pulleys, idlers, take-ups, take-up structure, internal and external belt cleaners, pull chord switches, belt sway and zero speed switches, electro-hydraulic thruster brakes, all electrical, etc. including all civil, structural architectural works and their associated foundations.

d. Two numbers (02) motorized travelling tripper on conveyors 6A/B for feeding the gypsum to the storage shed. Trippers shall be complete with all mechanical, electrical equipment, rails, chute work, rail supporting structures (along with structural stools, as required), cables with cable festooning arrangement, thruster brakes, rail clamps, electric hoist, actuator flap gates etc.

e. Minimum four (4) Nos. sump pumps in gypsum storage shed complete with drives, accessories, local control panel, level switches, individual discharge piping with fittings and valves to settling pit.

f. Complete dust suppression system for control of fugitive dust in gypsum storage shed complete with pumps, water sump, drives, accessories handling arrangements, piping, valves and all electrical, civil and structural works.

g. Service water and potable water system for complete gypsum handling plant including Pumps, drives, sumps, piping accessories and all mechanical, electrical and civil works.

h. Exhaust fans for ventilation for gypsum storage shed complete with drives, accessories and all electrical, civil & structural works

SUB-SECTION-III-A3

PLANT UTILITIES

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES

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**

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 FGD Control room building.

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. 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 control system. Control and monitoring of air conditioning system from FGD 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
1.02.00	**Redundancies of equipments:** 100% standby unit shall be kept for FGD 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) **F.G.D Control Room Building (Non-A/C areas)**

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 control system is also acceptable.

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3.00.00 General

i. All associated Civil & structural work for air conditioning and Ventilation package.

ii. Set of commissioning spares as may be required during erection and commissioning.

iii. One (1) set Special tools and tackles required for maintenance of all the Mechanical, Electrical and C & I equipments under the scope of bidder.

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.

v. Any additional items required to make the system complete.

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.

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.

Corrosion protection painting for all equipments / items by Bidder as detailed in relevant clauses of technical specification.

4.00.00 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.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES

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.

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)

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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-A4

ECW SYSTEM

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES

EQUIPMENT COOLING WATER SYSTEM

1.00.00 **SCOPE**

1.01.00 **Equipment Cooling Water System for Unit auxiliaries**

The Bidder shall provide common Equipment Cooling water system for three units with a closed circuit cooling system for cooling of the various auxiliaries of FGD system. The equipment cooling water system shall include the following and as detailed out in relevant sub section of Part-B of Technical Specification.

(a) 1x100% capacity DM cooling water pumps alongwith drives for each unit and one 1x100% common standby.

(b) 1x100 % capacity auxiliary circulating water pumps, alongwith drives for each unit and one 1x100% common standby.

(c) 2x100% capacity self-cleaning strainers on the secondary side

(d) 1x100% capacity of plate type heat exchangers for each unit and one 1x100% common standby.

(e) One Overhead DM water tank (ECW O/H tank).

(f) One no. Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc.

(g) Induced Draft Cooling Towers (IDCT) -One (1) no

Cooling Towers shall be as per the system requirements and the specification requirements as specified in Part-B

(h) Piping from service water system to FGD system and IDCT make-up, piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump and complete piping, fittings, supports, valves and specialties including instrumentation and electrical equipment as required and as specified for the system.

Notes-

a) Clarified water from Cooling Tower basin (cooling Tower specific to FGD system) shall be used as secondary cooling water. Cooling tower basin shall be elevated enough to provide flooded suction to ACW pumps.

b) Hot secondary water from the PHE's shall be fed back to Cooling tower through hot water pipe.

c) Make up connection to ECW overhead tank shall be provided from terminal point as specified in terminal points chapter. Necessary connections to be made by contractor.

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1.02.00 **Consumptive water/ process water/ raw water for FGD system**

Consumptive water/ process water for FGD system shall be provided from the raw water reservoir inside the plant. Complete raw water system from the reservoir upto the end consumption point includes the following:

a) 2x 100% raw water pumps complete with valves, drives and accessories for FGD system of all the three units.

b) Storage tank if applicable by FGD sytem.

c) Complete piping, fittings, supports, valves and specialties including instrumentation and electrical equipment as required and as specified for the system.

d) Handling facilities such as monorail hoists/gantry cranes as required.

e) Butterfly valves, non-return valves at the discharge, recirculation pipe with Recirculation Butterfly valves for the above pumps.

All pumps shall be as per system requirement and as specified in design criteria and Part-B of the specification and head to suit system requirement.

1.03.00 **Clarified water/ Service water**

Clarified water shall be provided by existing service water pumps (Employers scope) at terminal point as specified in terminal points chapter. Necessary connections to FGD facilities shall be made by contractor.

1.04.00 Suitable chemical treatment program including scale/ corrosion inhibitor shall be provided to prevent scaling/ corrosion in the secondary cooling water circuit.

SUB-SECTION-IIIB

ELECTRICAL SYSTEM/EQUIPMENT

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES

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. 4410-109-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. 4410-109-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** 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. 4410-109-POE-J-001).
1.07.00	**DG SET (IF APPLICABLE)** Diesel Generator sets of stationary type comprising the following: (1.) Diesel Engine Complete with all accessories (2.) An alternator directly coupled to engine through flexible/rigid coupling complete with all accessories (CT's & VT's etc.) (3.) Control Panel (4.) Complete starting arrangement along with battery ,its charger (5.) Base frame and foundation bolts etc. (6.) Exhaust ducting meeting the statuary requirements, accessories, support structure and foundation bolts. (7.) Day Oil Tank, fuel piping and accessories (8.) Interconnection piping and accessories (9.) Power and control cable gland and lugs at Bidder's equipment for all cables (10.) Cable & Cabling between Bidder's equipment. (11.) All lubricants for first filling, consumables and touch up paints etc for commissioning. (12.) Acoustic enclosure meeting the statuary requirements. Necessary ventilation along with necessary starters & lighting shall be provided.
1.08.00	**CABLING** 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. 2) Contractor scope shall include laying of cable from employer board as shown in Electrical Single Line Diagram Drg No. 4410-109-POE-J-001 on the employers nearest trestle in the FGD area as shown in Drg no 4410-999-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.

3) Contractor shall supply, lay and terminate the cables under his scope of supply

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.

5) Contractor shall provide cable glands and lugs for all equipment's in his scope.

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.

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.

8) Contractor shall provide Galvanised steel pipes/HDPE/hume pipes/PVC pipes, Miscellaneous items like M.S sections etc as required,

9) Contractor shall provide Fire proof cable penetration sealing system of Type-A and Type-B for cable galleries, cable exits etc

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

11) Control interconnection charts shall also be prepared by bidder

1.09.00 **LIGHTING**

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.

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 of North Karanpura STPP. 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.

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The Contractor shall maintain a minimum drawl power factor as per DISCOM regulations for their substations, and all such devices for maintaining power factor 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-IIIC

CONTROL & 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 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

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be acceptable except Nucleonic type density meter), pH analyser, SO2 analyser, Flue Gas flow transmitter, vibration transmitter 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

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	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 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.

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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.

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.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
	f) Junction boxes 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.
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 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. Contractor shall ensure that RIO cabinets are provided in air conditioning environment.
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: a) Start Push Button b) Stop Push Button c) ON Running Lamp d) OFF Lamp e) MCC Disturbance Indicating Lamp

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES

6.04.00 The contractor has top 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:

a)	Chair	-	4 nos.
b)	Printer table	-	1 no
c)	Computer table	-	2 no.
d)	Key pad	-	1 no.
e)	Locker set	-	1 no

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.

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.

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.

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.

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.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES

7.00.00 **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.

8.00.00 **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.

9.00.00 **Interfacing with Employer's DDCMIS and Station LAN**

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 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 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:

1) The FGD plant operation from CCR shall be made available through Ethernet link following TCP/IP standard. The system shall be OPC compliant.

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.

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.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES
	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	Contractor to refer the General Layout Plan (GLP) to estimate the distance between FGD control room and Employer's CCR/CER.
10.00.00	**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 tender drawing 0000-999-POI-019A and Sub-Section titled "Basic Design Criteria" in Part-B, of this Technical Specification.

SUB-SECTION-IIID

CIVIL WORKS

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES

1.00.00 **SCOPE OF CIVIL WORKS**

Scope of Bidder shall include all Civil, Structural, Architectural works including underground facilities like drainage, sewerage, trenches, earthing mat/ grounding associated with complete Flue gas desulfurization (FGD) package covering but not be limited to the following:

a) Truck hopper (if applicable)

b) Limestone storage hopper with shed

c) Transfer points, Conveyor Galleries & Tunnels

d) Crusher House

e) Ball Mill Foundation

f) Ball Mill building

g) FGD Control Room building, MCC Buildings

h) Gypsum dewatering building

i) Gypsum storage shed

j) Pent house

k) Chimney including elevator, electrical works, aviation obstruction lighting

l) Absorber Tower foundations

m) Tank Foundations

n) Pump & Fan Foundations

o) Transformer foundations including Fencing, Paving etc.

p) Pipe and cable Trestles

q) Site levelling in Lime & Gypsum Handling area, as shown in tender drawing.

r) Roads Lime & Gypsum Handling area, as shown in tender drawing.

s) Fencing in Lime & Gypsum Handling area, as shown in tender drawing

t) Storm water drainage network for all areas in bidder's scope and its connection with the nearest owner's drain.

u) Sewerage network for all buildings and facilities and connection with the nearest owner's sewerage system.

v) Paving in entire FGD absorber area and parking block of Lime & Gypsum Handling area.

w) Any other miscellaneous building or facility required for FGD system.

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.

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.

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.

Uniform Finished ground level (FGL) in FGD absorber area shall be made available by the owner at a level specified in "Layout plan of FGD system". Refer Tender drawing no. 4410-999-POC-F-001.

Terminal points for site levelling, roads, drainage network & fencing shall be as indicated in "Layout plan of FGD system". Refer Tender drawing no. 4410-999-POC-F-001.

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.

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES

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 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 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.

	TECHNICAL SPECIFICATION FOR CHIMNEY NORTH KARANPURA FGD (3X660MW)	SPEC. NO. PE-TS-441-620-c002
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		SECTION - C (ELECTRICAL)
		REV.NO. 0 DATE
		SHEET OF

VOLUME – II

SECTION-C

SPECIFIC TECHNICAL REQUIREMENTS FOR ELECTRICAL WORKS

SPECIFICATION NO. PE-TS-441-620-C002

Note : In case of any conflict between section-C & section-D of electrical portion, section-C of electrical portion shall prevail.

Electrical System

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.

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.

All equipment supplied shall comply with relevant IS Standards.

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.

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. 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.

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. 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 4,000 to 2, 00,000 cd depending upon back ground illuminance. Obstacle lights shall have a day time effective intensity of minimum 2,00,000 cd. The intensity of lights shall reduce automatically to 20,000 cd ± 25% at twilight through the use of photocell and again automatically to a night time intensity of 4,000 cd ± 25% through the use of photo-cell. The obstacle lights shall flash simultaneously at a rate between 40 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 70 meters above the ground and vertical spacing of the intermediate levels could vary between 70 and 105 meters. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc. The arrangement of light should be marked such

that the object is indicated from every angle in azimuth. The aviation warning lighting system shall also conform to the latest Indian standard IS 4998.

Aviation Warning Lights (AWL) shall be mounted on door panel of required size (openable 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 metres above the top of platform to enable easy handling for maintenance.

A temporary aviation obstruction lighting system shall be provided during construction of the chimney. Power for these lights shall be obtained from the construction power system including cable, cabling & maintenance by bidder.

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/ aluminium 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 aluminium. Minimum size of control cable shall not be less than 1.5 sq.mm.

The lighting system also includes supply and installation of GS Cable Trays along with tray cover, GI conduits, conduits fitting, weatherproof junction boxes, lead coated flexible conduits all accessories viz. supports, clamps, mounting structure/brackets etc. to make the installation complete. Supporting structure for the above shall be hot dip galvanised. Refer general arrangement & Typical details of cable trays & tray covers drawing attached with the specification. Cable trench, cable trays/GI pipes up to the boundary limit of the chimney i.e. 3M away from outer shell is in the scope of the bidder. Bidder shall coordinate with the purchaser for layout and matching.

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. 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.

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 dia 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.

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
(C) Lighting fixtures of each type
(D) Junction Box of each type

All lighting fixtures, lamps and other items shall be subjected to acceptance and routine test, as per relevant specified standards. Junction boxes, switch boxes, receptacle enclosure etc. shall be subjected to physical and dimensional checks also.

For various equipment, the technical requirements and practices shall conform to the relevant clauses of the electrical specification.

Chimney staircase/ladder shall be electrically connected to the down conductors both at top and bottom. For this, the two lower pairs of inserts supporting the staircase shall be adequately grounded by connecting to the circumferential conductor connected to the down conductor. All intermediate breaks in the staircase should be electrically bonded to maintain continuity from top to bottom.

All connections, clamps anchors, etc. of the lightning protection system shall be made of copper or suitable alloy fittings. All electrical connection, unless otherwise specified, shall be clamped or bolted by high pressure contact or by copper brazing of the metal to form a connection of adequate current carrying capacity and mechanical strength. Soldered connections will not be permitted.

Air terminals, connections, conductors, clamps, fixtures, anchors, etc. exposed within 12000 mm of the top of the chimney shall have a continuous covering of a sheath of commercially pure lead not less than 2.0 mm in thickness extruded and fused upon bare copper, the ends being covered by soldering. Where lead covering is specified, connection shall be made from copper to copper and after the joints have been made, they shall be again covered with solder or lead either by wiping or casting so that copper will not be exposed.

Make of all items used shall be of reputed and reliable make. These makes shall be subject to customer approval without any commercial implication during contract stage.

OTHER REQUIREMENTS

In case of any deviation the bidder shall indicate the same clause by clause in enclosed deviation schedule. In the absence of duly filled in schedules, it will be construed that the offer confirms strictly to the specification.

Bidder shall furnish duly filled in data sheets (enclosed with specification) for electrical equipment after the award of contract for approval. Technical data sheet of any other electrical equipment if required by the purchaser shall be furnished to the contractor after award of contract to enable them to furnish the same.

The bidder shall furnish signed and stamped copy of the specification as a token of acceptance and submit the same along with the technical offer. Further, Quality plan shall be subject to BHEL/customer/consultant approval after award of contract without any commercial or delivery implication. Inspection shall be carried out as per approved Quality Plan approved during detailed engineering.

Bidder shall furnish details of aviation obstruction lights with catalogues.

Bidder shall furnish all drawings/data/catalogues as indicated in different electrical equipment specifications along with the offer in sufficient nos. as indicated in the civil part of the specification.

In case of any conflicts between two sections of specification, the stringent one shall be followed.

Schedule of Equipment given in Electrical BOQ is for reference. All electrical items/accessories required for completeness of Chimney Electrical System shall be supplied by the contractor without any additional commercial implication during contract execution.

The minimum illumination level shall be provided as indicated below. Lux level calculation shall be furnished after award of contract for approval of purchaser/customer/consultant.

- Ground Floor, platforms 70 LUX
- Area of different distribution boards 150 LUX
- Stairs & landings 100 LUX

Any item or work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification and shall be provided by the tenderer without any commercial implication.

Contractor shall demonstrate the average lux level achieved for different areas as per specification requirements, after completion of the lighting work, at site to the satisfaction of engineer-in-charge.

Maharatna Company	**TITLE: 3X660 MW NORTH KARANPURA STPP FGD SYSTEM PACKAGE.** **SPECIFICATIONS FOR SINGLE FLUE RCC CHIMNEY**	SPECIFICATION NO: PE-TS-441-620-C002 VOLUME : SECTION : REV.NO : 00 SHEET :

SECTION-C

SPECIFIC TECHNICAL REQUIREMENTS FOR CHIMNEY ELEVATOR

SPECIFICATION NO. PE-TS-441-620-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 One No. 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 Elevator	:	Rack and Pinion type Stack
2	Type of loading	:	Passenger cum goods
3	Quantity	:	As per project requirement
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	:	Four (4) nos. including ground. (0.0 m, 47 m, 92 m, and 137 m)
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**

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

CLAUSE NO.	MANDATORY SPARES	
6.00.00	**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

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION

1.16.00	**Elevators (Rack and Pinion Type)**
	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 part of the quality assurance plan to be agreed with the owner.
1.16.01	All forgings shall be subjected to ultrasonic test to ensure free from internal defects in addition to check for chemical and mechanical properties.
1.16.02	10% of the welds selected at random shall be subject to DP test.
1.16.03	All forged components shall be subjected to DPI/MPI after machining.
1.16.04	Gear Reducer shall be checked for gear ratio, backlash, contact pattern. No load shop trial run shall be conducted on gear boxes to check for oil leakage, temperature rise, noise and vibration.
1.16.05	Buffer springs shall be subjected to load test as per relevant specifications. Material certificates for springs shall also be furnished.

CLAUSE NO.	QUALITY ASSURANCE & INSPECTION
1.16.06	All components prior to assembly shall be checked for dimensions.
1.16.07	Function test of Elevator assembly shall be carried out.
1.16.08	All electrical equipments shall be of proven quality.
1.16.09	Galvanized components/parts shall be checked for weight of Zn coating, thickness of coating, uniformity of coating and adhesion test and visual examination as per IS 2633 and IS 2629.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

<table>
<tr><td></td><td colspan="6">REFERENCE</td><td>EXISTING</td><td>READ AS</td></tr>
<tr><td>Sl No.</td><td>Sec</td><td>Part</td><td>Sub Sec</td><td>Page No</td><td>Clause</td><td>Para/ Line</td><td></td><td></td></tr>
<tr><td>1.</td><td>VI</td><td>E</td><td>I</td><td>1 OF 2
10 of 14</td><td>1.00.00 (B)</td><td></td><td>SCHEMES
<table><tr><th>Sl. No</th><th>Drawings Title</th><th>Drawings No.</th><th>Rev. No.</th><th>No. of Sheets</th></tr><tr><td>1)</td><td>……..</td><td>……</td><td>.</td><td>….</td></tr><tr><td>…</td><td>……..</td><td>…….</td><td>.</td><td>…</td></tr><tr><td>3)</td><td>LIME STONE FLOW DIAGRAM</td><td>4410-000-2-POM-002</td><td>A</td><td>2</td></tr><tr><td>..</td><td>……</td><td>…..</td><td>.</td><td>..</td></tr></table></td><td>SCHEMES
<table><tr><th>Sl. No</th><th>Drawings Title</th><th>Drawings No.</th><th>Rev. No.</th><th>No. of Sheets</th></tr><tr><td>1)</td><td>……..</td><td>……</td><td>.</td><td>….</td></tr><tr><td>…</td><td>……..</td><td>…….</td><td>.</td><td>…</td></tr><tr><td>3)</td><td>LIME STONE FLOW DIAGRAM</td><td>4410-000-2-POM-002</td><td>B</td><td>2</td></tr><tr><td>..</td><td>……</td><td>…..</td><td>.</td><td>..</td></tr></table>Revised Drawing attached at Annexure V</td></tr>
<tr><td>2.</td><td>VI</td><td>A</td><td>III-A2</td><td>1 of 7</td><td>1.01.00</td><td></td><td>SYSTEM DESCRIPTION

LIMESTONE HANDLING PLANT

This shall be read in conjunction with Limestone Flow Diagram and the Limestone layout enclosed elsewhere in the specification.

ROM Limestone of (-) 250 mm size shall be delivered to North</td><td>SYSTEM DESCRIPTION

LIMESTONE HANDLING PLANT

This shall be read in conjunction with Limestone Flow Diagram and the Limestone layout enclosed elsewhere in the specification.

ROM Limestone of (-) 250 mm size shall be delivered to North Karanpura power plant by trucks. Two (2) numbers Truck Tipplers</td></tr>
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AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
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							Karanpura power plant by trucks. The Limestone shall be unloaded in underground RCC hoppers by means of self-tippling trucks and shall be conveyed though a series of conveyors for further crushing, conveying/storage etc. Alternatively, Bidder may provide complete Truck unloading system comprising of of Bulk material receiving unit and Surface feeder.	**capable of handling minimum 40 Ton Capacity Trucks (Gross Weight: 60 Ton) shall be provided.** The Limestone shall be unloaded in underground RCC and shall be further conveyed though apron feeder and a series of conveyors for further crushing, conveying/storage etc. Alternatively, Bidder may provide complete Truck unloading system comprising of of Bulk material receiving unit and Surface feeder.
3.	**VI**	**A**	**III-A2**	**3 of 7**	**2.01.01**		ading system for unloading of limestone from trucks complete with drives, accessories all mechanical, electrical civil & structural works, including enclosure for dust containment during unloading. The truck unloading system shall comprise of either of the following a. Two number underground RCC Truck hoppers (TH1 & TH2), each of 60 ton capacity, along with access ramp for trucks, grating, dust enclosure etc. Clear access shall be provided for movement of pay loaders/ bulldozers on the paved area and on the hopper grating in order to remove the oversized limestone. Gratings with 300mm X 300mm clear openings over	Two (2) numbers unloading system **comprising Two Truck Tipplers** for unloading of limestone from trucks complete with **hydraulic drives**, accessories all mechanical, electrical civil & structural works, including enclosure for dust containment during unloading. The truck unloading system shall comprise of either of the following a. Two number underground RCC Truck hoppers (TH1 & TH2), each of **90 ton** capacity, along with access ramp for trucks, grating, dust enclosure etc. Clear access shall be provided for movement of pay loaders/ bulldozers of **35MT weight** on the paved area and on the hopper grating in order to remove the oversized

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
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							unloading hopper shall be placed and designed accordingly. b. Two number bulk receiving units for ROM Limestone of size (-)250 mm each rated for 75TPH along with access ramp as required, receiving hoppers/box feeder/surface feeder, dust enclosure etc. The units shall be complete with drives, accessories all mechanical, electrical civil & structural works	limestone. Gratings with 300mm X 300mm clear openings over unloading hopper shall be placed and designed accordingly. b. Two number bulk receiving units for ROM Limestone of size (-)250 mm each rated for **150 TPH** along with access ramp as required, receiving hoppers/box feeder/surface feeder, dust enclosure etc. The units shall be complete with drives, accessories all mechanical, electrical civil & structural works
4.	**VI**	**A**	III-A2	1 of 7	1.01.00		**Each Apron feeder shall be of 75 MTPH rated capacity**. The rated capacity of conveyor 1A/B shall be 150 MTPH. Alternatively two numbers **bulk receiving unit along with surface feeders etc. each rated for 75TPH capacity** shall be provided.	**Each Apron feeder shall be of 150 MTPH rated capacity**. The rated capacity of conveyor 1A/B shall be 150 MTPH. Alternatively two numbers **bulk receiving unit along with surface feeders etc. each rated for 150 TPH capacity** shall be provided.
5.	**VI**	**B**	**I-M2**	**2.02.10**	**3 of 111**			Truck Tippler a. Each hydraulic Truck tippler shall consist of heavy duty steel fabricated frame with anti skid chequered plate welded on it, pair of heavy duty hydraulic cylinder for lifting, overturning arrestor, a pair of back stopper and mechanical locking arrangement. b. The hydraulic power pack shall shall be totally enclosed and consist of hydraulic gear pump, electric motor with starter panel, hydraulic oil tank, control valves,

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

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								high pressure pipe line & hoses , control panel fitted with push button switches etc c. Capacity : 60 Ton Max. Tilting angle : 55 Main Structure : Steel IS 2062/IS 1570
6.	**VI**	**A**	**III-A2**	**1 of 7**	**1.01.00**		In Crusher house, Limestone from incoming Conveyor 1A will pass through dedicated Vibrating Feeder (VF-1) and dedicated Crushers (CR-1). Similarly Limestone from incoming Conveyor 2B will pass through dedicated **Vibrating Screening Feeders (VF-2)** and dedicated Crushers (CR-2) respectively. Each dedicated stream shall have a set of Rod gate and Rack & Pinion Gate before Vibrating Feeder. The dedicated Limestone flow stream shall permit maintenance of equipment, hoppers and chutes in one stream without affecting the operation of other stream.	In Crusher house, Limestone from incoming Conveyor 1A will pass through dedicated Vibrating Screening Feeder (**VSF-1)** and dedicated Crushers (CR-1). Similarly Limestone from incoming Conveyor 2B will pass through dedicated **Vibrating Screening Feeders (VSF-2)** and dedicated Crushers (CR-2) respectively. Each dedicated stream shall have a set of Rod gate and Rack & Pinion Gate before Vibrating Feeder. The dedicated Limestone flow stream shall permit maintenance of equipment, hoppers and chutes in one stream without affecting the operation of other stream.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

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<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Each Vibrating Feeder shall be of 150TPH rated capacity. Each crusher shall be of 150 MTPH rated capacity which shall crush limestone to (-) 20mm size. Crushed limestone shall drop on Conveyor 2A/B.</td><td>Each Vibrating Screening Feeder shall be of 150TPH rated capacity. Each crusher shall be of 150 MTPH rated capacity which shall crush limestone to (-) 20mm size. Crushed limestone shall drop on Conveyor 2A/B.</td></tr>
<tr><td>7.</td><td>VI</td><td>B</td><td>I-M2</td><td>3 of 112</td><td>2.02.03</td><td></td><td>Design capacities & margins
<table>
<tr><th>Sl no</th><th>Equipment</th><th>Duty requirement</th></tr>
<tr><td>1</td><td>Crushers</td><td>2x50%</td></tr>
<tr><td>2.</td><td>Vibrating screening feeders</td><td>2x50%</td></tr>
<tr><td>3.</td><td>Paddle feeders</td><td>1X100%</td></tr>
<tr><td>4</td><td>Belt feeder for crusher house</td><td>2x50%</td></tr>
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AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
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8.	VI	**A**	**III-A2**	**6 of 7**	**2.01.27**		Service water, cooling water and potable water system for complete limestone handling plant including Pumps ,drives, sumps, piping etc and all mechanical, electrical and civil works.	Service water, cooling water and potable water system for complete limestone handling plant including Pumps ,drives, sumps, piping etc and all mechanical, electrical and civil works. Alternatively, Air cooled type scoop coupling is also acceptable for all conveyors with HT motors for (LHP, GHP) and crusher scoop couplings. Suitable interlock…….
9.	**VI**	**A**	**III-A2**	**5 of 7**	**2.01.23**		Two (2) numbers of in line magnetic separators on conveyors 1A/B and two (2) number of suspended magnets on each conveyor 1A/B complete with handling arrangement, reject chutes, reject trolleys, supporting arrangement and all mechanical, electrical, civil, structural works and accessories	Two (2) numbers of in line magnetic separators on conveyors 1A/B and **four (4) number of suspended magnets** on each conveyor 1A/B & 5A/B complete with handling arrangement, reject chutes, reject trolleys, supporting arrangement and all mechanical, electrical, civil, structural works and accessories
10.	**VI**	B	**I-M2**	**3 of 112**	**2.02.06**		Crushers, **wagon tipplers, apron feeders, side arm j-rail 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.	Crushers, apron feeders, 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.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

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11.	VI	**A**	**Functional Guarantees**	**12 of 16**	5.00.00		Guaranteed power consumption of single stream conveyors and associated equipments (**vibrating screen**, crushers, belt feeders, paddle feeders) for limestone and gypsum handling at rated capacities.	Guaranteed power consumption of single stream conveyors and associated equipments (**vibrating screen feeder,** crushers, belt feeders, paddle feeders) for limestone and gypsum handling at rated capacities. **Duty Factor 0.3 shall be considered for the for Limestone handling system and Duty Factor 1 shall be considered for Gypsum handling system .**
12.	**VI**	**A**	III-A2	2 OF 7	1.01.00		Stacking Conveyor 3A/B will drop limestone to **over ground storage hopper** provided within a shed via travelling trippers. One (1) number Traveling Tripper is mounted on each of the Stacking Conveyor 3A/B.	Stacking Conveyor 3A/B will drop limestone to **storage hopper (One fourth (1/4 th) of total stipulated crushed limestone storage shall be considered in the hopper, if applicable, and hopper length shall be equal to stockpile length placed along the tripper centerline**) provided within a shed via travelling trippers. One (1) number Traveling Tripper is mounted on each of the Stacking Conveyor 3A/B.
13.	**VI**	**A**	III-A2	5 OF 7	2.01.22		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 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, accessories and electrical to serve various floors of lime stone crusher house. **Staircase access for machine room shall also be**

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

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								provided by the bidder.
14.	**VI**	**A**	III-A2	5 of 7	2.01.18		Two (02) numbers limestone sampling units one each for conveyors 1A/B & 5A/B for sampling of as received limestone and crushed limestone being fed to the FGD System complete with all accessories and electrical, civil, structural works, supporting structures, approach/ maintenance platforms etc.	One (01) numbers limestone sampling units one each for conveyors 1A/B for sampling of as received limestone being fed to the FGD System complete with all accessories and electrical, civil, structural works, supporting structures, approach/maintenance platforms etc.
15.	**VI**	**A**	III-A2	4 of 7	2.01.10		Two (2) numbers of vibrating feeders of 150TPH rated capacity in limestone crusher house to feed the limestone to crushers with drives, dust hoods, all mechanical, electrical accessories and supporting structures etc.	wo (2) numbers of vibrating screening feeders of 150TPH rated capacity in limestone crusher house to feed the limestone to crushers with drives, dust hoods, all mechanical, electrical accessories and supporting structures etc.
16.	SECTION-VI/ Part-B		I-M4 Fire Detection & Protection System	1 OF 18	3.01.00		HVW and MVW spray system 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,	HVW and MVW spray system It shall consist of 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

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							instrumentation, local control panels, cables etc.	panels, cables etc.
17.	SECTION-VI/ Part-B		I-M3 Air Conditioning & Ventilation System	2 of 27	3.02.00 (iii)		(iii) Battery Rooms & Oil rooms and fumes/odour generating areas - Combination of Supply air fan & Exhaust air fans. Motor shall be flame proof.	(iii) Battery Rooms & Oil Rooms and **Othe**r fumes / odour generating areas - Combination of **exhaust air fans / roof exhausters and intake louvers fans**. Motor shall be flame proof.
18.	SECTION-VI/ Part-B		SUB-SECTION-I-M3 (AIR CONDITIONING AND VENTILATION SYSTEM)	1 of 27 1-2 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 (e.g. Switch gear rooms, cable galleries, etc.)	Modular type Unitary Air Filtration (UAF) units of suitable capacity ((1X100%) shall be provided for non-Air conditioned area of FGD (e.g. Switch gear rooms, cable galleries, etc.). Design condition of evaporative type ventilation system mentioned in clause 7.02.02 sub-Section-V (salient design data, 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.
19.	SECTION-VI/ Part-B		I-M4 Fire Detection & Prote	16 of 18	7.06.00		Deluge Valves, Alarm Valves, **Foam monitors**, Water monitors, **Foam Proportioning equipments, Foam makers**, etc.	Deluge Valves, Alarm Valves, Water monitors, etc.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
			ction System					
20.	SECTION-VI/ Part-B		**SUB SECTION-I M4 Fire Detection & Protection System**	13 of 18	5.15.00 **Cabling for fire alarm system** NOTES: (3)-		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.	3. Over and above, contractor may note that short term fire proof cables shall be provided for coal handling plant 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.
21.	SECTION-VI/ Part-B		**SUB SECTION-I M4 Fire Detection & Protection Syst**	14 of 18	5.18.00		**Multisensor Detection System** 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.	**Multisensor Detection System** ii) Cross zoning of the signal from two adjacent multisensor detectors shall be employed to initiate the fire extinguishing system of MVW spray system of cable galleries.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

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			em					
22.	Section -VI (TS) Part -A		Sub-section-III-A3 Fire Fighting System	4 of 5	4.00.00, 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. 1. Pressurized water type (9lit. capacity as per IS 15683): 5 nos 2. Co2 type (4.5 kg Cap IS:15683): 5 nos 3. Dry chemical type (6 kg Cap IS:15683) : 5 nos
23.	VI	A	I	3 of 18	1.03.01		Wet limestone based Flue gas desulphurization(FGD) for 2X 800 MW unit, capable of reducing to the specified limits the emissions of Sulphur Dioxide in flue gas produced by specified coal being fired in boiler….	Wet limestone based Flue gas desulphurization(FGD) for **3X 660 MW** unit, capable of reducing to the specified limits the emissions of Sulphur Dioxide in flue gas produced by specified coal being fired in boiler….
24.	VI	A	I	4 of 18	3.00.00		The drawings…….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…….	The drawings…….The scope and terminal points of the equipment to be furnished under this **FGD package** shall be as identified in these drawings and read in conjunction with text of the specification…….

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
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25.	VI	B	I-M1	23 of 49	6.07.02		The limestone slurry pumps shall be designed to meet the requirements stipulated in Cl. No.9.00.00. of this Sub-Section.	The limestone slurry pumps shall be designed to meet the requirements stipulated in **Cl. No.8.00.00** of this Sub-Section.
26.	VI	A	I	13 of 18	4.02.04		In case Bidder or its agency do not meet the requirements at 2.1	In case Bidder or its agency do not meet the requirements at **4.02.01**
27.	VI	A	III – A1	3 OF 8	3.01.03		Two (2) limestone slurry tanks, each tank sized to meet 12 hrs total limestone slurry storage requirement for two units at Design point, complete with all accessories and Agitator(s).	Two (2) limestone slurry tanks, each tank sized to meet 12 hrs total limestone slurry storage requirement for **Three units** at Design point, complete with all accessories and Agitator(s).
28.	VI	A	III – A1	4 OF 8	5.01.00		The employer envisages a common gypsum dewatering system for the two (2) units.	Gypsum dewatering system shall be common for all the **Three (3)** units.
29.	VI	B	I-M1	22 OF 49	6.06.02		The agitators shall be designed to meet the requirements stipulated in Cl. No. 12.00.00 of this Sub-Section.	The agitators shall be designed to meet the requirements stipulated in Cl. No. **11.00.00** of this Sub-Section.
30.	VI	B	I-M1	3 OF 49	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	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 of FGD, Process water pump &

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							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.	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**.
31.	VI	B	I-M1	5 OF 49	3.02.01		The flue gas ducts shall be sized and designed to meet all the criteria as specified in Cl. No 17.00.00 this subsection.	The flue gas ducts shall be sized and designed to meet all the criteria as specified in Cl. No **16.00.00** this subsection.
32.	VI	B	I-M1	20 OF 49	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**.
33.	VI	B	I-M1	22 OF 49	6.06.01		The contractor……common for all mills. Each tank ……. requirement of the two units operating ……. whichever is lower.	The contractor……common for all **units**. Each tank ……. requirement of **the three units** operating ……. whichever is lower.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
34.	VI	B	I-M1	32 OF 49	13.03.00		2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 3x660 MW) along with all necessary piping, valves, control & instrumentation shall be provided by the Contractor.	2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (**total 6 nos**. of pumps for 3x660 MW) along with all necessary piping, valves, control & instrumentation shall be provided by the Contractor.
35.	VI	B	I-M1	15 OF 49	5.04.00		Gypsum Bleed Pump ……. ……. ……. ……. The Pumps shall be designed to meet the stipulation of Clause No. 9.00.00 of this sub-section	Gypsum Bleed Pump ……. ……. ……. The Pumps shall be designed to meet the stipulation of Clause No. **8.00.00** of this sub-section
36.	VI	A	III-A1	8 OF 8	18.00.05		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.	A common Nickel based alloy material storage/neutralizing tank for the **all the three units** of storage capacity of 12 hrs of stack condensate of all the three stack shall be provided.
37.	VI	B	I-M1	29 OF 49	10.01.00		All the slurry …… 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 ……. suction-side of these pumps shall be	All the slurry …… 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 ……. suction-side of these pumps shall be provided.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

<table>
<tr><th></th><th colspan="6">REFERENCE</th><th>EXISTING</th><th>READ AS</th></tr>
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<tr><td>38.</td><td>VI</td><td>A</td><td>V</td><td>2 OF 10</td><td>3.00.00</td><td></td><td>
<table>
<tr><th>Sl. No.</th><th>Item</th><th>Guarantee Point</th><th>Design Point</th></tr>
<tr><td>1</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>2</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>5</td><td>Gas flow at the FGD inlet when firing respective coal (Nm3/sec)</td><td>769 (1135 m3/s)</td><td>852 (1305 m3/s)</td></tr>
<tr><td>6</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>7</td><td>Flue gas----</td><td></td><td></td></tr>
<tr><td>(i)</td><td>O_2 (% v/v wet)</td><td>6.18</td><td>5.8</td></tr>
<tr><td>(ii)</td><td>CO_2 (% v/v wet)</td><td>9.1</td><td>8.92</td></tr>
<tr><td>(iii)</td><td>H_2O (% v/v wet)</td><td>14.63</td><td>17.92</td></tr>
<tr><td>(iv)</td><td>SO_2 (% v/v wet)</td><td>0.088</td><td>0.087</td></tr>
<tr><td>(v)</td><td>N_2 (% v/v wet)</td><td>70</td><td>68.00</td></tr>
<tr><td>(vi)</td><td>Inlet SO_2 (mg/Nm^3-wet)</td><td>2437</td><td>2407</td></tr>
<tr><td>(vii)</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>(viii)</td><td>Dust (mg/Nm^3)</td><td>50-200</td><td>50-200</td></tr>
<tr><td>(iv)</td><td>SO_3 (ppm) (at 6% O2 wet)</td><td>--</td><td>--</td></tr>
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</td><td>
<table>
<tr><th>Sl. No.</th><th>Item</th><th>Guarantee Point</th><th>Design Point</th></tr>
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<tr><td>2</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>5</td><td>Gas flow at the FGD inlet when firing respective coal (Nm3/sec)</td><td>748 (1188 m3/s)</td><td>800 (1317 m3/s)</td></tr>
<tr><td>6</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>7</td><td>Flue gas----</td><td></td><td></td></tr>
<tr><td>(i)</td><td>O_2 (% v/v wet)</td><td>6.23</td><td>6.156</td></tr>
<tr><td>(ii)</td><td>CO_2 (% v/v wet)</td><td>8.9845</td><td>8.6910</td></tr>
<tr><td>(iii)</td><td>H_2O (% v/v wet)</td><td>14.58</td><td>16.9425</td></tr>
<tr><td>(iv)</td><td>SO_2 (% v/v wet)</td><td>0.0855</td><td>0.0845</td></tr>
<tr><td>(v)</td><td>N_2 (% v/v wet)</td><td>70.12</td><td>68.13</td></tr>
<tr><td>(vi)</td><td>Inlet SO_2 (mg/Nm^3-wet)</td><td>2440</td><td>2410</td></tr>
<tr><td>(vii)</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>(viii)</td><td>Dust (mg/Nm^3)</td><td>50</td><td>50-200</td></tr>
<tr><td>(ix)</td><td>SO_3 (ppm) (at 6% O2 wet)</td><td>--</td><td>--</td></tr>
</table>
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AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

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<tr><th></th><th colspan="6">REFERENCE</th><th>EXISTING</th><th>READ AS</th></tr>
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<tr><td>8</td><td>--</td><td>--</td><td>--</td></tr>
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<table>
<tr><td>(x)</td><td>HCL (ppm) wet</td><td>45</td><td>45</td></tr>
<tr><td>(xi)</td><td>HF (ppm) wet</td><td>12</td><td>12</td></tr>
<tr><td>8</td><td>--</td><td>--</td><td>--</td></tr>
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</td></tr>
<tr><td>39.</td><td>VI</td><td>A</td><td>V</td><td>3of 10</td><td>3.01.00</td><td></td><td>
Wet stack sizing criteria
Wet stack shall be sized for the following conditions
<table>
<tr><th>SN</th><th>Item</th><th>Design Condition</th></tr>
<tr><td>1.</td><td>Boiler load in MW (e)</td><td>VWO</td></tr>
<tr><td>2.</td><td>Gas flow at FGD inlet (m3/sec)</td><td>Design point (as given in cl. No. 3.00.00)</td></tr>
<tr><td>3.</td><td>Gas temperature at chimney inlet (deg. C)</td><td>To be worked out by bidder considering design point condition.</td></tr>
</table>
</td><td>
Wet stack
<table>
<tr><th>SN</th><th>Item</th><th>Design Condition</th></tr>
</table>
a) Wet stack sizing criteria
A wet stack shall be installed downstream of wet flue gas Desulfurization system by the contractor. Clean gas from the absorber shall be taken to wet stack 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 wet stack flue liner considering Steam Generator in operation both with & without FGD system in operation. The wet stack fuel liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8mm 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 wet stack flue liner projecting over the wet stack roof shall be wrapped with 2mm thick Titanium/ C-276 sheet over insulation. The wet stack shall be designed as per the guidelines of ERPI Revised Wet Stack Design Guide.
Alternatively, Contractor can also provide wet stack of 8 mm thick (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.
External surface of wet stack flue liner projecting over the wet stack roof shall be wrapped with 2 mm thick Titanium / C-276 sheet.
</td></tr>
</table>

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							4 | Flue gas velocity (m/sec) (Maximum) | 18	1. | Boiler load in MW (e) | VWO 2. | Gas flow at FGD inlet (m3/sec) | Design point (as given in cl. No. 3.00.00) 3. | Gas temperature at chimney inlet (deg. C) | To be worked out by bidder considering design point condition. 4 | Flue gas velocity (m/sec) (Maximum) | 18 (b) 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) Computation flow model for plume downwash analysis (iv) Physical or computation flow model for CEMS elevation flow performance (c) 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

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
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								the wet stack liner, in the wet stack liner, and in the exit nozzle. These collectors shall collect liquid from surfaces, prevent re-entrainment, and guide the liquid to location 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.
40.	VI	B	I-M1	6 OF 49	3.02.04		The duct to Absorber inlet ……. thickness. The duct from Absorber outlet to wet stack inlet shall be made of cladded sheet of minimum 2 mm thickness of either Titanium (Grade 2 as per ASME SB265) or C-276 over 8 mm thick (minimum) mild steel base metal. Cladding	The duct to Absorber inlet ……. thickness. The duct from Absorber outlet to wet stack inlet shall be made **of Carbon steel of minimum 7 mm thickness cladded with minimum 2 mm thickness of Alloy C-276 / Alloy 59 or better material.**

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							shall be done to achieve the required quality as per ASTM B 898-11.	
41.	VI	B	I-M1	26 OF 49	7.07.03		2x100% horizontal centrifugal pumps shall be provided to feed the secondary hydrocyclones. **Each pump shall be sized to empty the full storage capacity of the tank in 6 hrs.**	2x100% horizontal centrifugal pumps shall be provided to feed the secondary hydrocyclones.
42.	VI	B	I-M1	6 OF 49	3.03.01		The arrangement ……. in operation. Guillotine gate type damper is being provided by the Employer before the suction of each Booster fan. A gas tight …… outlet of each booster fan. **A Pneumatic operated multi louver damper with seal air arrangement shall also be provided by the Contractor in the clean gas duct after GGH.**	The arrangement …….. in operation. Guillotine gate type damper **shall be provided by the contractor** before the suction of each Booster fan. A gas tight…….. outlet of each booster fan.
43.	VI	B	I-M1	7 OF 49	3.03.07		A damper in the bypass duct is being provided by the Employer for quick opening to allow……condition.	**A quick acting biplane damper shall be provided by the contractor in the bypass duct (flue gas duct connecting the**

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
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								existing chimney) for quick opening to allow…….. condition. All the gates……use of seal air fans of the damper & **100 % with seal air fans under operation**. **The bypass dampers (quick acting biplane) 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…… ….and size.
							All the gates……use of seal air fans of the damper. The dampers shall be 100% leak tight with seal air fans under operation. The gas tightness …..…… and size.	
44.	VI	B	I-M1	7 OF 49	3.03.08		The blades ……. material.	Clause deleted.
45.	VI	B	I-M1	7 OF 49	3.03.09		The dampers……. absorber spray system or the GGH. The dampers …….. hand wheel.	The dampers……. absorber spray system **or any emergency condition in FGD system.** The dampers ……..hand wheel.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
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46.	VI	B	I-M1	7 OF 49	3.03.10		The isolating…… in fully closed position.	The isolating…… in fully **open &** closed position.
47.	VI	B	I-M1				Nil	**Clause added** **3.03.11** **Pressurization Fan :** **a) All the 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.**
48.	VI	B	I-M1				Nil	**Clause added** **3.03.12** **All gates shall be designed to withstand the operating air and flue gas temperature without distortion.**
49.	VI	B	I-M1				Nil	**Clause added** **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.**
50.	VI	A	III – A1	6 OF 8	6.02.00		The contractor shall provide 1x100% slurry pumps …….. of the contractor.	The contractor shall provide **2x100%** slurry pumps…….. of the contractor.
51.	VI	B	I-M1	21 OF 49	6.05.01		There shall be 2X100% **tube mills** for grinding of limestone. Each …….. …….. occurring together. (i) ---- ------- (ii) Flow 110% of limestone requirement of two absorbers at Design point.	There shall be 2X100% **Wet ball mills** for grinding of limestone. Each …….. occurring together. (i) ---- ------- (ii) Flow 110% of limestone requirement of **all the**

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							(iii) ---- ------- ----- ------ -------	----- ------ **three** absorbers at Design point. (iii) ---- ------- ----- ------ -------
52.	VI	B	I-M1	27 OF 49	**7.07.09**		Contractor shall provide …… on-load cleaning system, etc.	Clause deleted.
53.	VI	B	I-M1	27 OF 49	**7.07.10**		Bucket conveyors shall …….. in the Contractor's scope.	Clause deleted.
54.	VI	B	I-M1	27 OF 49	**7.07.11**		A storage room for …… provided by the contractor.	Clause deleted.
55.	VI	A	III-A1	5 OF 8	5.02.00		Each set (suitable for handling /dewatering of one unit) of dewatering equipment …….. wash water line.	Each set (suitable for handling /dewatering **of all the three units**) of dewatering equipment ……..wash water line.
56.	VI	B	I-M1	9 of 49	4.01		…….. Note to 4.01.01 & 4.01.02: Booster fan shall have a minimum stall margin of 10% over the Design duty points.	…….. Note to 4.01.01 & 4.01.02: **1.** Booster fan shall have a minimum stall margin of 10% over the Design duty points.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								2. Pressure specified at Booster Fan suction is without DeNox system in service. Suction pressure correction in view of DeNOx system in service has to be considered.
57.	VI	B	I-M1	25 of 49	7.04.09		Gypsum cake …….. being provided by the **Employer. The elevation of discharge point of vacuum belt filter shall be at least 10.0 m above GL.**	Gypsum cake …….. being provided by the **Contractor**.
58.	VI	B	I-M1	38 of 49	16.01.08 (b)(ii)		Internal stiffening ……. external stiffeners. **Such internal stiffeners for the flue gas duty between boiler and ESP shall be provided with erosion protection shields.**	Internal stiffening ……. external stiffeners.
59.	VI	B	I-M1	13 of 49	5.01.00 A(iii)		The slurry recirculation pumps shall have a minimum margin of 10% of flow and head, over the actual ……size and type.	The slurry recirculation pumps shall have a minimum margin of 10% of flow and **frictional** head, over the actual ……size and type.
60.	VI	A	III-A1	5 OF 8	5.02.00		The over flow from the …….. 2X100% vacuum belt filter system.	**The gypsum slurry from each Absorber shall be fed to a common Primary hydro cyclone**

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

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<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>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 over flow from the …….. 2X100% vacuum belt filter system.</td></tr>
<tr><td>61.</td><td>VI</td><td>B</td><td>I-M1</td><td>5 of 49</td><td>3.01.00</td><td></td><td>The entire flue …… conditions:
<table><tr><td>1</td><td>Design internal pressure at 67% yield strength (mm wc)</td><td>+660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher.</td></tr><tr><td>2</td><td>--</td><td>--</td></tr><tr><td>--</td><td>--</td><td>--</td></tr><tr><td>6</td><td>--</td><td>--</td></tr></table></td><td>The entire flue …… conditions:
<table><tr><td>1</td><td>Design internal pressure at 67% yield strength (mm wc)</td><td>For upto booster fan inlet ±660 mm wg & +660 and -150 mmwc for booster fan outlet onward or maximum conceivable head of Booster fan, whichever is higher.</td></tr><tr><td>2</td><td>--</td><td>--</td></tr><tr><td>--</td><td>--</td><td>--</td></tr><tr><td>6</td><td>--</td><td>--</td></tr></table></td></tr>
<tr><td>62.</td><td>VI</td><td>B</td><td>I-M1</td><td>37 of 49</td><td>16.01.03</td><td></td><td>Duct Design Pressure

All flue gas ducts shall also be designed for ± 660 mm w.g., or maximum</td><td>Duct Design Pressure

The flue gas upto Booster fan inlet shall be designed for 660 mm w.g. at 67 % yield strength of</td></tr>
</table>

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							conceivable pressure of the relevant fans, whichever is higher at 67% of yield strength of material	**material. The flue gas duct from Booster fan outlet shall be designed for +660 mm and -150 mm w.g. or maximum conceivable pressure of the Booster fan, at 67 % yield strength of material.**
63.	VI	A	V	4 of 10	4.00.00		Predicted Performance data at FGD Inlet at various Loads Table- 1 …… Table-2 …….. …….. VWO - Valve wide open	Predicted Performance data at FGD Inlet at various Loads Refer Annexure-I
64.	VI	B	I-M1	28 of 49	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.	The design of the shaft shall ensure that the **critical speed is at least 20% above the operating speed of the shaft.**

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
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65.	VI	B	I-M1	19 of 49	5.06.23		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 line side of Gas Cooling Pumps. For the agitators a flushing system for start ups shall be provided.	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 line side of Gas Cooling Pumps. **The Suction screen shall be made of Alloy 59 / C276 or abrasion resistant FRP/Polypropylene (in case Contractor/Collabrator has proven experience).** For the agitators a flushing system for start ups shall be provided.
66.	VI	B	I-M1	19 of 49	5.06.22		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/**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.
67.	VI	B	I-M1	23 of 49	6.07.03		The limestone ……. load operation. The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of	The limestone ……. load operation. The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of **minimum 6 mm**

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

<table>
<tr><td></td><td colspan="6">REFERENCE</td><td>EXISTING</td><td>READ AS</td></tr>
<tr><td>Sl No.</td><td>Sec</td><td>Part</td><td>Sub Sec</td><td>Page No</td><td>Clause</td><td>Para/ Line</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>minimum 10 mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends.</td><td>thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends.</td></tr>
<tr><td>68.</td><td>VI</td><td>B</td><td>I-M1</td><td>28 of 49</td><td>8.07.00</td><td></td><td>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.</td><td>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.</td></tr>
<tr><td>69.</td><td>VI</td><td>A</td><td>VII</td><td>4 of 38</td><td>1.03.00</td><td></td><td><table><tr><td>Absorber</td><td></td></tr><tr><td>1. Liner Material</td><td>15% coverage of each material and thickness for one Unit/absorber</td></tr><tr><td>2. Absorber Spray/Oxidation nozzles</td><td>20% of each type</td></tr><tr><td>3. Absorber Mist Eliminator Washing Nozzles</td><td>20% of each type</td></tr><tr><td>4. Absorber Mist Eliminator</td><td>15% of each type</td></tr></table></td><td><table><tr><td>Absorber</td><td></td></tr><tr><td>1. Absorber Spray/Oxidation nozzles</td><td>20% of each type</td></tr><tr><td>2. Absorber Mist Eliminator Washing Nozzles</td><td>20% of each type</td></tr><tr><td>3. Absorber Mist Eliminator</td><td>15% of each type</td></tr></table></td></tr>
<tr><td>70.</td><td>VI</td><td>A</td><td>VI</td><td>8 of 24</td><td>4.02.00</td><td></td><td>The parameters/capabilities ……following:-

(i) Wet ball Mill capacity at rated fineness .....</td><td>The parameters/capabilities ……following:-

(i) Wet ball Mill capacity at rated fineness .....</td></tr>
</table>

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							Contractor shall demonstrate the above capacity with the originally installed grinding elements in nearly worn-out condition as mutually agreed for the purpose of ascertaining wear life of any of the wear parts.	**Contractor shall demonstrate the above capacity with the originally installed grinding liners in nearly worn-out condition with recommended ball top up charge.**
71.	VI	B	I-M1	10 of 49	4.04.00		**DESCRIPTION** | **Booster Fans** The construction ……. requirements	**DESCRIPTION** | **Booster Fans** The construction ……. requirements

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

<table>
<tr><th></th><th colspan="6">REFERENCE</th><th>EXISTING</th><th>READ AS</th></tr>
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<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>
<table>
<tr><td>Type of fan blades</td><td>…….</td></tr>
<tr><td>……..</td><td>……</td></tr>
<tr><td>Fan casing material thickness</td><td>Abrasion and wear resistant, high BHN steel having minimum 8.0mm thickness or 12mm mild steel with liner of thickness 10mm (min.)</td></tr>
<tr><td>……</td><td>……</td></tr>
</table>
</td><td>
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<tr><td>Fan casing material thickness</td><td>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.</td></tr>
<tr><td>……</td><td>……</td></tr>
</table>
</td></tr>
<tr><td>72.</td><td>VI</td><td>A</td><td>VII</td><td>4 of 38</td><td>1.02.00</td><td></td><td>
<table>
<tr><td>Gates in Flue Gas System</td><td></td></tr>
<tr><td>1. Seals</td><td>3 sets of each type (Set means complete replacement for one gate)</td></tr>
<tr><td>2. Actuator</td><td>1 no. of each type</td></tr>
</table>
</td><td>
<table>
<tr><td>Gates in Flue Gas System</td><td></td></tr>
<tr><td>1. Seals</td><td>3 sets of each type (Set means complete replacement for one gate)</td></tr>
<tr><td>2. Expansion Joint</td><td>1 no. of each type & size</td></tr>
</table>
</td></tr>
<tr><td>73.</td><td>VI</td><td>B</td><td>I-M1</td><td>18 of 49</td><td>5.06.11</td><td></td><td>The absorber vessel shall be made of minimum 7 mm thick carbon steel.</td><td>The complete absorber vessel (absorber oxidation tank, absorber tower & absorber outlet duct) shall</td></tr>
</table>

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							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.	**be made of clad sheet of C276 / Alloy 59 (minimum 2 mm thickness) having minimum 7 mm thich carbon steel as base material.**
74.	VI	B	I-M1	20 of 49	6.02.03		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.
75.	VI	C	GTR	42 of 92	30.00.00		**NOISE LEVEL** 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: a) Ball Mill < 90 dBA	**NOISE LEVEL** 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 **and limestone crusher** the noise levels as per following shall also be acceptable: a) Ball Mill < 90 dBA **b) Limestone crusher < 90**

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								dBA
76.	VI	B	I-M1	19 OF 49	5.06.24		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.
77.	VI	B	I-M1	27 OF 49	7.08.01		The Contractor shall provide **an auxiliary absorbent tank, for the unit**, sized to contain the complete slurry ……. It should be possible to discharge the each absorber into the **emergency drain** tank within 2 hours.	The Contractor shall provide a **common auxiliary absorbent tank, common for all the three units, shall be** sized to contain the complete slurry ……. It should be possible to discharge the each absorber into the **Auxiliary Absorbent** tank within 2 hours.
78.	VI	B	I-M1	28 OF 49	8.05.00		**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.
79.	VI	A	III-A1	6 OF 8	7.01.02		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.**
80.	VI	A	VII	4 of 38	1.03.00		Absorber	Absorber

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							1. Liner Material — 15% coverage of each material and thickness for one Unit/absorber 2. Absorber Spray/Oxidation nozzles — 20% of each type 3. Absorber Nozzles Mist Eliminator Washing Nozzles — 20% of each type 4. Absorber Mist Eliminator — 15% of each type	1. Absorber Spray/Oxidation nozzles — 20% of each type 2. Absorber Nozzles Mist Eliminator Washing Nozzles — 20% of each type 3. Absorber Mist Eliminator — 15% of each type
81.	VI	B	I-M1	23 OF 49	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.	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 gypsum shall be as per the requirement of the vacuum belt filters
82.	VI	A	III-A1	4 OF 8	4.01.04		2x100% Centrifugal/ positive displacement type oxidation blowers / compressors.	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

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

<table>
<tr><td></td><td colspan="6">REFERENCE</td><td>EXISTING</td><td>READ AS</td></tr>
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<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>reaction tank.</td></tr>
<tr><td>83.</td><td>VI</td><td>B</td><td>I-M1</td><td>10 OF 49</td><td>4.04.00</td><td></td><td>Booster Fan:
Fan rotational speed: 600 rpm (max.)</td><td>Booster Fan:
Fan rotational speed: 745 rpm (max.)</td></tr>
<tr><td>84.</td><td>VI</td><td>A</td><td>V</td><td>6 of 10</td><td>6.00.00</td><td></td><td>LIMESTONE CHARACATERSTICS

Table-3

<table><tr><td colspan="4">Chemical Analysis(% by mass)</td></tr><tr><td>1.</td><td>…….</td><td>…..</td><td>…….</td></tr><tr><td>2.</td><td>…….</td><td>……</td><td>…….</td></tr><tr><td colspan="4">Physical properties</td></tr><tr><td>1</td><td>Bond Index</td><td>kWh/t</td><td>13</td></tr><tr><td>2</td><td>……</td><td>……</td><td>…….</td></tr></table></td><td>LIMESTONE CHARACATERSTICS

Table-3

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<tr><td>85.</td><td>VI</td><td>B</td><td>I-M1</td><td>21 OF 49</td><td>6.05.03</td><td></td><td>The mill hydro-cyclone set shall have sufficient ……. The liners shall have a minimum wear life of not less than 7000 hrs.</td><td>The mill hydro-cyclone set shall have sufficient ……. The liners shall have a minimum wear life of not less than 8000 hrs.</td></tr>
<tr><td>86.</td><td>VI</td><td>A</td><td>I</td><td>12 of 18</td><td>4.01.08</td><td></td><td>In case the Bidder or the proposed sub-vendor is a manufacturer of Slurry Pumps who meets the requirements</td><td>In case the Bidder or the proposed sub-vendor is a manufacturer of Slurry Pumps who meets the requirements</td></tr>
</table>

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							stipulated at clause 4.01.02(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 **4.01.02(e)** above for the Slurry Recirculation Pumps. However, in this case ……. Million only).	stipulated at clause 4.01.02(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 **4.01.02(b)** above for the Slurry Recirculation Pumps. However, in this case ……. Million only).
87.	VI	A	I	9 of 18	4.01.02 Table Sl. No. (c)		Application : Wet Limestone based FGD application in **Coal fired power plant**	Application : Wet Limestone based FGD application in **Coal fired power plant or any other process application.**
88.	VI	A	I	9 of 18	Para below the clause No. 4.01.02 table		Bidder shall offer ……. reference plant equipment.	Bidder shall offer ……. reference plant equipment. **The provenness criteria for equipment (Slurry Recirculation Pump) stipulated at Sl. No. 4.01.02(b) above shall also be considered acceptable**

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								provided the rating parameters (i.e., flow, head) is covered within the operating regime of the respective Slurry Recirculation Pump performance curve of the reference plant equipment.
89.	VI	A	I	9 of 18	4.01.06		In case the Bidder ……only).	(i)In case the Bidder ……only). OR **(ii)In case, the bidder or proposed sub vendor is not a manufacturer of proven Wet Limestone Grinding Mills as per clause no. 1.2 (d) above, but have designed, manufactured and 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**

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								requirements stipulated at clause 1.2 (d) above for the We limestone Grinding mills and provides extended warranty of three (3) years for Wet Limestone Grinding Mills. In such a case Bidder shall provide an additional on demand bank guarantee for INR 1.5 Million (Indian Rupees One and Half Million only).
90.	VI	B	I-M1	4 OF 49	1.06.01		The Contractor shall offer the best design to accommodate the Flue Gas Desulphurization (FGD) System and Lime stone & Gypsum handling & storage system within the confines of the space available. The location of FGD System and associated facilities have been indicated in the tender drawings No. 9578-999-POM-F-001 & General Layout Plan.	The Contractor shall offer the best design to accommodate the Flue Gas Desulphurization (FGD) System and Lime stone & Gypsum handling & storage system within the confines of the space available. The location of FGD System and associated facilities have been indicated in the tender drawings No. 4410-999-POC-F-001 & 4410-999-POM-A-001.
91.	VI	A	I	5 OF 18	3.00.00 (B)		**SCHEMES**	**SCHEMES**

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

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<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>
<table>
<tr><th>Sl. No</th><th>Drawings Title</th><th>Drawings No.</th><th>Rev. No.</th><th>No. of Sheets</th></tr>
<tr><td>1)</td><td>Scheme of Absorber system</td><td>4410-109-POM-A-005</td><td>A</td><td>1</td></tr>
<tr><td>2)</td><td>Scheme of Limestone Milling system</td><td>4410-109-POM-A-006</td><td>A</td><td>1</td></tr>
<tr><td>3)</td><td>Scheme of Gypsum De-watering system</td><td>4410-109-POM-A-007</td><td>A</td><td>1</td></tr>
</table>
</td><td>
<table>
<tr><th>Sl. No</th><th>Drawings Title</th><th>Drawings No.</th><th>Rev. No.</th><th>No. of Sheets</th></tr>
<tr><td>1)</td><td>Scheme of Absorber system</td><td>4410-109-POM-A-005</td><td>A</td><td>1</td></tr>
<tr><td>2)</td><td>Scheme of Limestone Milling system</td><td>4410-109-POM-A-006</td><td>B</td><td>1</td></tr>
<tr><td>3)</td><td>Scheme of Gypsum De-watering system</td><td>4410-109-POM-A-007</td><td>B</td><td>1</td></tr>
</table>
</td></tr>
<tr><td>92.</td><td>VI</td><td>E</td><td>I</td><td>1 OF 2
12 of 14
13 of 14</td><td>1.00.00 (B)</td><td></td><td>
SCHEMES
<table>
<tr><th>Sl. No</th><th>Drawings Title</th><th>Drawings No.</th><th>Rev. No.</th><th>No. of Sheets</th></tr>
<tr><td>1)</td><td>……..</td><td>……</td><td>.</td><td>….</td></tr>
<tr><td>…</td><td>……..</td><td>…….</td><td>.</td><td>…</td></tr>
<tr><td>5)</td><td>Scheme of Limestone Milling system</td><td>4410-109-POM-A-006</td><td>A</td><td>1</td></tr>
<tr><td>6)</td><td>Scheme of Gypsum De-watering system</td><td>4410-109-POM-A-007</td><td>A</td><td>1</td></tr>
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SCHEMES
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<tr><td>…</td><td>……..</td><td>…….</td><td>.</td><td>…</td></tr>
<tr><td>5)</td><td>Scheme of Limestone Milling system</td><td>4410-109-POM-A-006</td><td>B</td><td>1</td></tr>
<tr><td>6)</td><td>Scheme of Gypsum De-watering system</td><td>4410-109-POM-A-007</td><td>B</td><td>1</td></tr>
</table>
Revised Drawing attached at Annexure III & IV
</td></tr>
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AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
93.	VI	A	VI	11 OF 14	5.00.00		**AUXILIARY POWER CONSUMPTION (PA)** The unit auxiliary power consumption shall be calculated……. …….. …….. ……	**Refer Annexure VII**
94.	SECTION – VI, PART-A		SUB-SECTION-III-B ELECTRICAL SYSTEM/ EQUIPMENT	1 of 6	1.02.00		**HT/ LT SWITCH GEAR** HT and 415V Switchgear / Motor control centers (as shown in Electrical Single Line Diagram Drg No. 4410-109-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** HT and 415V Switchgear / Motor control centers (as shown in Electrical Single Line Diagram Drg No. 4410-109-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. **HT Switchgear**- All HT switchboards shall be provided with one spare motor feeder and one transformer feeder on each section as spares. **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. In addition, all LT Switchgears, MCCs and AC distribution boards shall have

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								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.
95.	SECTION – VI, PART-A		SUB-SECTION-III-B ELECTRICAL SYSTEM/ EQUIPMENT	1 of 6	1.02.00		**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	**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 Sub-section-II- E1 Part-B of Technical specifications
96.	SECTION – VI, PART-B		SUB-SECTION-II-E1 GENERAL ELECTRICALSPECIFICATION	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 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.	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 be imposed.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
97.	SECTION – VI, PART-B		SUB-SECTION-II-E1 GENERAL ELECTRICAL SPECIFICATION	3 of 7	2.02.00		**MV Switchgears** 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 capacityrequirements,standardization, etc.	**MV Switchgears** Sizing of HT Switchgears (11kV/3.3kV) shall be in accordance with Clause No. 1.00.00 of Sub-section E9and its sub-clauses covering sizing criteria, performance / reliability criteria, layout criteria, spare capacityrequirements,standardization, etc.
98.	SECTION – VI, PART-B		SUB-SECTION-II-E1 GENERAL ELECTRICAL SPECIFICATION	3 of 7	2.03.00		**LV Switchgears** 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** 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.
99.	SECTION – VI, PART-B		SUB-SECTION-II-E1 GENERAL ELECTRICAL SPECIFICATION	4 of 7	2.03.00		**LV Switchgears** ……. 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** **……** 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.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
100	SECTION – VI, PART-B		SUB-SECTION-II-E1 GENERAL ELECTRICAL SPECIFICATION	4 of 7	2.04.00		Integration with Employer's Switchgear SCADA 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 switchgear. 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.	**THIS CLAUSE DELETED.**
101	SECTION – VI, PART-B		SUB-SECTION-II-E1 GENERAL ELECTRICAL SPECIFICATION	4 of 7	2.05.00		Control Philosophy The Control Philosophy shall be as follows: (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. (b)The motor feeders shall be controlled from the DDCMIS only	Control Philosophy The Control Philosophy shall be as follows: a) All switchgears and MCCs shall be controlled from PLC/DCS.
102	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHG	1 of 39	1.00.00		…… **Sizing For fault Conditions** Fault Level shall be the basic selection Criteria for MV switchgears. Typical Fault ratings	…… **Sizing For fault Conditions** Fault Level shall be the basic selection Criteria for MV switchgears. Typical Fault ratings are as detailed under

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
			EAR				are as detailed under Technical parameters (B-0).	Technical parameters (sub-section-II-E1).
103	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	2 of 39	1.00.00		**Spare capacity and Future Requirements** all MV Switchboards is provided with one spare motor feeder and one transformer feeder on each section for future requirements.	…… **Deleted**
104	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	6 of 39	3.00.00		**h) SURGE ARRESTERS (FOR MOTOR FEEDERS)** 3. Rated Voltage of Surge arrestor 12 KV for 11 KV And 4.5 KV for 3.3 KV	**h) SURGE ARRESTERS (FOR MOTOR FEEDERS)** 3. Rated Voltage of Surge arrestor 12 KV(Phase to Phase) for 11 KV And 4.5 KV (Phase to Phase) for 3.3 KV
105	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	9 of 39	4.2.00(b)		Outgoing breakers shall be suitable for switching transformers and motors at any load. They shall be capable of being used for frequent direct-on-line starting of squirrel cage induction motors of following ratings : 1)3.3KVAbove 160 kW up to 1500 kW (The contractor may adopt415V/3.3KV for drives rated in the range of 160-210 kW) 2) 6.6 kV Above 200 kW 3) 11 kVAbove 1500 kW Surge arrestor shall be provided for each motor feeder.	Outgoing breakers shall be suitable for switching transformers and motors at any load. They shall be capable of being used for frequent direct-on-line starting of squirrel cage induction motors of following ratings : 1)3.3KV : Above 160 kW up to 1500 kW (The contractor may adopt415V/3.3KV for drives rated in the range of 160-210 kW) 2) 11 kV :Above 1500 kW Surge arrestor shall be provided for each motor feeder

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
106	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	11 of 39	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.	The circuit breaker / contactor will normally be controlled from remote control panels (PLC/DCS) (via Numerical Relays) through closing and shunt trip coils.
107	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	15 of 39	4.10.00		(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. (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. e) Power Supply to Numerical Relayshall be an independent circuit with switch and fuse tapped from the panel DC supply…..
108	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	19 of 39	5.1.4		(d) Board IED (Switchgear Control Unit)-32BI + 32 BO	DELETED
109	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	19 of 39	5.1.7		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	All the numerical relays shall have communications on two ports, local front port for communication to laptop and one RJ45 port on IEC 61850.

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							separate Ethernet switches (provided by employer) to form part of the Switchgear SCADA.	
110	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	22 of 39	5.3.1		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 provided.	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.
111	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	23 of 39	5.3.8		The alarm / status of each individual protection function and trip operation shall be communicated to the Switchgear SCADA system.	DELETED
112	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	23 of 39	5.4.00 5.4.1		**NETWORKING** 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	DELETED

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							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.	
113	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	25 of 39	6.1.00		**…….** 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. …..	… 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. …….
114	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	27 of 39	7.0.00		**Training workshop at site for Switchgear** Workshop Training at site shall aim for familiarization of Site Engineers for commissioning and day to day O & M of MV Switchgears. 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 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	**Training workshop at site for Switchgear** Workshop Training at site shall aim for familiarization of Site Engineers for commissioning and day to day O & M of MV Switchgears. 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 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.

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	REFERENCE						EXISTING	READ AS
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							Unit Commissioning. Employer shall provide the required Infrastructure such as Training Conference room, Projection systems etc.	
115	SECTION – VI, PART-B		SUB-SECTION-II-E9 HT SWITCHGEAR	28 of 39	8.0.00		**Training workshop at site for Numerical Relay** 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. 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. 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 workshop at site for Numerical Relay** 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. 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 MV Switchboard. Employer shall provide the required Infrastructure such as Training Conference room, Projection systems etc.
116	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	1 of 58	1.01.01		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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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
117	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	2 of 58	1.03.00		Spare capacity and Future Requirements All LV Switchboard shall be provided with spare feeders / modules as specified in relevant clause of Part-A of Technical Specification.	DELETED
118	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	2 of 58	1.04.00		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
119	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	2 of 58	1.05.00		(f)Separate control cables shall be laid for EPB (Emergency/Local Push Button) status from EPB toSwitchgear for the Switchgear and DCS.	(f)Separate control cables shall be laid for EPB (Emergency/Local Push Button) status from EPB toSwitchgear for the Switchgear and PLC/DCS.
120	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITC	12 of 58	4.25.00		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	**DELETED**

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
			HGEARS & LT BUSDUCTS				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.	
121	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	18 of 58	11.00.00		**TELESCOPIC TROLLEY** **…….** The quantity of telescopic trolleys to be supplied shall be 2 Nos. per switchgear room.	**TELESCOPIC TROLLEY** **…….** The quantity of telescopic trolleys to be supplied shall be 1 No. per switchgear room.
122	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	20 of 58	18.00.00		**Numerical relays & networking**	**Numerical relays**
123	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS &	20 of 58	18.01.00		**…….** These relays shall be connected to the Switchgear SCADA System, through Ethernet switches…….	**…….** **DELETED** **……**

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
			LT BUSDUCTS					
124	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	21 of 58	18.02.00		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.
125	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	21 of 58	18.03.00		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**
126	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	21 of 58	18.04.00		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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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
127	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	21 of 58	18.05.00		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**
128	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	22 of 58	18.11.00		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.
129	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	23 of 58	18.26.00		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.
130	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITC	23 of 58	18.27.00		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.

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
			HGEARS & LT BUSDUCTS					
131	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	23 of 58	18.27.00		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.
132	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	24 of 58	19.08.00		The alarm/status of each individual protection function and trip operation shall be communicated to Switchgear SCADA / DDCMIS.	**DELETED**
133	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	24 of 58	19.12.00		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**

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
134	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	24 of 58	19.13.00		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…….
135	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	24 of 58	19.14.01		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** Workshop Training at site shall aim for familiarization of Site Engineers for commissioning and day to day O & M of LT Switchgears. 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.
136	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITC	24 of 58	19.14.02		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	**Training workshop at site for Numerical Relay** Workshop Training at site shall aim for familiarization of Site Engineers for commissioning and day to day O & M

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
			HGEARS & LT BUSDUCTS				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.	of Numerical Relays and trouble shooting. 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
137	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	31 & 32 of 58	31.00.00 31.01.00 31.02.00 31.03.00 31.04.00 31.05.00 31.06.00 31.07.00 31.08.00 31.09.00 31.10.00 31.11.00		**BUS TRUNKING SYSTEM (SANDWICH TYPE BUSDUCT)**	**DELETED**
138	SECTION – VI, PART-B		SUB-SECTION-II-E10 LT SWITCHGEARS & LT BUSDUCTS	34 of 58	38.04.00		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.

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
139	SECTION – VI, PART-B		SUB-SECTION-II-E11 DIESEL GENERATORS	3 0F 19	5.03.00		Owner shall provide two (2) number…… . The alternator outgoing supply of DG set shall be fed into employers breaker panel.	**Bidder** shall provide two (2) number…….. The alternator outgoing supply of DG set shall be fed into **bidder's** breaker panel.
140	SECTION – VI, PART-B		SUB-SECTION-II-E11 DIESEL GENERATORS	4 of 19	6.01.00		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
141	SECTION – VI, PART-B		SUB-SECTION-II-E11 DIESEL GENERATORS	7 OF 19	7.10.03		(I) Earth fault (alarm) input from owners switchgear	(i) Earth fault (alarm) input from **bidder's** switchgear
142	SECTION – VI, PART-B		SUB-SECTION-II-E11 DIESEL GENERATORS	8 of 19	7.11.00		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
143	SECTION –		SUB-SECTION-	8 of 19	7.12.00		The bidder is required to provide coupling relays (with diodes) having 24V DC energising coil in	The bidder is required to provide coupling relays (with diodes) having 24V DC energising coil in

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
	VI, PART-B		II-E11 DIESEL GENERATORS				the control panel for the followings for owner's use	the control panel for the followings for **bidder's** use
144	SECTION – VI, PART-B		SUB-SECTION-II-E11 DIESEL GENERATORS	8 of 19	7.14.00		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:
145	SECTION – VI, PART-B		SUB-SECTION-II-E11 DIESEL GENERATORS	2 of 19	3.00.00		Technical Requirements:- i) Fuel service tank:-8 hours running	Technical Requirements:- i) Fuel service tank:- 990 litres
146	SECTION – VI, PART-B		SUB-SECTION-II-E11 DIESEL GENERATORS	5 of 19	7.04.00		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
147	SECTION – VI, PART-B		SUB-SECTION-II-E15 STATION	5 of 17	4.00.00		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-B:** While finalizing the detailed layout of lighting fixtures, the position/location and layout of

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
			LIGHTING					equipments should be taken into account to have adequate illumination at desired locations
148	SECTION – VI, PART-B		SUB-SECTION-II-E15 STATION LIGHTING				NA	**Annexure -B** attached
149	SECTION – VI, PART-B		SUB-SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION	23 OF 69	9.00.00		e) NA	e) The cable entry and exit from switchgear room shall be from 1.5 mtr (minimum) above FGL
150	SECTION – VI, PART-B		SUB-SECTION-II-E6 CABLING, EARTHING & LIGHTNING PRO	7 of 69	3.10.01		Receptacles boxes shall be fabricated out of MS …… …… …… …. The welding receptacle shall be provided with inbuilt ELCB rated for suitable mA sensitivity ranging from 30-300mA	Receptacles boxes shall be fabricated out of MS …… …… …… The welding receptacle shall be provided with **RCCB/RCD of 30 mA sensitivity having facility for manual testing/checking of operation of RCCB/RCD.**

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
			TECTION					
151	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-A**
152	SECTION – VI, PART-B SECTION – VI, PART-E		SUB-SECTION-III-C5 PLC BASED CONTROL SYSTEM Tender drawing	19 of 27	9.05.00		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. 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. Scheme of UPS system	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. UPS Configuration-B drawing 0000-999-POI-A-019C updated. (Annexure-

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
			C&I				Configuration-B Drg. no. 0000-999-POI-A-019C	IX)
153	SECTION – VI, PART-A		SUB-SECTION-IIIC C&I	6 of 9	6.01.00		Contractor shall ensure that RIO cabinets are provided in air conditioning environment.	Contractor shall ensure that RIO cabinets are provided in air conditioning environment. The construction & civil works of air conditioning room shall be in the scope of bidder. RIO panel with panel air conditioning shall also be acceptable if such RIO panels are be placed inside a ventilated building. The construction & civil works of building (inside which RIO panel with panel air conditioning shall be placed) and its ventilation, shall be in the scope of bidder.
154	SECTION – VI, PART-E		Tender drawing C&I				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). Annexure- X
155	SECTION – VI, PART-A		SUB-SECTION-IIIC C&I	5 of 9	New clause 2.07.00		-	2.07.00 Contractor shall provide one no. of Hand held HART calibrator per generating unit.
156	SECTION – VI, PAR		SUB-SECTION-IIIC C&I	7 of 9	New clause 6.08.00		-	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

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
	T-A							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 North Karanpura (3x660MW), 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.
157	SECTION – VI, PART-B		SUB-SECTION-III-C2, MEASURING INSTRUMENTS	15 of 30	8.00.00		Viscosity range of Fluid 0-500cst for HFO.	DELETED
158	SECTION – VI, PART-A		SUB-SECTION-IIIC C&I	6 of 9	6.01.00		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	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

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							programming station of PLC and Human Machine Interface system (EWS cum OWS). The PLC configuration drawing……	PLC and Human Machine Interface system (EWS cum OWS). However, bidder to consider minimum quantity of OWS and OWS cum EWS as follows: a) OWS (placed in FGD control room)- 4 (Four) b) OWS cum EWS (placed in FGD control room)- 1 (ONE) c) OWS (placed in central control room of each generating unit)- 2 (TWO). The PLC configuration drawing……
159	SECTION – VI, PART-A		SUB-SECTION-IIIC C&I	7 of 9	New clause 6.09.00			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	27 of 27	16.01.00		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.

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
160	SECTION – VI, PART-E		Tender drawing C&I				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. Annexure-XI
161	SECTION – VI, PART-A		SUB-SECTION-IIIC C&I	7 of 9	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. 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.
162	SECTION – VI, PART-A		SUB-SECTION-IIIC C&I	3 of 9	2.03.02		CEMS, instruments shall be provided with provision for ……. implementation of above connectivity. For CEMS - In addition to above requirement, 4-20 mA connectivity to DDCMIS shall be provided by the Contractor.	CEMS, instruments shall be provided with provision for ……. implementation of above connectivity. For CEMS - In addition to above requirement, 4-20 mA connectivity to employer's **BOP**-DDCMIS shall be provided by the Contractor.
163	Part B (1)– Section VI		Sub Section-I-M1	20 of 49	6.02.03		a) 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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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
164	SECTION – VI, PART-B		SUB-SECTION-III-C2, MEASURING INSTRUMENTS	29 of 30	11.07.00 Note 1		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.	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 type dryer (located near the tapping point) may also be provided in place of sample cooler.**
165	SECTION – VI, PART-A		SUB-SECTION-VII, Mandatory Spares	23 of 38	5.00.00		5.00.00 CONTROL AND INSTRUMENTATION	5.00.00 CONTROL AND INSTRUMENTATION **(EXCLUDING AIR CONDITIONING AND VENTILATION SYSTEM, FIRE DETECTION AND PROTECTION SYSTEM. For mandatory spare of these systems, refer mandatory spare clauses specified under respective systems)**
166	SECTION – VI, PART-A		SUB-SECTION-IIIC C&I	7 of 9	6.07.00		……..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 to note that UPS of configuration C is acceptable only upto 5 KVA. In	……..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. Contractor to note that UPS of

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							case the consolidated load requirements……	configuration C is acceptable only upto 5 KVA. In case the consolidated load requirements……
167	SECTION – VI, PART-A		SUB-SECTION-IIIC C&I	7 of 9	New clause 6.11.00		-	Output redundancy is applicable for 10% of drives distributed in various functional groups (Exact application shall be finalized during detailed engineering).
168	SECTION – VI, PART-B		SUB-SECTION-III-C2 MEASURING INSTRUMENTS	3 of 30	2.01.00 (16)		16. Adjustment/calibration/maintenance From hand held HART calibrator/ centralized PC based system (as applicable).	16. Adjustment/ calibration/ maintenance From hand held HART calibrator.
169	VI	E		1 OF 2 6 of 14	1.00.00 (A)		**(A) LAYOUT & CIVIL DRAWINGS** (1) Layout Plan of FGD System : ……. (2) Layout of FGD Area : Drg No. : 4410-999-POM-A-001	**(A) LAYOUT & CIVIL DRAWINGS** (1) Layout Plan of FGD System : ……. (2) Layout of FGD Area : Drg No. : 4410-999-POM-A-001 **Rev-B** **Revised Drawing attached at Annexure VI**

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
170	VI	B	I-M1	13 OF 49	5.01.00 (B)		(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. The sparger and ……. a minimum life of 5 years. Minimum 10% redundancy, …….. Sparger Tubes.	(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 **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 specified for slurry recirculation pumps.** The Cooling Pumps shall be installed inside a building. The sparger ……. minimum life of 5 years. Minimum 10% ……..Sparger Tubes.
171	VI	B	I-M1	2 OF 49	1.03.02		The FGD system shall …….. Steam Generator is in operation. However, provision has be made by the Employer for	The FGD system shall …….. Steam Generator is in operation. However, **provision shall be made by the contractor for**

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							facilitating operation of unit with FGD bypass. This …….unit in operation. For this purpose. Motorized Guillotine type gates shall be provided at (i) hot gas inlet to Absorber and (ii) in the bypass duct. Further, Quick opening Bi-plane motorized/pneumatic damper along with 2x100% seal air fans shall be provided in the by-pass duct. The same shall also be taken into account while designing the control & logics for the FGD System.	**facilitating operation of unit with emergency FGD bypass**. This …….unit in operation. For this purpose. Motorized Guillotine type gates shall be provided at (i) hot gas inlet to Absorber, **(ii) hot gas inlet to booster fan and (iii) outlet of booster fan.** Further, Quick opening Bi-plane motorized / pneumatic damper along with 2x100% seal air fans shall be provided in the by-pass duct. The same shall also be taken into account while designing the control & logics for the FGD System.
172	VI	B	I-M1	9 of 49	4.01.02 (iv)		Margin over pressure requirement: 44% over the calculated value	Margin over pressure requirement: 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

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								requirements of fan.
173	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 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.	All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized**/pneumatic** 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.
174	PART-B		IV-D Civil Works	8 OF 114	3.07.00		**Gypsum Storage Shed** 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	**Gypsum Storage Shed** 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

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							provided with troughed profile permanently colour coated sheet with slope for quick drainage of rain water.	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.**
175	VI/B		IV-D Civil Works	3.14.01, Para 1	10 of 114		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.**
176	VI/B		IV-D Civil Works	3.14.08	14 of 114		**Thermal insulation** 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	**Thermal insulation (Applicable in case of Titanium / C-276 Flue Liner)** 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

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							washer.	used. ..... pins and speed washer.
177	VI/B		IV-D Civil Works	3.14.09,	15 of 114		(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.
178	VI/B		Sub-section IVD Civil Works	1.02.00	01 of 114		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**

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								the Engineer. Some of the relevant I. S. Codes to be followed 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.
179	Section VI / Part B		Sub-Section-IV-D Civil Works	2.00.00	1 of 114		**"Sub QR for civil works:"**	**" Clause Deleted"**
180	VI/B		IV-D Civil works	Annexure-A	Para-5, 71 of 114		For regular buildings less than 12m in height…… with appropriate multiplying factor given in Appendix-I.	**"Deleted"**
181	VI/B		IV-D Civil works	Annexure-A	72 of 114		**Appendix-I** "SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT"	**"SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT"** given in **"Annexure-VIII"** to this amendment shall replace the **"SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND**

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								EQUIPMENT" at Appendix-I, Annexure-A, Sub-section- IV-D Civil works, Part-B, Sec-VI, of Tech. Specification.
182	Section VI / Part A		Sub-section IIID Civil Works	2.00.00	3 of 4		8. Approach road to project site……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.	8. Approach road to project site……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 roads shall be **6 M / 12 M** concrete pavement.
183	Section VI / Part B		Sub-section IVD	15.00.00	32 of 114		…… Sewage pump house shall be provided as per IS:4111.	…… Sewage pumping stations shall be provided as per IS:4111.
184	Section VI / Part B		Sub-section IVD	14.00.00	31 of 114		…… …..These values shall be based on rainfall intensity of **90mm/hr** ……	…….. These values shall be based on rainfall intensity of **75mm/hr** …… ……
185	Section		Sub-Secti	17.01.00	34 of 114		Design of steel structures shall be done by working stress method. Design shall be as per	Design of steel structures shall be done as per provisions of IS:800: 2007 (Limit state design) and

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
	VI / Part B		on-IV-D Civil Works				provisions of IS:800:1984.	other relevant IS standards.
186	Section VI / Part B		Sub-Section-IV-D Civil Works	17.26.00	38 of 114		-	For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015 for Earthquake loads.
187	Section VI / Part B		Sub-Section-IV-D Civil Works	17.27.00	38 of 114		-	Design drawings of steel structures shall include the connection, joint & fastener details for Main columns, Beams & Bracings.
188	Section VI / Part B		Sub-Section-IV-D Civil Works	4.02.00	18 to 19 of 114		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. **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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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
189	Section VI / Part B		Sub-Section-IV-D Civil Works	7.00.00, Para-2	24 of 114		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.
190	Section VI / Part B		Sub-Section-IV-D Civil Works	3.03.00, Para-1	6 of 114		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**	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

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							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 with0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses.	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.
191	Section VI / Part B		Sub-Section-IV-D Civil Works	3.04.00, Para-1	7 of 114		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.
192	Section VI / Part B		Sub-Section-IV-D Civil Works	3.09.00, Para-1	8 of 114		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 (minimum ISMC 250) and tread shall be of steel gratings. Out side stairs to	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 (minimum ISMC 250) and tread shall be of steel gratings. Out side stairs to transfer points/crusher house

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	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							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.	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.
193	Section VI / Part B		Sub-Section-IV-D Civil Works	3.01.00, Para-11	3 of 114		Plinth protection along with drains shall be provided along the Hopper complex. 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**.
194	Section VI / Part B		Sub-Section-IV-D Civil Works	24.00.00,	42 of 114		**CONCRETE** c) M35- For spring supported RCC deck	**CONCRETE** c) M35- For spring supported RCC deck **and rail load bearing structure (if applicable).**
195	Section VI / Part B		Sub-Section-IV-D Civil Works	39.03.00,	66 of 114		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:	**Cement** 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

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
							8112, IS: 12269, & IS: 455.	as per IS code. Ordinary Portland Cement (OPC) shall necessarily be used for the following structures. a) Spring supported decks of limestone crusher b) RCC for Chimney shell. The grade of cement shall be Grade 43 for OPC conforming to IS:8112. 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 on trial mix. Mix design shall be done with varying percentage of fly ash mix with cement.
196	Section VI / Part		Sub-Section-IV-D	39.05.00,	67 of 114		-	**Aggregates** a) **Coarse Aggregate** Coarse aggregate for concrete

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
	B		Civil Works					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. b) **Fine Aggregate** Fine aggregate shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or 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. 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

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								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 chalcedony, opal etc. The procedure laid down in IS 2430 for sampling of aggregates may be followed. 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

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								are not satisfactory, shall be submitted to the Engineer for his review, in a report form. 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. In case aggregates indicate residual expansion, under repeated temperature cycle test (from 10^{o} Celsius to 65^{o} 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 temperature cycle. The contractor shall use aggregates free from residual expansion under repeated temperatures cycle test.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
197	Section VI / Part B		Sub-Section-IV-D Civil Works	8.00.00, Para-3	26 of 114		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%.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
198	SECTION – VI, PART-A		SUB-SECTION-IIIC C&I	5 of 9	New clause 2.07.00		-	2.07.00 Microprocessor based vibration monitoring system shall be provided for booster fans, limestone crushers, wet limestone mills and all other equipment 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 bearing locations (except for vertical pumps for which one bearing location may be sufficient).
199	SECTION – VI, PART-B		SUB-SECTION-III-C2 MEASURING INSTRUMENTS	30 of 30	New clause 12.00.00		-	**12.00.00 Vibration Monitoring System (VMS)** i)The vibration monitoring system shall be furnished on a system basis including vibration transducers 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. The vibration monitoring system shall include all power supplies, interconnecting cabling, calibration equipment, indicators, integrating units, signal

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								conditioning devices and all other accessories required for monitoring of vibration at each point. ii)Eddy current type proximity transducers shall be used. However, the finally selected sensor type shall also depend on recommendation of the equipment manufacturer & suitable for application requirement. Transducers shall be furnished in weatherproof housing suitable for field conditions. iii)Vibration monitoring system shall give buffered output of 4-20 mA DC for each point monitored. The signal shall be suitable for use as an input to PLC as well as for analog recording & analysis, linear in proportion to vibration velocity as well as displacement. 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. For each vibration monitor, two independent potential free contacts shall be made available for alarm & trip purposes.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								iv)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 UPS feeders with auto changeover scheme. v)The functional requirement for vibration monitoring system shall include but not be limited to the following: a)Vibration monitor front face status indications shall be available for indications of healthy conditions of pick up circuit, monitor circuit and power supply. Also set point indication with set point adjustment facility for setting alarm & trip levels shall be provided. b)The facility shall be available from front of mounting rack for functional checking of monitors with inhibition of alarm and trip contact outputs during test. Alarm inhibition shall also be provided during start-up.

AMENDMENT NO. 1 TO TECHNICAL SPECIFICATION (SECTION-VI) FOR NORTH KARANPURA (3X660MW) FGD PACKAGE

	REFERENCE						EXISTING	READ AS
Sl No.	Sec	Part	Sub Sec	Page No	Clause	Para/ Line		
								vi)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 and all other applicable codes & standards. In case it is the proven standard practice of a Bidder to provide vibration monitoring TFTs 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 purchaser's approval. vii)All vibration monitoring equipment shall be functionally tested for circuit continuity and Vibration monitoring system shall comply the complete requirements as per API 670 – 5th edition or latest edition at the time of supply.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
1	Section-VI Part-A Sub-Sec-I / Intent of Specification				1.01.00	1 of 18	Compliance with statutory requirements and obtaining clearances from statutory authorities, wherever required;	Since, the proposed FGD package is a brown field project, seeking statutory clearances (if any) related to existing facilities will be NTPC's responsibility.	Specification requirement is clear in this regard. Bidders to comply.
2	Section-VI Part-A Sub-Sec-I / Intent of Specification				1.03.01	3 of 18	Wet limestone based Flue gas desulphurization(FGD) for 2X 800 MW unit, capable of reducing to the specified limits the emissions of Sulphur Dioxide in flue gas produced by specified coal being fired in boiler….	Since the plant consists of 3X660 MW units, "2X800 MW" mentioned in this clause is presumed to be a typo. NTPC to confirm.	Refer Amendment to technical specification in this regard.
3	Section-VI Part-A Sub-Sec-I / Intent of Specification				3.00.00	4 of 18	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.	The term "Steam Generator Package" mentioned in this clause is considered to be a typo and the same is presumed to be referring to "FGD System Package". NTPC to confirm.	Refer Amendment to technical specification in this regard.
4	Section- VI, Part-A Sub Section-I Intent of Specification				4.01.02 (c)	9 of 18	**Oxidation Blowers** Application : Wet Limestone based FGD application in Coal fired power plant	Since, there are many constraints in obtaining the performance certificates of oxidation air blowers from some of the global power plant owners in overseas countries as these blowers were mostly in FGD supplier scope and not directly purchased by the power plant owner, NTPC is requested to qualify the Oxidiation Blower supplier who has previously designed (either by itself or under collaboration / licensing agreement), manufactured / got manufactured the blower with 80% of the flow & 100% of the head of the offered Oxidation Blower for any process application (instead of only FGD application). Also, performance certificates of oxidation air blower will be arranged for other process applications from blower suppliers.	Refer Amendment to technical specification in this regard.
5	Section-VI Part-A Sub-Sec-II / Project Information				Annexure-III	6 of 10	CLARIFIED WATER ANALYSIS	NTPC is requested to provide the detailed composition including chlorides for clarified water.	Shall be provided during detailed engineering
6	Section VI Part-A Sub-section-III-B Electrical System & Equipment				1.03.00	1 of 6	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.	Bidder has considered Nickel cadmium type of batteries. NTPC to confirm.	Specification requirements are clear. Bidder to comply the requirement of technical specifications.

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Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
7	Section VI Part-A Sub-section-III-B Electrical System & Equipment				1.04.00	1 of 6	Transformers as per Electrical Single Line Diagram Drg No. 4410-109-POE-J-001 and system requirement, however bidder to provide complete sizing & selection criteria of Transformer's feeding Contractor's own systems.	Bidder has considered LT transformers of 2x100% or 3x50% configuration and HT transformers of 2x100% configuration. 3x100% configuration for any of the transformer is not considered. NTPC to confirm.	Refer Amendment to technical specification in this regard.
8	Section VI Part-A Sub-section-III-B Electrical System & Equipment				1.07.00	2 of 6	DG SET (IF APPLICABLE)	One no. emergency DG set shall be provided common for all three FGD units. NTPC to confirm.	Min 1 (one) number of DG set common for entire FGD plant shall be provided by bidder for meeting emergency process loads envisaged for FGD plants. Refer tender SLD
9	Section VI Part-A Sub-section-III-B Electrical System & Equipment				1.09.00	3 of 7	Complete lighting system for internal and external areas for the plant, buildings, chimney and equipment in the bidder's scope.	Lighting shall be provided only for those systems which are in bidder scope. For other areas including roads, lighting will be in customer's scope. NTPC to confirm.	Lighting system shall be provided for all the internal and external area including roads which is under bidder's scope
10	Section-VI Part-A Sub Sec-IV Terminal Points & Exclusions				1.07.00	2 of 3	**Waste Water:** FGD waste water pipes shall be terminated at 5M away from the nearest Mixing tank of Employer in HCSD Silo area. Pressure at terminal point shall be 3kg/cm2(g) at 300mm above FFL. pH shall be 7.0 (approx.) and temperature shall be <50°C.	The temperature of waste water will normally be in the range of 50 to 60°C, however, no separate cooling system is considered for waste water. NTPC to confirm.	Bidder to note down that the tempreture of waste water at terminal point shall be < 50°C. In case it is greater then 50°C, bidder to make necessary cooling arrangment to get it below 50°C.

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Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
11	Section-VI Part-A Sub-Sec-V / Salient Design Data				3.00.00 Sl. No. 7	2 of 10	**Flue Gas Composition at FGD system inlet (Guarantee Point):** (i) O2 (% v/v wet): 6.18 (ii) CO2 (% v/v wet): 9.1 (iii) H2O (% v/v wet): 14.63 (iv) SO2 (% v/v wet): 0.088 (v) N2 (% v/v wet): 70.1 (vi) Inlet SO2 (mg/Nm³-wet): 2437 **Flue Gas Composition at FGD system inlet (Design Point):** (i) O2 (% v/v wet): 5.8 (ii) CO2 (% v/v wet): 8.92 (iii) H2O (% v/v wet): 17.29 (iv) SO2 (% v/v wet): 0.087 (v) N2 (% v/v wet): 68.00 (vi) Inlet SO2 (mg/Nm³-wet): 2407	Summation of flue gas constituents furnished is not equal to 100 (100.098 for Guarantee Point & 100.097 for Design Point). NTPC is requested to provide the flue gas analysis having sum of its constituents as 100. Also, the values of SO2 (% v/v wet) and Inlet SO2 (mg/Nm³-wet) furnished in the design data are not consistent with each other. NTPC is requested to clarify.	Refer Amendment to technical specification in this regard.
12	Section-VI Part-A Sub-Sec-V / Salient Design Data				3.00.00 Sl. No. 7	2 of 10	(iv) SO3 (ppm) (at 6% O2 wet)	Sl. No. for SO3 constituent is presumed to be a typo and the same is read as follows: (ix) SO3 (ppm) (at 6% O2 wet)	Refer Amendment to technical specification in this regard.
13	Section-VI Part-A Sub-Sec-V / Salient Design Data & Sizing				3.00.00 Sl. No. 5	2 of 10	Gas flow at the FGD inlet when firing respective coal	Since, FGD inlet flue gas flow (in m³/s) calculated by applying the pressure & temperature correction on the flue gas flow furnished at normal conditions is not matching with the actual flue gas value provided in salient design data, NTPC to clarify the flue gas pressure *(including site altitude correction)* and temperature corresponding to the FGD inlet flue gas flow (in m³/s).	Refer Amendment to technical specification in this regard.
14	Section-VI Part-A Sub-Sec-I / Intent of Specification				4.01.08	12 of 18	In case the Bidder or the proposed sub-vendor is a manufacturer of Slurry Pumps who meets the requirements stipulated at clause 4.01.02(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 4.01.02(e) above	Bidder understand that the bidder or proposed sub-vendor who does not meet the requirements of 4.01.02 (e) can also manufacture slurry pumps provided it has collaboration or valid license agreement with manufacturer who meet the requirements of 4.01.02 (e). NTPC to confirm	Refer Amendment in this regard.
15	Section-VI Part-A Sub-Sec-I / Intent of Specification				4.02.04	13 of 18	In case Bidder or its agency do not meet the requirements at 2.1	Bidder could not locate the Clause 2.1. NTPC to clarify.	Refer Amendment to technical specification in this regard.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
16	Section- VI, Part-A Sub Section-III-A1 FGD				2.02.00	1 of 8	Bidder shall make opening in the existing duct at ID Fan outlet duct at the terminal point and connect to the booster fan inlet ducting.	Incase, opening is already available in the existing ID fan duct at ID fan outlet, NTPC to clarify whether the tapping for booster fan inlet duct is to be taken from the same opening or it can also be taken from any other suitable location in ID fan outlet duct. If the same is acceptable, the new opening in the ID fan outlet duct will be in bidder's scope.	Bidders to comply the specification requirement.
	Section- VI, Part-A Sub Section-IV Terminal Points and Exclusions				1.02.00	1 of 3	**Flue Gas Duct** (i) Un cleaned Flue Gas For each unit: Outlet flange (matching flanges/ expansion joint included in the Contractor's scope) in the tapping from the common Flue Gas Duct going towards the existing Chimney. No load of duct shall be transmitted on the Employers facilities. In case no opening or flange connection is available in the ducts from where tapping will be taken, the cutting in the duct as well as flange connection shall be in the scope of the contractor.		
17	Section-VI Part-A				Drg. No. 0-00-020-76722, Rev. 02		Gen. Arrgt. - Back end Elevation (Layout of ID system - Elevation)	Since, the dimensions mentioned on this drawing provided along with Section-VI, Part-A are not readable, NTPC is requested to provide these drawings in CAD format.	PDF FORMAT DRWAING AGAIN ENCLOSED AT ANNEXURE-II.
18	Section-VI Part-A				Drg. No. 0-00-020-76723, Rev. 02		Gen. Arrgt. - Back end Plan (Layout of ID system - Plan)		

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
19	Section-VI Part-A Sub-Sec-III-A1 / FGD				3.01.03	3 of 8	Two (2) limestone slurry tanks, each tank sized to meet 12 hrs total limestone slurry storage requirement for two units at Design point, complete with all accessories and Agitator(s).	Since, the proposed FGD system is for 3x660 MW plant, it is presumed that each limestone slurry tank is to be sized for meeting 12 hrs storage requirement of three units and not two units. NTPC to confirm.	Refer Amendment to technical specification in this regard.
20	Section-VI Part-A Sub-Sec-III-A1 / FGD				5.01.00	4 of 8	The employer envisages a common gypsum dewatering system for the two (2) units.	Since, the proposed FGD system is for 3x660 MW plant, it is presumed that the gypsum dewatering system is common for three units and not two units. NTPC to confirm.	Refer Amendment to technical specification in this regard.
21	Section- VI, Part-A Sub Section-III-A1 FGD				5.02.00	5 of 8	Each set (suitable for handling /dewatering of one unit) of dewatering equipment (01 working set + 01 standby set) shall comprise of the following items as a minimum requirement:	When two or more units are combined into a common dewatering facility, providing a holding tank (with dedicated primary hydrocyclone feed pump) in between bleed pumps and primary hydrocyclone is critical for achieving the desired performance from the hydrocyclones. NTPC to advise. Also, since dewatering system is common for all the units, the statement "Each set (suitable for handling /dewatering of **one unit**) of dewatering equipment" mentioned in this clause is ignored. NTPC to confirm.	Specification requirement stipulated are minimum requirement. However, for proper functioning of system, bidders may also provide additional facilities as per the system requirement. For the query as per second para refer Amendment to the technical specifications.
22	Section-VI Part-A Sub-Sec-V / Salient Design Data				4.00.00	4 of 10	Predicted Performance data at FGD Inlet at various Loads	NTPC is requested to also provide the volumetric gas flow & flue gas composition to be considered for all the specified load cases.	Refer Amendment to technical specification in this regard.
23	Section-VI Part-A Sub-Sec-VI / FGD				4.02.00 (i)	8 of 14	**Wet ball mill capacity** Contractor shall demonstrate the above capacity with the originally installed grinding elements in nearly worn-out condition	Since grinding elements of limestone mills are balls which need to be replaced at regular intervals, the worn-out condition is not applicable for these kind of mills and hence not considered. NTPC to confirm.	Refer Amendment to technical specification in this regard.

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Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
24	Section-VI Part-A Sub Sec-IV Terminal Points & Exclusions				1.07.00	2 of 3	**Waste Water:** FGD waste water pipes shall be terminated at 5M away from the nearest Mixing tank of Employer in HCSD Silo area. Pressure at terminal point shall be 3kg/cm2(g) at 300mm above FFL. pH shall be 7.0 (approx.) and temperature shall be <50°C.	The temperature of waste water will normally be in the range of 50 to 60°C, however, no separate cooling system is considered for waste water. NTPC to confirm.	Bidder to note down that the tempreture of waste water at terminal point shall be < 50°C. In case it is greater then 50°C, bidder to make necessary cooling arrangment to get it below 50°C.
25	Section-VI Part-A Sub Sec-IV Terminal Points & Exclusions				1.11.01	2 of 3	**Electrical** 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 Employer's 11 KV switch gear.	HT Switchgear is located in main plant AB bay.
26	Section-VI Part-A Sub Sec-III-A1- (FGD)				18.00.05	8 of 8	**Wet Stack Condensate Collection system** 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.	Bidder proposes to transfer the condensate collected in wet stack back to the absorber, which will not require neutralization of condensate. NTPC to advise if the same is acceptable.	Specification requirement is clear in this regard. Bidders to comply.
27	Section-VI Part-A Sub Sec-III-A1- (FGD)				17.00.00	8 of 8	In case higher pressure/flow requirements are envisaged for instrument & service air Contractor shall make its own arrangement.	NTPC to inform the pressure of instrument & service air available at plant to decide the requirement of new arrangement.	At terminal point 5-7 kg/cm2 pressure available.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION: Section / Part / Chapter	Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
28	Section-VI Part-A Sub-Sec-VI / Functional Guarantees & Liquidated Damages	4.02.00 (vi)	8 of 14	**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.	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 plant (i.e. total 30 m³/hr for the complete plant). NTPC to confirm.	Specification requirement is clear in this regard. Bidders to comply.
27	Section-VI Part-A Sub-Sec-V / Salient Design Data	6.00.00	6 of 10	**Limestone Characteristics:** Bond Index : 13 kWh/t	Bond Work Index of limestone is considered as 13 kWh/t, which is presumed to be same as 13 kWh/MT. NTPC to confirm bidder's understanding.	
	Section-VI Part-B Sub-Sec-I-M1 (FGD)	6.05.01 (vi)	21 of 49	Limestone Bond Index : 13 kWh/Sh.T (Min.)		Refer Amendment to technical specification in this regard.
28	Section-VI Part-B Sub-Sec-I-M1 (FGD)	6.06.02	22 of 49	The agitators shall be designed to meet the requirements stipulated in Cl. No. 12.00.00 of this Sub-Section.	Since, Clause No.17.00.00 of this Sub-Section refers to Slurry lines and Valves. bidder believes that the correct reference clause is 11.00.00 -Agitators. NTPC to confirm.	Refer Amendment to technical specification in this regard.
29	Section-VI Part-B Sub-Sec-I-M1 (FGD)	3.03.09	7 of 49	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 the proposed FGD project, the requirements specified in tender related to the same have been ignored. NTPC to confirm.	Refer Amendment to technical specification in this regard.
	Section-VI Part-B Sub-Sec-I-M1 (FGD)	3.03.01	7 of 49	A Pneumatic operated multi louver damper with seal air arrangement shall also be provided by the Contractor in the clean gas duct after GGH.		Refer Amendment to technical specification in this regard.
	Section-VI Part-B Sub-Sec-I-M7	MDL		Documents & Drawings related to GGH.		Since GGH is not applicable, hence, documents & drawings mentioning GGH requirement may be ignored.
30	Section-VI Part-B Sub-Sec-I-M1 (FGD)	1.03.02	2 of 49	However, provision has be made by the Employer for facilitating operation of unit with FGD bypass.	Please clarify whether only quick opening bi-plane damper or both guillotine gate and bi-plane damper of bypass duct are in NTPC's scope.	
	Section-VI Part-B Sub-Sec-I-M1 (FGD)	1.03.02	2 of 49	Motorized Guillotine type gates shall be provided at (i) hot gas inlet to Absorber and (ii) in the bypass duct. Further, Quick opening Bi-plane motorized/pneumatic damper along with 2x100% seal air fans shall be provided in the by-pass duct.		All the mentioned dampers / gates are in Bidders scope.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
	Section-VI Part-B Sub-Sec-I-M1 (FGD)				3.03.07	7 of 49	A damper in the bypass duct is being provided by the Employer for quick opening to allow bypass to come into operation in case of emergency.	scope.	Refer Amendment to technical specification in this regard.
	Section-VI Part-E				Drg. No.: 4410-109-POM-A-005		Scheme of FGD-Absorber System showing guillotine gate in bypass duct to be in FGD scope.		
31	Section-VI Part-A Sub-Sec-III-A1 FGD				6.02.00	6 of 8	**Auxiliary Absorbent Tank:** The contractor shall provide 1x100% slurry pumps for pumping the slurry back to the absorber of any of the units in 8 hrs (max.).	Since, the requirement for no. of pumps specified in both of these clauses is contradictory, 1x100% slurry pump per station has currently been considered to pump back the slurry from absorbent tank to the absorber. NTPC to confirm.	Refer Amendment to technical specification in this regard.
	Section-VI Part-B Sub-Sec-I-M1 (FGD)				7.08.02	27 of 49	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.		
32	Section-VI Part-B Sub-Sec-I-M1 (FGD)				5.06.24 7.08.01	19 of 49 27 of 49	It should be possible to discharge the absorber sump into the emergency drain tank within 2 hours.	It is presumed that emergency drain tank mentioned in this clause refers to auxiliary absorbent tank. NTPC to confirm.	Bidders understanding is correct. Refer Amendment to technical specification in this regard.
33	Section-VI Part-B Sub-Sec-I-M1 (FGD)				1.09.00	4 of 49	**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).	Noise level for limestone crusher will be ≤ 105 dB(A). Also, noise level for Limestone ball mill will be ≤ 90 dB(A) outside sound barrier. NTPC to confirm.	
	Section-VI Part-C General Technical Requirements				30.00.00	42 of 82	**Noise Level:** 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: a) Ball Mill < 90 dBA		Refer Amendment to technical specification in this regard.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
34	Section-VI Part-B Sub Sec-I-M1 (FGD)				7.06.02	26 of 49	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 water as stated in Section-VI, Sub-Section IV, Clause No- 1.05.00, Page No- 1 of 3. Therefore, 2x100% pumps for wash water (filtrate) are not envisaged. NTPC to confirm.	Specification requirement is clear. Bidder to comply the specification requirement.
	Section-VI Part-A Sub Sec-III-A1 FGD				5.04.00	5 of 8	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.		
	Section-VI Part-A Sub Sec-IV Terminal Points & Exclusions				1.05.00	1 of 3	**Gypsum Wash Water (Clarified Water):** 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.).		
35	Section-VI Part-B Sub Sec-I-M1 (FGD)				1.03.08	3 of 49	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 project, flue gas damper downstream of FGD is not required and hence not envisaged. NTPC to confirm.	Refer Amendment to technical specification in this regard.
36	Section-VI Part-B Sub Sec-I-M1 (FGD)				3.01.00 (1)	5 of 49	**The entire flue gas system, flue gas ducts, absorber etc. shall be designed to meet the following conditions:** Design internal pressure at 67% yield strength (mmwc): +660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher	The duct design pressure is considered inline with Clause No. 3.01.00 (1), Section-VI Part-B, Sub Sec-I-M1 (FGD) i.e. +660 & -	Refer Amendment to technical specification in this regard.

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Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
	Section-VI Part-B Sub Sec-I-M1 (FGD)				16.01.03	37 of 49	**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	150 mmWC. NTPC to confirm.	
37	Section-VI Part-B Sub Sec-I-M1 (FGD)				3.01.00 (5)	5 of 49	Maximum flue gas velocity through the Absorber (M/sec) : Not more than 4 m/s at Design Point Conditions	It is presumed that the specified flue gas velocity limit refers to "Superficial gas velocity". NTPC to confirm.	Bidders understanding is correct.
38	Section-VI Part-B Sub Sec-I-M1 (FGD)				3.02.01	5 of 49	The flue gas ducts shall be sized and designed to meet all the criteria as specified in Cl. No 17.00.00 this subsection.	Since, clause No.17.00.00 of this Sub-Section is related to Dampers, bidder believes that the correct reference clause is 16.00.00-Duct Work & Dampers. NTPC to confirm.	Refer Amendment to technical specification in this regard.
39	Section-VI Part-B Sub Sec-I-M1 (FGD)				4.01.00	8 of 49	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.	Since, additional pressure loss of 100 mmWc is to be considered on account of De-NOx system for booster fan sizing, NTPC is requested to re-confirm the specified flue gas pressure at booster fan inlet. Also, it may be noted that there will not be enough pressure available to overcome draft loss of DeNOx system during FGD bypass condition. In addition, NTPC to inform the draft loss of SCR to be considered for guarantee point.	Pressure specified at Booster Fan suction is without DeNox system in service. Suction pressure correction in view of DeNOx system in service has to be considered. Refer Amendment of the Technical specifications.
	Section-VI Part-B Sub Sec-I-M1 (FGD)				4.01.01 (3 -iii)	8 of 49	Pressure at Booster Fan suction : 0 mmWc		
	Section-VI Part-B Sub Sec-I-M1 (FGD)				4.01.02 (vi)	9 of 49	Pressure at Booster Fan suction : 0 mmWc		
40	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.01.00 (iii)	13 of 49	The slurry recirculation pumps shall have a minimum margin of 10% of flow and 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.	The 10% margin on head is considered to be on its frictional component only.	Refer Amendment to technical specification in this regard.

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Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
41	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.04.00	15 of 49	**Gypsum Bleed Pump:** The pumps shall be designed to meet the stipulations of Clause No.9.00.00 of this Sub-Section.	Since, clause No.9.00.00 of this Sub-Section is related to Vertical Sump Pumps, bidder believes that the correct reference clause is 8.00.00-Slurry Pumps. NTPC to confirm.	Refer Amendment to technical specification in this regard.
	Section-VI Part-B Sub Sec-I-M1 (FGD)				6.07.02	23 of 49	The limestone slurry pumps shall be designed to meet the requirements stipulated in Cl. No.9.00.00. of this Sub-Section.		Refer Amendment to technical specification in this regard.
42	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.06.10	17 of 49	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.	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 per the experience of QFGDM. So, duct wash & normal quench system is not required and hence not envisaged.	Bidder to comply the specification requirements for flushing system.
	Section-VI Part-E				Scheme of FGD Absorber system	Drawing No: 4410-109-POM-A-005 - Rev.No: A	Normal Quench System with Quench Nozzles and Control valves		Normal quench system with quench nozzles and control valves may be provided if it is the standard practice of bidder / its collaborator.
43	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.06.13	18 of 49	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 Screens, 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 the internal members of Absorber shall be lined with minimum 2 mm Alloy 59/C276 unless material is specifically specified for any component.
					11.05.00	30 of 49	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.		
					5.06.23	19 of 49	In case of Spray Tower System, Suction screens shall be installed inside the Absorber vessel to protect the Slurry recirculation pumps.		Regarding suction screen refer necessary amendment.
44	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.06.22	19 of 49	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.	Refer Amendment to technical specification in this regard.
45	Section-VI Part-B Sub Sec-I-M1 (FGD)				10.01.00	29 of 49	**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.	Bidders to comply the specification requirement for flushing system..
46	Section-VI Part-B Sub Sec-I-M1 (FGD)				6.03.05	20 of 49	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 the same shall be replaced with "limestone". NTPC to confirm.	Refer Amendment to technical specification in this regard.

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Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
47	Section-VI Part-B Sub Sec-I-M1 (FGD)				6.05.01 (ii)	21 of 49	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 three absorbers in operation at Design point". NTPC to confirm.	Refer Amendment to technical specification in this regard.
48	Section-VI Part-B Sub Sec-I-M1 (FGD)				6.06.01	22 of 49	For tank volume calculation, solid concentration (by weight) in the slurry shall be assumed, not more than 20% or actual required whichever is lower.	Since 30% solid concentration is considered for limestone feed slurry, NTPC to advise whether solid concentration (by weight) of 30% can be considered for tank volume calculation also.	Bidders to comply the specification requirement.
49	Section-VI Part-B Sub Sec-I-M1 (FGD)				6.06.01	22 of 49	Each tank shall be sized to meet 12 hours continuous limestone requirement of the two units operating at Design point.	Since plant capacity is 3x660 MW, it is presumed that the storage tank is to be sized for 12 hours storage of limestone slurry requirement of three units and not two units. NTPC to confirm.	Refer Amendment to technical specification in this regard.
50	Section-VI Part-B Sub Sec-I-M1 (FGD)				6.07.03	23 of 49	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 whether the same can be considered.	Refer Amendment to technical specification in this regard.
51	Section-VI Part-B Sub Sec-I-M1 (FGD)				7.04.01 (c)	24 of 49	Gypsum Purity: 90% (minimum)	The gypsum purity of 90% will be maintained at guarantee point condition using limestone having available (reactive) CaCO3 of 89%.	Bidders to comply the specification requirement.
	Section-VI Part-A Sub Sec-VI Functional Guarantees & Liquidated Damages				4.02.00 (v)	8 of 14	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 the range of specified coal(s) and limestone.		
52	Section-VI Part-B Sub Sec-I-M1 (FGD)				7.04.03	24 of 49	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.	Specification requirement is clear in this regard.Bidders to comply the specification requirement.
53	Section-VI Part-B Sub Sec-I-M1 (FGD)				7.04.09	25 of 49	Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided by the Employer.	Please clarify whether gypsum conveying system is in bidder's scope or NTPC's scope.	Gypsum handling/ conveying is in the bidders scope. Please refer of the Amendment in this regard.
	Section-VI Part-A Sub Sec-III-A2				1.02.00	2 of 7	GYPSUM HANDLING PLANT		

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Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
54	Section-VI Part-B Sub Sec-I-M1 (FGD)				7.05.05	25 of 49	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 vacuum pump proposed is of liquid ring type which doesn't require any 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.
55	Section-VI Part-B Sub Sec-I-M1 (FGD)				10.01.00	29 of 49	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.	IS 803 code will be considered for slurry tank design. However, the hazard related requirements specified in this code which are applicable for oil storage will not be considered. NTPC to confirm.	Noted
56	Section VI Part B Sub-Section-II-E1 General Electrical Specifications				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.	Bidder 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. NTPC to confirm.	Refer Amendment to technical specification in this regard.
57	Section VI Part B Sub-Section-II-E1 General Electrical Specifications				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.	One no. 110V DC system shall be considered common for all the units of FGD package. Battery shall be of Ni-Cd type. NTPC to confirm.	Bidder to comply the requirement of technical specifications.
58	Section VI Part B Sub-Section-II-E6 General Electrical Specifications				3.02.01	4 of 69	Cable tray support system shall be pre-fabricated	Welded type channel / angle support shall be provided for all cable trays. Kindly confirm.	Bidder to comply the requirement of technical specifications.
59	Section-VI Part-C General Technical Requirements					74 of 82	Public Address System	It is presumed that public address system is not in bidder's scope of supply. NTPC to confirm.	Bidders understanding is correct.
60	Section-VI Part-A Sub Sec-IV Terminal Points & Exclusions				1.11.01	2 of 3	Electrical Terminal points of Contractor's electrical scope, applicable for all systems/ subsystems described in	NTPC is requested to provide the location of Employer's 11 KV switch gear.	HT Switchgear is located in main plant AB bay.

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Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
61	Section-VI Part-B Sub Sec-I-M1 (FGD)				7.07.07	26 of 49	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 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.	NTPC to furnish the size of Lime powder and inform whether the lime will be supplied in the form of bags or transported loose through truck.	Specification requirement is clear in this regard.Bidders to comply the specification requirement.
62	Section-VI Part-B Sub Sec-I-M1 (FGD)				7.07.02	26 of 49	The secondary hydrocyclone feed tank shall be sized to provide a minimum storage of 1 hr of primary hydro-cyclone 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 the flow entering to the tank. NTPC to confirm.	Bidders to comply the specification requirement.
63	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.01.00 A (v)	13 of 49	Minimum 10% spare nozzles shall be provided at each level.	Since a complete spray level for recirculation has been kept as stand-by, 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 in this regard, please ready the specification in totality. Bidders to comply the specification requirement.
64	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.06.06	16 of 49	The mist eliminator spray headers shall be made of FRP or rubber lined Carbon Steel, corrosions and erosion resistant in the inner and outer side (Silicon Carbide coating on metal/FRP surface exposed to slurry).	Since ME wash water is process water and not exposed to slurry, silicon carbide coating for ME spray headers is not required. In addition, the Mist Eliminator Wash spray nozzles will be of polypropylene material. NTPC to confirm.	Bidders to comply the specification requirement.
65	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.03.02	14 of 49	**Absorber oxidation systems** Margin on Head 10% under above conditions.	Margin of 10% will be considered only on frictional component of head. NTPC to confirm.	Bidders to comply the specification requirement.
66	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.06.03	16 of 49	Inaccessible gaps or hollow beams shall be avoided.	Incase beams are made of 100% C-276 / A-59 material, whether hollow beams (or pipes for trusses) can be used for supporting members located inside the absorber.	Bidders to comply the specification requirement.
67	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.06.18 (iv)	18 of 49	A flushing device of the spray levels with water shall be installed. Flushing shall take place if spray levels are out of operation.	Since, the design of spray headers proposed allows its self drainage, separate flushing system for spray headers is not required and hence not considered. NTPC to confirm.	Bidders to comply the specification requirement.

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Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
68	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.06.15	18 of 49	The other bridges(supports) shall be lined with minimum 2 Alloy 59/C276	NTPC to advise whether Flake glass can be considered as the alternative lining material for support trusses of Spray headers and Mist eliminators.	Bidders to comply the specification requirement.
69	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.06.17	18 of 49	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).	Since, bidder has offered the lance type oxidation air system, NTPC to advise whether alloy material can also be considered as an alternate MOC for lances.	Bidders to comply the specification requirement.

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	Section / Part / Chapter				Clause No.	Page No.			
70	Section-VI Part-B Sub Section-I-M1 (FGD)				5.06.11	18 of 49	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 MOC. " 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." NTPC to confirm the acceptability of the above.	Refer Amendment to technical specification in this regard.
71	Section-VI Part-B Sub Sec-I-M1 (FGD)				5.06.20	19 of 49	In case the contractor offers a multiple spray level design, minimum distance of 1.5 m shall be maintained between individual spray levels.	The specified minimum distance of 1.5 m will be kept between the center lines of spray levels.	Specification requirement is clear in this regard. Bidders to comply the specification.
72	Section-VI Part-B Sub Sec-I-M1 (FGD)				7.03.05	24 of 49	The hydro-cyclone shall be of proven design and shall be provided with replaceable rubber lining. The feed chamber shall be provided with a minimum lining thickness of 25mm.	In line with Clause no. 7.07.04 (related to Secondary Hydro Cyclone), the primary Hydrocyclone shall also be made up of polyurethane or urethane materials. Also, based on feed back received from sub-vendors, 12 mm rubber lining is sufficient for feed chamber. NTPC to confirm.	Bidders to comply the specification requirement.
73	Section-VI Part-B Sub Sec-I-M1 (FGD)				7.04.02	24 of 49	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.	NTPC to advise whether PET (Polyethylene Terephthalate) can also be considered as the alternate MOC for filter cloth which ensures the specified minimum life of 7000 hours.	Bidders to comply the specification requirement.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
74	Section-VI Part-B Sub Sec-I-M1 (FGD)				13.03.00	32 of 49	2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks (total 4 nos. of pumps for 3x660 MW) along with all necessary piping, valves, control & instrumentation shall be provided by the Contractor.	It is presumed that total 6 nos. of mist eliminator pump are to be provided for 3x660 MW plant. NTPC to confirm.	Refer Amendment to technical specification in this regard.
75	Section-VI Part-B Sub Sec-I-M1 (FGD)				10.01.00	29 of 49	**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.	Since, contradictory requirements related to corrosion allowance in process water tanks is specified in these clauses, corrosion allowance of 1.5 mm will be considered for process water tanks. NTPC to confirm.	Refer Amendment to technical specification in this regard.
	Section-VI Part-B Sub Sec-I-M1 (FGD)				13.01.00	31 of 49	**Process Water Storage tanks** Additional Corrosion allowance of 1.50 mm on the minimum tank shell thickness		
	Section-VI Part-B Sub Sec-I-M1 (FGD)				13.03.07	32 of 49	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.		

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
76	Section-VI Part-B Sub Sec-I-M1 (FGD)				13.01.00	31 of 49	**Process Water Storage Tanks:** 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.	Since, corrosion allowance specified in both of these requirements is contradictory, additional corrosion allowance of 1.50 mm will be considered for all the Process water tanks over and above the minimum tank shell thickness as calculated per IS:803. NTPC to confirm.	Refer Amendment to technical specification in this regard.
	Section-VI Part-B Sub Sec-I-M1 (FGD)				13.03.07	32 of 49	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.		
77	Section-VI Part-B Sub Sec-I-M1 (FGD)				14.17.00	34 of 49	**Approach and Handling Facilities:** Inter-connecting pipes/cables between various facilities of FGD plant shall be routed on the steel trestles to be provided by the contractor.	NTPC to advise whether existing pipe rack (wherever possible) can be used instead of separate pipe rack for routing of long distance piping.	Specification requirement is clear in this regard. Bidders to comply the specification.
78	Section-VI Part-B Sub Sec-I-M1 (FGD)				16.01.04	37 of 49	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.	Only absorber inlet wet dry interface will be sloped towards absorber, remaining inlet duct will not have any slope.	Specification requirement is clear in this regard. Bidders to comply the specification.
79	Section-VI Part-B Sub Sec-I-M1 (FGD)				16.01.05	37 of 49	The duct shall be of rectangular cross-section	NTPC to advise whether circular cross-section can be used for flue gas ducts from absorber outlet to wet stack.	Bidders to comply the specification requirement.
80	Section-VI Part-B Sub Sec-I-M1 (FGD)				16.01.05 a)	37 of 49	Duct stiffening shall be by means of rolled sections of duct material.	If size (depth) of duct stiffener member exceeds 600 mm, plate fabricated sections will be used. NTPC to confirm.	Bidders to comply the specification requirement.
81	Section-VI Part-B Sub Sec-I-M1 (FGD)				16.01.08 b) (ii)	38 of 49	Such internal stiffeners for the flue gas duty between boiler and ESP shall be provided with erosion protection shields.	Duct between boiler & ESP is not in bidder scope. NTPC to confirm.	Refer Amendment to technical specification in this regard.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
82	Section-VI Part-E				Drg. No. 4410-000-POM-A-001 , Rev. A		Layout of FGD area	As per the flue gas flow scheme shown in this layout drawing, the flue gas duct from FGD absorber is connecting to the individual flue gas duct entering the existing chimney. Since, new wet stack is considered for the proposed FGD project, this flow scheme is presumed to be not valid now. NTPC to confirm.	Query is not clear. Bidder to read the specifications in totality.
83	Section-VI Part-B SUB-SECTION-IV-D CIVIL WORKS				3.14.01	10 of 114	Single-flue or multi-flue chimney(s) shall be provided.	NTPC to advise whether common chimney for all the three units (i.e. chimney with three flues) is acceptable.	Specification requirement is clear in this regard. Bidders to comply the specification.
84	Section-VI Part-B SUB-SECTION-IV-D CIVIL WORKS				6.08.00	24 of 114	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 & Oxidation blower house are RCC framed building with Brick walls. In addition, no wall / cladding shall be provided for areas where Blower, Slurry Recirculation Pumps, Dewatering equipment, Limestone Ball mill will be located since these areas need maintenance access for the above equipment. However, Electrical Control room, MCC room will be of enclosed type with Brick walls. NTPC to confirm.	Type of building structure (Steel/RCC) and 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).
85	Section-VI Part-E				Drg. No. 4410-999-POC-F-001, Rev. 0		Layout plan of FGD system	NTPC is requested to provide the layout drawings in CAD format.	CAD format Drawing cannot be provided.
					Drg. No. 4410-999-POM-A-001, Rev. A		Layout of FGD area		

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
86	Section-VI Part-E				Drg. No. 4410-109-POM-A-007, Rev. A		Scheme of Gypsum Dewatering System The source of process water is specified as CW blowdown.	Source of process water specified in both of these clauses is contradictory. NTPC to clarify.	There is no CW blowdown in North Karanpura s it has air cooled condenser. Raw water is the source of process water.
	Section-VI Part-A Sub Sec-IV Terminal Points & Exclusions				1.04.00	1 of 3	**Process Water** Employer shall provide Raw water tap off from 700NB header in raw water pump area near raw water reservoir for further connection by bidder.		
87	Section-VI Part-E				Drg. No. 4410-109-POM-A-007, Rev. A		Scheme of Gypsum Dewatering System The source of water for cake wash is specified as process water.	NTPC to clarify the source of water to be considered for gypsum washing i.e. whether it is clarified water or process water (raw water)	Specifiaction requirement is clear in this regard.
	Section-VI Part-A Sub Sec-IV Terminal Points & Exclusions				1.05.00	1 of 3	**Gypsum Wash Water (Clarified Water)** 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.		
88	Section-VI Part-E				Drg. No. 4410-000-POM-A-00, Rev. 0		Terminal Point for Normal Make-up of E.C.W overhead tank for FGD	There appears to be an error in the said terminal point shown in drawing. NTPC to clarify.	Bidder's query not clear
89	Section - VI, Part - A			Sub Section - I	3 of 18	1.03.01	Wet limestone based Flue gas desulphurization (FGD) for 2X 800 MW unit, capable of reducing	We understand that the proposed enquiry is for 3x660 MW North Karanpura, the plant capacity indicated is an typographical error.	Refer Amendment to technical specification in this regard.
90	Section - VI, Part - A			Sub Section - III-A1	1 of 8	1.03.00	The FGD system shall have an independent absorber for each unit and two (2) nos of Booster fans each unit shall be provided in downstream of ID fans capable of handling the pressure drop in the FGD system, ducting, Selective Catalytic Reactor (SCR) (in Employer's Scope) and maintain required chimney inlet pressure.	Please furnish the pressure across SCR system (In Employer's scope) so that the the same pressure drop will be considered while designing the Booster Fan supplied by FGD supplier.	Already indicated. Please read the specification in totality.
91	Section - VI, Part - A			Sub Section - III-A1	3 of 8	3.01.03	Two (2) limestone slurry tanks, each tank sized to meet 12 hrs total limestone slurry storage requirement **for two units at Design point**, complete with all accessories and Agitator(s).	We understand that bidder to furnish two (2) limestone slurry tanks, each tank is sized to meet the total limestone slurry requirement of three (3) units at design point instead of two (2) units as specified. Kindly confirm.	Refer Amendment to technical specification in this regard.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
92	Section - VI, Part - A			Sub Section - III-A1	3 of 8	3.01.04	2x100% limestone slurry pumps for each absorber connected to each of the limestone slurry tank (total 6 nos. of pumps for 3x660 MW).	Please note that in the flow scheme (Dwg No. 4410-109-POM-A-006) 3x100% limestone slurry pumps are indicated for each absorber/limestone slurry tank but in the specification 2x100% pumps are specified. Please clarify the discrepancy.	Specifiaction requirement is clear in this regard.
93	Section - VI, Part - A			Sub Section - III-A1	4 of 8	4.01.05	1 No. Emergency water tank for spraying water at inlet of Absorber for upset condition.	Kindly clarify the storage time or capacity to be considered by bidder.	Already indicated. Please read the specification in totality.
94	Section - VI, Part - A			Sub Section - III-A1	4 of 8	5.01.00	The employer envisages a common gypsum dewatering system for the two (2) units.	Please note that in the the technical specification Section VI, Sub Section III-A2 Cl. No. 3.01.00 it is specified that complete gypsum dewatering system including Gypsum conveying from Vacuum belt filter outlet to Gypsum storage shed are included in Bidder's scope but as per reference clause common gypsum dewatering system is excluded from bidder's scope. Please clarify the discrepancy.	Refer Amendment to technical specification in this regard.
95	Section - VI, Part - A			Sub Section - III-A1	5 of 8	5.02.00	Each set (suitable for handling/dewatering of one unit) of dewatering equipment (01 working set + 01 standby set) shall comprise of the following items as a minimum requirement:	As per technical specification for all three (3) units a common Gypsum dewatering system shall be provided and the equipmets related to gypsum dewatering system shall be sized to handle maximum gypsum produced by Three (3) units, but in the reference clause it is stated that each set should be suitable for handling/dewatering of one unit. Please clarify the discrepancy.	Refer Amendment to technical specification in this regard.
96	Section - VI, Part - A			Sub Section - III-A1	8 of 8	17.00.00	Contractor shall provide separate air receivers of adequate capacity for meeting the instrument and service air requirements.	Please furnish the Instrument air, Service air Quantity and Pressure provided by M/s NTPC at bidder's terminal point.	It is in the Bidders scope. However preesure at terminal point will be 5-7 Kg/cm2.
97	Section - VI, Part - A			Sub Section - III-A1	8 of 8	18.00.05	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 bidder to furnish one (1) common Nickel based alloy material storage/Neutralizing tank twelve (12) hrs storage of Three (3) units stack condensate instead of two (2) units.	Refer Amendment to technical specification in this regard.
98	Section - VI, Part - A			Sub Section - III-A2	3 of 7	2.01.01 (a)	Clear access shall be provided for movement of pay loaders/ bulldozers on the paved area and on the hopper grating in order to remove the oversized limestone.	Please conrim that pay loaders/bulldozers required for remove the oversized limestone on truck hoppers are in owner's scope.	CONFIRMED

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
99	Section - VI, Part - A			Sub Section - III-A2	5 of 7	2.01.22	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 limestone crusher house.	Please clarify capacity of Passenger cum Goods Elevator to be considered by bidder in Limestone crusher house.	Refer amendment in this regard
100	Section - VI, Part - A			Sub Section - III-A2	7 of 7	3.01.00 (b)	One number of covered storage shed for gypsum complete with all mechanical, electrical & civil works including floors for tripper and at ground level and truck bay.	Please clarify the storage period to be considered by bidder for Gypsum storage shed.	Refer Technical Specification Part-A ,Sub section III-A2 Cl. 1.02.00 (a)
101	Section - VI, Part - A			Sub Section - IV	1 of 3	1.03.01	Normal make up to ECW tank	Please furnish the water quantity available at Bidder's terminal point.	Refer tender drawing no. 4410-000-POM-A-01
102	Section - VI, Part - A			Sub Section - IV	1 of 3	1.03.02	Emergency make up to ECW tank	Please furnish the water quantity available at Bidder's terminal point.	Refer tender drawing no. 4410-000-POM-A-01
103	Section - VI, Part - A			Sub Section - IV	1 of 3	1.04.00	Process Water	Please furnish the water quantity available at Bidder's terminal point.	Refer tender drawing no. 4410-000-POM-A-01. Process water is raw water from the reservoir.
104	Section - VI, Part - A			Sub Section - IV	1 of 3	1.05.00	Gypsum Wash Water (Clarified Water)	Please furnish the water quantity available at Bidder's terminal point.	Bidder to design the system for optimal the water requirement for Gypsum washing and same shall be made available.
105	Section - VI, Part - A			Sub Section - IV	2 of 3	1.09.00	Hydrant and spray header each of size 150 NB available in near Chimney for tapping required for Hydrant and spray system for FGD facilities.	Please furnish the Co-ordination point of Hydrant spray water header for each size to enable us to design/consider the further routing to FGD system.	Co-ordinate point for hydrant & spray water header shall be furnished during detailed engg. However, one no. tapping each for hydrant & spray shall be provided around 50m vicinity.
106	Section - VI, Part - A			Sub Section - IV	2 of 3	1.12.00	b) Instrument air at one point (if required).	Please furnish the Co-ordination point of Instrument air to consider the same as bidder's terminal point. Also please furnish the Instrument air quantity and Pressure available at Bidder's terminal point.	Bidder to note that piping header is available at C row (running along CD bay rack). Exact location will be finalized during detail engineering. Pressure available is approx 5-7 kg/cm2.
107	Section - VI, Part - A			Sub Section - V	2 of 10	3.00.00	Sl. No. 7) Flue Gas Composition at FGD system inlet: (viii) Dust (mg/Nm^3) 50-200	Please note that the Maximum Dust content indicated at FGD system inlet in both Guarantee Point and Design Point seems very high. We request you to kindly once again check and confirm.	Bidders to comply the specification requirement.
108	Section - VI, Part - A			Sub Section - V	2 of 10	3.00.00	Sl. No. 7) Flue Gas Composition at FGD system inlet:	Please furnish the HCL and HF value in Flue gas for both Guarantee Point and Design Point with reference condition, the same is not mentioned in the specification.	Refer Amendment to technical specification in this regard.
109	Section - VI, Part - A			Sub Section - I-M1	2 OF 49	1.03.02	Motorized Guillotine type gates shall be provided at (i) hot gas inlet to Absorber and (ii) in the bypass duct. Further, Quick opening Bi-plane motorized/pneumatic damper along with 2x100% seal air fans shall be provided in the by-pass duct.	Please note that in the Flow Diagram {Dwg No. 4410-109-POM-A-005} 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	Refer Amendment to technical specification in this regard

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
110	Section - VI, Part - A			Sub Section - I-M1	2 OF 49	3.03.07	The Guillotine gate type dampers mentioned at Clause No. 3.03.01 above shall have a guaranteed gas tightness efficiency ..... without the use of seal air fans of the damper.	dampers. Please clarify whether bidder to consider the Seal air fans for Bi-plane type dampers only or for both Bi-plane type and Guillotine type dampers.	regard.
111	Section - VI, Part - A			Sub Section - I-M1	6 OF 49	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.	We propose Borosilicate lining in the chimey in addition to the proposed titanium and C-276 as specified in the reference clause. We request you to kindly confirm the same.	Bidders to comply the specification requirement.
112	Section - VI, Part - A			Sub Section - I-M1	6 OF 49	3.03.01	Guillotine gate type damper is being provided by the Employer before the suction of each Booster fan.	Please note that in the flow scheme (Dwg No. 4410-109-POM-A-005, Rev. A) Guillotine gate type dampers at Booster fan inlet is indicated in Biddder's scope, but in the reference clause it is specified in Employer's scope. Please clarify the discrepancy.	Refer Amendment to technical specification in this regard.
113	Section - VI, Part - A			Sub Section - I-M1	7 OF 49	3.03.01	A Pneumatic operated multi louver damper with seal air arrangement shall also be provided by the Contractor in the clean gas duct after GGH.	Please confirm the requirement of GGH. We understand that this is a typographical error and GGH is not envisaged for the proposed project.	
114	Section - VI, Part - A			Sub Section - I-M1	7 OF 49	3.03.07	A damper in the bypass duct is being provided by the Employer for quick opening to allow bypass to come into operation in case of emergency.	Please note that in the flow scheme (Dwg No. 4410-109-POM-A-005, Rev. A) dampers in the bypass duct is is indicated in Biddder's scope, but in the reference clause it is specified in Employer's scope. Please clarify the discrepancy.	Refer Amendment to technical specification in this regard.
115	Section - VI, Part - A			Sub Section - I-M1	7 OF 49	3.03.09	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.	Please confirm the requirement of GGH. We understand that this is a typographical error and GGH is not envisaged for the proposed project.	Refer Amendment to technical specification in this regard.
116	Section - VI, Part - A			Sub Section - I-M1	13 OF 49	5.01.00	iii) The slurry recirculation pumps shall have a minimum margin of 10% of flow and 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.	Bidders to comply the specification requirement. Please also Refer Refer Amendment to technical specification in this regard.
117	Section - VI, Part - A			Sub Section - I-M1	13 OF 49	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 standard.	Bidders to comply the specification requirement.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
118	SECTION-VI, PART-B			SUB-SECTION-I-M1	15 OF 49	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/spargers will be applicable as per bidder design standard.	Specification requirements is clear. Bidders to comply the specification requirement.
119	SECTION-VI, PART-B			SUB-SECTION-I-M1	15 OF 49	5.04.00	Margins Flow -- 15% Head – 20%	Please note that for since the Gypsum bleed pumps are continuous operation hence Margin on flow are not required. Kindly check the requirement.	Bidders to comply the specification requirement.
120	SECTION-VI, PART-B			SUB-SECTION-I-M1	16 OF 49	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 porpose to accept polypropylene (PP) Mist Eliminator elements/lamellas and frames as per manufacturers standards.	Bidders to comply the specification requirement.
121	SECTION-VI, PART-B			SUB-SECTION-I-M1	18 OF 49	5.06.14	The absorber wet-dry interface shall be made of solid Alloy 59 or C276 of minimum 6 mm thickness.	As per technology partner experience 2 mm thick Alloy 59 or C-276 cladding over MS plate is adequate to protect wet Dry interfaces from corrosion. Kindly confirm.	Bidders to comply the specification requirement.
122	SECTION-VI, PART-B			SUB-SECTION-I-M1	18 OF 49	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).	Please note that FRP spray headers and alloy steel air supply pipes in Absorber do not require any protective linings on inner/outer surfaces. Please confirm.	Specification requirements is clear. Bidders to comply the specification requirement.
123	SECTION-VI, PART-B			SUB-SECTION-I-M1	20 OF 49	6.03.02	All parts of the gate in contact with limestone shall be of stainless steel construction.	Please furnish the the Material code for Stainless Steel to be considered by bidder or please confirm that the material code for SS will be as per Manufacturer/Vendor standard suitable for the limestone handling system.	Specifiaction requirement is clear in this regard. Bidder to comply.
124	SECTION-VI, PART-B			SUB-SECTION-I-M1	21 OF 49	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 below limestone silo to be considered by bidder for more clarity.	Specification requirement is clear in this regard. Bidders to comply the specification requirement.
125	SECTION-VI, PART-B			SUB-SECTION-I-M1	22 OF 49	6.05.03	The hydro-cyclone shall be of proven design and shall be provided with replaceable rubber lining.	Please confirm if polyurethane/polypropylene Hydro-cyclones are also acceptable as per manufacturer standard.	Bidders to comply the specification requirement.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
126	SECTION-VI, PART-B			SUB-SECTION-I-M1	22 OF 49	6.06.01	Each tank shall be sized to meet 12 hours continuous limestone requirement of the two units operating at Design point.	Please note that since the proposed project is having Three (3) units, hence we understand that bidder to design/size the limestone slurry tank to meet 12 hours continuous limestone requirement for three (3) units instead of two (2) units specified in the reference clause. Please confirm	Refer Amendment to technical specification in this regard.
127	SECTION-VI, PART-B			SUB-SECTION-I-M1	23 OF 49	6.07.01	2x100% centrifugal type limestone slurry pump shall be provided for each unit.	Please note that in the flow scheme (Dwg No. 4410-109-POM-A-006, Rev. A) three (3) nos 3x100% Limestone slurry pumps are specified. Please clarify the discreancy and confirm the actual number of Limestone slurry pumps to be considered by bidder.	2x100% centrifugal type limestone slurry pump shall be provided for each unit. Please read the specification in totality.
128	SECTION-VI, PART-B			SUB-SECTION-I-M1	23 OF 49	6.07.03	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.	Please note that FRP pipes and bends are suitable for lime slurry duty and do not require any wear resistant lining. Please check the requirement of rubber lining in FRP pipes.	Bidders to comply the specification requirement.
129	SECTION-VI, PART-B			SUB-SECTION-I-M1	24 OF 49	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 concenctration from Primary Hydrocyclone underflow is based on the mass balance and may vary from supplier to supplier based on the proprietary design. Please confirm that the same will be as per bidder's design standard.	Bidders to comply the specification requirement.
130	SECTION-VI, PART-B			SUB-SECTION-I-M1	26 OF 49	7.07.02	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.	Please note that in Cl. No. 7.07.02 the Secondary hydrocyclone feed tank storage is specified to design **1Hr storgae of Primary hydrocyclone overflow** and in the same page under Cl. No. 7.07.03 it is specified that the Secondary hydrocyclone feed pump is designed to empty the Secondary hydrocyclone feed tank with in **6 Hrs**. Please check and clarify the discrepancy	Refer Amendment to technical specification in this regard.
131	SECTION-VI, PART-B			SUB-SECTION-I-M1	26 OF 49	7.07.03	2x100% horizontal centrifugal pumps shall be provided to feed the secondary hydrocyclones. Each pump shall be sized to empty the full storag capacity of the tank in 6 hrs.		

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
132	SECTION-VI, PART-B			SUB-SECTION-I-M1	26 OF 49	7.05.05	The vacuum receiver and pump internals shall be suitably lined to protect against the corrosive environment.	Please check the requirement. Since there is no lining inside the liquid ring type vacuum pump.	The material selected for vacuum pumps & vacuum receivers shall be proven for similar application and shall be subjected to approval of the employer.
133	SECTION-VI, PART-B			SUB-SECTION-I-M1	27 OF 49	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 Section-III A-1, P No. 6 of 8 Clause No .6.02.00, the same is specified as 1x100% slurry pumps for pumping the slurry back to any of the absorber of the units . Please clarify the discrepancy and confirm actual number of slurry pumps to be considered by bidder.	Refer Amendment to technical specification in this regard.
134	SECTION-VI, PART-B			SUB-SECTION-I-M1	28 OF 49	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.	Refer Amendment to technical specification in this regard.
135	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				16 of 49	5.06.06	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 in this regard. Bidder to comply the specification.
136	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				28 of 49	8.04.00	The flushing water for the pumps shall be taken from 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.	Bidder to comply the specification requirement.
137	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				5 of 49	3.01.00.5	Maximum flue gas velocity through the Absorber (M/sec) Not more than 4 m/s at Design Point	Bidder understands that this clause is applicable for spray tower systems. Since the gas flow path is different in offered jet bubbling technology, this clause is not applicable to our offered Process. Kindly confirm.	Bidder to comply the specification requirement.
138	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				30 of 49	11.09.00	Static and dynamic balancing shall of all agitators shall be carried out after assembly	Since all the agitators are vertically mounted & rotating at low rpm, the static & dynamic balancing after assembly are not envisaged.	Bidder to comply the specification requirement.
139	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				24 of 49	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 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 in this regard. Bidder to comply the specification.
140	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				17 of 49	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.	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 in this regard. Bidder to comply the specification.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
141	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				20 of 49	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.	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. 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 in this regard. Bidder to comply the specification.
142	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				27 of 49	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	The two clauses are contradictory. Bidder understands that only one common auxillary absorbant tank is required. Kindly clarify.	Refer Amendment to technical specification in this regard.
143	SECTION- VI, PART-A/ SUB SECTION-111-A1 FGD				6 of 8	6.01.00	The employer shall provide a common auxiliary absorbent tank, common for the three (03) units, of sufficient capacity for storage of absorber slurry of one unit.		
144	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				27 of 49	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.	Draining of absorber using a pumping system is possible between normal slurry level and minimum slurry level. The balance slurry will be drained to the drain sump by gravity. Kindly confirm.	Bidder to comply the specification requirement.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
145	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				31 of 49	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.	Bidder proposes FRP as alternative material for all sizes of slurry pipes, please confirm.	specification requirement is clear in this regard. Bidder to comply the specification.
146	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				4 of 49	1.09.00	Noise level	Bidder understand that for ball mill noise level limit shall be<90 dB(A). Please confirm.	specification requirement is clear in this regard.Also Refer Amendment to technical specification in this regard.
147	SECTION – VI, PART-C / General technical requirements				42 of 82	30.00.00	Noise level <90 dB(A)		
148	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				5 of 49	3.01.00	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 in this regard. Bidder to comply the specification.
149	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				21 of 49	6.05.01	Limestone bond index(kWh/sh. T) 13 (min)	Bidder considers Limestone bond index as 13 kWh/metric ton. Please confirm.	Refer Amendment to technical specification in this regard.
150	SECTION-VI, PART·A/SUB·SECTION·V SALAIENT DESIGN DATA				6 of 10	6.00.00	Bond Index 13 kWh/t		
151	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				34 of 49	15.01.00	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 than 20M.	Biddrs understanding is correct.
152	SECTION – VI, PART-A / SUBSECTION-III-A1 (FGD)				6 of 8	8.01.00	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)....		
153	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				2 of 49	1.03.02	Motorized Guillotine type gates has to 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.	Refer Amendment to technical specification in this regard. Bidder to comply the specification requirement.
154	SECTION- VI, PART-A/SUB SECTION-111-A1 FGD				6 of 8	6.02.00	The contractor shall provide 1 x 100% slurry pumps	The two clauses are contradictory. Kindly clarify.	Refer Amendment to technical specification in this regard.
155	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				27 of 49	7.08.02	The contractor shall provide 2 x 100% pump		
156	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				32 of 49	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	The two clauses are contradictory. Bidder shall consider 1.5mm corrosion allowance. Please confirm.	Refer Amendment to technical specification in this regard.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
157	SECTION – VI, PART-B SUB·SECTION·I·M1				31 of 49	13.01.00	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.		
158	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				5 of 49	3.01.00 (3)	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 in this regard. Bidder to comply the specification.
159	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				9 of 49	4.03.00	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……		
160	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				24 of 49	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.	Bidder proposes CS body with epoxy paint for the complete frame which is also followed as standard by vendors. However, if different material is required the same need to be specifically mentioned.	Bidder to comply the specification requirement.
161	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				2 of 49	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 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 s 96.997%and design point is VWO & worst coal and corresponding SO2 emoval efficiency is 96.997%. 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 in regard. Bidders to comply the specification requirement.
162	SECTION-VI, PART·A/ SUB·SECTION·V SALIENT DESIGN DATA				3 of 10	3.00.00	Guarrantee point is 100% TMCR & worst coal and corresponding SO2 removal efficiency is 96.997% and design point is VWO & worst coal and corresponding SO2 removal efficiency is 96.997%		Bidder to comply the specification requirement. Refer Amendment to technical specification in this regard.
163	SECTION – VI, PART-E / TENDER DRAWING LIST					4410-109-POM-A-006	Limestone grinding area sump	Bidder considers only Limestone grinding area sump shown in "4410-109-POM-A-006". Please confirm.	Bidders understanding is incorrect. Kindly read the technical specification in totality.
						4410-109-POM-A-007	Limestone grinding area sump		

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
164	TECHNICAL SPECIFICATION SECTION – VI, PART-A SUB-SECTION-V (SALAIENT DESIGN DATA)				2 OF 10		Flue Gas Composition at FGD system inlet:	Please provide HCl & HF content in flue gas.	Refer Amendment to technical specification in this regard.
165	TECHNICAL SPECIFICATION SECTION-VI, PART·A SUB·SECTION·V SALAIENT DESIGN DATA				6 of 10	6.00.00 note-1	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 requirement is clear in regard. Bidders to comply the specification requirement.
166	TECHNICAL SPECIFICATION SECTION-VI, PART·A SUB·SECTION·V SALAIENT DESIGN DATA & SIZING				5 of 10	6.00.00	LIMESTONE CHARACATERSTICS: CaO: 47-51%		

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
167	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				21 of 49	6.05.01	iv) output fineness: 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.	Specification requirement is clear in this regard. Comply the specification.
168	TECHNICAL SPECIFICATION SECTION.YI, PART·A/ SUB-SECTION-VI - FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES				7 of 14	4.02.00	90% or higher (as per the requirement of the absorber) through 325 mesh.		
169	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				5 of 49	3.01.00	The entire flue gas system, flue gas ducts, absorber etc. shall be designed to meet the following conditions: Design internal pressure at 67% +660 and -150 mmwc or maximum yield strength (mm wc): +660 and -150 mmwc or maximum conceivable head of Booster fan (if provided), whichever is higher	Bidder shall consider the duct design pressure +660 and -150 mmwc. Please confirm.	Refer Amendment to technical specification in this regard.
					37 of 49	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		
170	TECHNICAL SPECIFICATION SECTION – VI, PART-A SUB-SECTION-V - SALIENT DESIGN DATA				2 OF 10		Flue Gas Composition at FGD system inlet: (iv) SO2 (% v/v wet) 0.088/ 0.087 correspondingly at Guarantee Point /Design Point	These two data are not conforming. Please confirm which one is to be considered for FGD sizing.	Refer Amendment to technical specification in this regard.
171					2 OF 10		Flue Gas Composition at FGD system inlet: (vi) Inlet SO2 (mg/Nm3-wet) 2437/ 2407 correspondingly at Guarantee Point /Design Point		
172	TECHNICAL SPECIFICATION SECTION-VI, PART-A, SUB-SECTION-IV - TERMINAL POINTS & EXCLUSIONS						TERMINAL POINTS	Please provide the terminal points for Service/ Instrument air.	Bidder to note that piping header is available at C row (running along CD bay rack). Exact location will be finalized during detail engineering.
173	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				27 of 49	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.	Bidder understands that the bucket conveyor quantity shall be (1Working+1Standby). Please confirm.	Refer Amendment to technical specification in this regard.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
174	SECTION – VI, PART-B / SUB-SECTION-I-M1 (FGD)				21 of 49	6.05.01	Each mill shall be sized to meet 110% of the maximum limestone requirement ….	Bidder understands each mill shall be sized to meet 110% of the maximum limestone requirement of all the three units in the project.	Refer Amendment to technical specification in this regard.
					21 of 49	6.05.01-ii	Flow: 110% of limestone requirement of two absorbers at Design point		
175	Section-VI PART-A, Sub-Section-III-C (C&I)				2 of 8	2.01.00	Primary instruments like… **vibration transmitter**..	Bidder understands that as specified in Section-VIA Sub-Section-IIIC (C&I), Vibration 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 System is envisaged for the same. Kindly confirm.	Bidder's understanding is generally correct that Vibration transmitters shall be considered for vibration monitoring of all critical HT drives in Bidder's scope & same shall be hardwired to FGD PLC system. However, bidder to refer Clause 1.02.07, sub section I-M2, PART B and Clause 2.01.11, sub section III-A2, PART-A of technical specification wherein Vibration Monitoring System is envisaged for each mill and crusher. Bidder to comply with the specification rrequirement.
176	Section-VI PART-A, Sub-Section-III-A2, Limestone & Gypsum Handling Plants				4 of 7	2.01.11	Two (2) numbers of hammer mills of 150TPH rated capacity each for crushing limestone complete with drives, …., **vibration monitoring system** etc.		
177	Section-VI PART-B, Sub-Section-I-M2, (Limestone & Gypsum Handling System)				60 of 112	1.02.07	Crusher shall be provided with **vibration monitoring (VMS) system**. Specification of VMS shall be as specified elsewhere.		
178	Section-VI PART-A, Sub-Section-III-C (C&I)				6 of 9	6.01.00	Contractor shall ensure that RIO cabinets are provided in air conditioning environment.	Bidder understands that RIO cabinets may be considered in air conditioned room or with Panel Air conditioning. Kindly confirm / clarify.	As per clause 6.01.00, PART-A, Sub Sec IIIC, it is envisaged that RIO panel shall be placed in air conditioning room. The construction & civil works of air conditioning room shall be in the scope of bidder. However, RIO panel with panel air conditioning shall also be acceptable if such RIO panels are be placed inside a ventilated building. The construction & civil works of building (inside which RIO panel with panel air conditioning shall be placed) and its ventilation, shall be in the scope of bidder. Refer amendment in this regard.
179	Section-VI PART-A, Sub-Section-III-C (C&I)				8 of 9	9.01.00	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. Kindly confirm.	Bidder's understanding is not correct. 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 provided on per unit basis.
180	Section-VI PART-A, Sub-Section-III-C (C&I)				8 of 8	9.02.00 (2)	Contractor shall provide necessary 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 accordingly. 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 to comply with the specification requirement.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
181	Section-VI PART-B, Sub-Section-III-C4, Instrumentation Cables				10 of 13	8.05.00	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 to comply with the specification requirement.
182	Section-VI PART-A, Sub-Section-III-C (C&I)				6 of 9	6.01.00	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 located in FGD control room	Bidder understands that as specified in Section-VI PART-B, Sub-Section-III-C5, Cl.No.2.05.01, 1 no. PC based OWS is to be provided for FGD PLC, in FGD Control room. Additional EWS cum OWS or PC based Programming station is required to be provided only if the FGD OWS cannot be used as programming station. Kindly confirm / clarify.	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: a) OWS (placed in FGD control room)-FOUR (4 Nos) b) OWS cum EWS (placed in FGD control room)-ONE (1 No) c) OWS (placed in central control room of each generating unit)-TWO (2 no.). Bidder to refer amendment in this regard. It is further clarified that, in case, FGD OWS can be used as programming station, One (1) no. of FGD OWS shall be provided in place of EWS cum OWS, which shall be used as a programming station.
183	Section-VI PART-E, Tender drawing no. 0000-151-POI-A-013				-	-	1 no. OWS & 1 no. EWS CUM OWS in FGD Control Room		
184	Section-VI PART-B, Sub-Section-III-C5, PLC Based Control System				4 of 27	2.05.01	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.		
185	Section-VI PART-B, Sub-Section-III-C5, PLC Based Control System				8 of 27	3.01.01	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. Kindly confirm.	Bidder's understanding is not correct. 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 modules can be used by other inputs of the same functional group.
186	Section-VI PART-B, Sub-Section-III-C5, PLC Based Control System				8 of 27	3.01.04	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. 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.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
187	Section-VI PART-B, Sub-Section-III-C5, PLC Based Control System				13 of 27	5.03.07	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. Kindly confirm / clarify.	Bidder's understanding is not correct. 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.) Refer amendment in this regard.
188	Section-VI PART-A, Sub-Section-III-C (C&I)				8 of 9	9.01.00	… 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. 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.
189	Section-VI PART-E, Tender drawing no. 0000-151-POI-A-013				-	-	FGD PLC OWS in Central Control Room		
190	Section-VI PART-A, Sub-Section-III-C (C&I)				8 of 9	9.01.00	… contractor to consider lOs … for minimum number of hardwired signal exchange per unit as follows Dl - 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. Kindly confirm.	Bidder's understanding is correct.
191	Section- VI, Sub section-II-E12				1 of 30	1.01.00	Outdoor transformers	Except control, lighting & welding transformer(dry types) all other transformers irrespective of its rating shall be oil filled outdoor types. Employer to confirm that the understanding is correct.	Bidder's understanding is correct. The Specification for Dry type Transformer is mentioned in Amendment of Technical Specification Section VI Part-B Sub section-II-E12 outdoor Transformers Clause 7.00.00.
192	Section- VI, Sub section-II-E11				4 of 19	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.	Bidders understanding is not correct. Please refer clause 6.02.01.
193	Section -IV, Part-A, SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT				4 of 6	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) We understand that for FGD area separate step & touch potential calculation is not required. Calculation shall be to check ground resistance within limits. 2) Employers to specify the ground resistance limits.(1 ohms or 5 ohms) 3) Bidder requests owner to provide soil resisitivity report for FGD area.	Bidder shall comply with requirement of technical specifications clause no:- 5.01.00, E-6, part-B

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
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194	SUB SECTION-II -E6 CABLING, EARTHING & LIGHTNING PROTECTION				15 0f 69	6.00.00	LIGHTNING PROTECTION SYSTEM 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 same shall be decided during detailed engg
195	SECTION-VI, PART-B, SUB-SECTION 11-E-16				1 of 14	1.00.00	BATTERY AND DC HEALTH MONITORING 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 system battery. Please confirm	Bidders understanding is correct.
196	SECTION- VI, PART-B, SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION				11 of 69	4.04.13	Separation At 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
197	SECTION - VI, PART-B SUB SECTION-II -E6 CABLING, EARTHING & LIGHTNING PROTECTION				3 of 69	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
198	SECTION - VI, PART-B SUB SECTION-11 -E6 CABLING, EARTHING & LIGHTNING PROTECTION				3 of 69	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 to comply with technical specification requirements.
199	Part E, Section-VI, Tender Drawings, Dwg. no. 4410-109-POE-J-001						Electrical Single Line Diagram	Bidder requests employers to furnish co-ordinates/location of 11kV switchgears (customer switchgear) inorder to enable us to calculate the cable route length.	Bidder to refer Electrical Single Line Diagram for FGD Package (Drg.no.4410-109-P0E-J-001- Rev A). Boards are located in main plant area (AB bay). Further details shall be furnished during Detailed engg.
200	SECTION- VI, PART-B, SUB SECTION-11-E9 HT SWITCHGEAR				2 of 39	1.00.00	Spare capacity and Future Requirements 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.	Please refer amendment-01 in this regard. "All HT switchboards shall be provided with one spare motor feeder and one transformer feeder on each section as spares."

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
201	Part E, Section-VI, Tender Drawings, Dwg. no. 4410-109-POE-J-001					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.	Bidder to refer clause 2.08.00 of Chapter E1 and Dwg. no. 4410-109-POE-J-001 regarding rating and number of battery system.
202	SECTION-VI, PART-A, SUB-SECTION-IV, TERMINAL POINTS & EXCLUSIONS				2 of 3	1.12.00 a), b), c) & d)	a) Employer's marshalling cabinets for hardwired signal exchange with Employer system. b) Instrument air at one point (if required). d) Employer's station wide LAN switch	Please provide the coordinates/ location of Employer's marshalling Cabinet, Instrument air terminal point & Station wide LAN switch	Employer's marshalling cabinet and station wide LAN shall be located in Central equipment room (CER) near B row. For coordinates of instrument air refer clarification no. 172.
203	SECTION- VI, PART-B, SUB SECTION-II-E6 CABLING, EARTHING & LIGHTNING PROTECTION				22 of 69	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 correct.
204	Section -VI, Part-A, SUB-SECTION-III-B ELECTRICAL SYSTEM/EQUIPMENT				4 of 6	1.12.00	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.	To meet the construction power requirement of the FGD and associated systems,the Employer shall provide Two Number 415V feeders in LT switchgears near ESP area.
205	Section -VI, Part-B, SUB-SECTION-II-E1				5 of 7	2.08.00	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 to comply technical specification
206	Section -VI, Part-B, SUB-SECTION-II-E2				2 of 9 5 of 9	3.01.00 (b) 8.00.00	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. 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. (a) Below 110KW : 11.0 (b) From 110 KW & up to 200 KW : 9.0 (c) Above 200 KW & up to 1000KW : 10.0 (d) From 1001KW & up to 4000KW : 9.0 (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 to comply with Technical Specification requirement.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
207	Section -VI, Part-B, SUB-SECTION-II-E6				2 of 69	2.01.04	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.
208	Part E, Section-VI, Tender Drawings, Dwg. no. 4410-109-POE-J-001				-	-	Note 3 - Standard LT Transformers ratings are as follows: 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 to comply technical specification
209	Part E, Section-VI, Tender Drawings, Dwg. no. 4410-109-POE-J-001				-	-	Electrical Single Line Diagram: 11KV Motor Feeders	Bidder understands that 11KV Motor feeders as required FGD pacakge will be fed from purchaser's 11KV Unit Boards. Modication required (if any) in existing 11KV Unit Board will not be in Bidder's scope.	Bidder to refer Electrical Single Line Diagram for FGD Package (Drg.no.4410-109-P0E-J-001- Rev A). Maximum one motor from each unit board shall be fed from owners 11kV Unit switchgear.
210	Part E, Section-VI, Tender Drawings, Dwg. no. 4410-109-POE-J-001				-	-	Electrical Single Line Diagram: 11KV Feeders from Station Board to FGD 11KV Switchgear	Bidder understands that modication required (if any) in existing 11KV Station Board will not be in Bidder's scope.	Bidders understanding is in order
211	Section -VI, Part-B, Sub-section-I-M1 (FGD)				36 of 49	16.01.02	All ducts to be designed for one tenth of duct full of ash….	The absorber (JBR) proposed by Bidder shall have zero ash carried over at the outlet of the absorber. Hence, Bidder proposes to consider zero ash load for the design of duct after the absorber upto the Wet Stack terminal point. NTPC is requested to confirm.	Bidder to comply the specification requirement in this regard.
212	Section -VI, Part-B, Sub-section-I-M1 (FGD)				37 of 49	16.01.02	All flue gas ducts shall also be designed for ± 660 mm w.g., or maximum conceivable pressure of the relevant fans….	(-)660mmWC is not envisaged in the FGD duct system. Hence bidder requests to consider (-)150mmWC as minimum pressure for duct design. NTPC is requested to confirm.	Refer Amendment in this regard.
213	Section -VI, Part-B, Sub-section-IV-D (Civil Works)				10 of 114	3.14.01	Single-flue or multi-flue chimney(s) shall be provided…..	NTPC is requested to confirm the minimum center to center distance to be maintained between existing chimney and new 150m High stack.	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. Also refer Amendment issued separately in this regard.
214	SECTION – VI, PART-A			SUB-SECTION-V SALIENT DESIGN DATA	3.00.00	3 OF 10,	**HCL** (PPM-WET) and **HF** (ppm-wet):	Employer is requested to confirm the concentration of HCL & HF.	Refer Amendment to technical specification in this regard.
215	SECTION – VI, PART-A			SUB-SECTION-V SALIENT DESIGN DATA	3.00.00, (Sub Item 7)	3 OF 10,	**Guarantee case**: SO2 (% v/v) : 0.088 and Inlet SO2 (mg/Nm3-wet) : 2437 **Design case**: SO2 (% v/v) : 0.087 and Inlet SO2 (mg/Nm3-wet) : 2407	The data in % v/v and mg/Nm3-wet are not matching (not in consonance with each other). Employer to confirm which one should be considered for design.	Refer Amendment to technical specification in this regard.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
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216	SECTION – VI, PART-A			SUB-SECTION-V SALIENT DESIGN DATA	3.00.00, (Sub Item 7)	3 OF 10,	**Guarantee case**: Dust (mg/Nm3): 50-200 **Design case**: Dust (mg/Nm3): 50-200	Bidder would like to clarify that 50 mg/Nm3 Dust concentration shall be considerd for guarantee case and 200 mg/Nm3 Dust concentration shall be considerd for design case. Employer is requested to confirm on bidder's clarification.	Bidder to comply the specification requirement.
217	SECTION – VI, PART-A			SUB-SECTION-IV TERMINAL POINTS AND EXCLUSION	1.07.00	2 OF 3	Waste water : ……. pH shall be 7.0 (approx) and temperature shall be <50 deg C	Employer to clarify whether waste water temperature of around 60 deg C at FGD Battery limit is acceptable.	Bidder to comply the specification requirement.
218	SECTION – VI, PART-A			SUB SECTION-II PROJECT INFORMATION	Annexutre-III	Page 6 of 10	Raw Water and Clarified water Analaysis	Employer is requested to provide TDS of Raw Water (Process Water for FGD) and clarfied water.	Bidder to refer raw water and clarified water analysis. Any additional information beyond that shall be discussed during detailed engineering

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
219	SECTION – VI, PART-A			SUB SECTION-II PROJECT INFORMATION	Annexutre-III	Page 6 of 10	Raw Water and Clarified water Analaysis	Employer is requested provide minimum & maximum temperature of Raw water (Process Water for FGD) and Clarified water	Bidder to refer weather data of project and estimate water temperature.Any additional information beyond that shall be discussed during detailed engineering
220	SECTION – VI, PART-A			SUB SECTION-II PROJECT INFORMATION	Annexutre-IV-4	Page 10 of 10	The sulphur content in the 'worst type' imported coal is 0.9 % which looks high..	Bidder request Employer to furnish the corresponding SO2 concentration in the flue gas corresponding to this type coal.	Refer Amendment in this regard.
221	SECTION – VI, PART-A			SUB-SECTION-III-A1 SCOPE OF SUPPLY & ABSORBER	4.01.03	4 of 8	Guillotine gates shall be provided at the inlet & outlet of the each Booster fan. One (1) no FGD by pass gate shall be provided in the existing duct connecting to existing chimney.	These Clauses are contracdictory to each others, so Bidder request Employer to clarify the dampers scope division between Employer and Bidder.	Refer Amendment to technical specification in this regard.
	SECTION – VI, PART-B			SUB-SECTION-I-M1 TECHNICAL REQUIREMENTS (FGD)	3.03.01	6 of 49	Guillotine gate type damper is being provided by the Employer before the suction of each Booster fan. A gas tight, motor operated Guillotine gate type damper shall be provided by the Contractor at the outlet of each booster fan. A Pneumatic operated multi louverdamper with seal air arrangement shall also be provided by the Contractor		Refer Amendment to technical specification in this regard.
	SECTION – VI, PART-B			SUB-SECTION-I-M1 TECHNICAL REQUIREMENTS (FGD)	1.03.02	2 of 49	Motorized Guillotine type gates shall be provided at (i) hot gas inlet to Absorber and (ii) in the bypass duct. Further, Quick opening Bi-plane motorized/pneumatic damper along with 2x100% seal air fans shall be provided in the by-pass duct.		Refer Amendment to technical specification in this regard.
	PART E, TENDER DRAWINGS			P&ID	4410-109-POM-A-005	11 of 14	FGD bypass Multilouvre Control Dampler in bypass duct is shown in Employer Scope		FGD byspass multilouvre damper shall be in the scope of bidder. Read tender document in totality.
222	SECTION – VI, PART-A			SUB-SECTION-VI FUNCTIONAL GUARANTEED AND LIQUIDATED DAMAGES	4.02.06	8 of 14	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 understand that **10 m3/hr** is for one boiler unit so the total 30 m3/hr for 3 x 660 MW units. Employer is requested to confirm on Bidder's understanding.	Specification requirement is clear in this regard. Bidders to Comply the specification requirement.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
223	SECTION – VI, PART-B			SUB-SECTION-I-M1 TECHNICAL REQUIREMENTS (FGD)	7.07.03	26 of 49	2x100% horizontal centrifugal pumps shall be provided to feed the secondary hydrocyclones. Each pump shall be sized to empty the full storage capacity of the tank in **6 hrs.**	Bidder understand the 6hrs is a typo and it should be 1 hr, which is in consonant with thr residence time of 1 hr for secondary hydrocyclone feed tank. Employer is requested to confirm on Bidder's understanding.	Refer Amendment to technical specification in this regard.
224	SECTION – VI, PART-B			SUB-SECTION-I-M1 TECHNICAL REQUIREMENTS	13.03.00	32 of 49	2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks **(total 4 nos. of pumps for 3x660 MW**) along with all necessary piping, valves, control & instrumentation shall be provided by the Contractor.	Bidder wish to clarify that there should be 6 nos of Mist Eliminator wash pumps instead of 4 nos for 3 X660 MW. Employer is requested to confirm on Bidder's clarification.	Refer Amendment to technical specification in this regard.
225	PART E, TENDER DRAWINGS			LAYOUT OF FGD AREA	4410-109-POM-A-005	6 of 14	Flue gas duct from FGD outlet to existing Chimney.	Bidder wish to clarify that, in the layout drawing it is shown that the Flue gas from FGD is returning to the existing stack. However as per SUB-SECTION-III-A1SCOPE OF SUPPLY , clause 18.00.00 there is a requirement of new stack (Wet Stack Condensate Collection System). Employer is requested to clarify the same.	Absorber outlet Flue gas duct shall be led to new wet stack. Please read the specification in totality.
226	SECTION – VI, PART-A			SUB SECTION-III-A2 LIMESTONE & GYPSUM HANDLING SYSTEM	1.01.00	2 OF 7	vii) Conveyors 5A/B shall drop limestone in to **Limestone Silos** of FGD System through fixed Tripper on the first silo in the path.	Employer to confirm the capacity requirements of these limestone silos.	Specification requirement is clear in this regard. Please refer clause No. 3.01.01, Section-VI, Sub-Section III-A1
227	SECTION – VI, PART-A			SUB-SECTION-IV Terminal Point & Exclusions	1.02.00	1 of 3	Flue Gas Duct (i) Un cleaned Flue Gas For each unit: Outlet flange (matching flanges/expansion joint included in the Contractor's scope) in the tapping from the common Flue Gas Duct going towards the existing Chimney. No load of duct shall be transmitted on the Employers facilities. In case no opening or flange connection is available in the ducts from where tapping will be taken, the cutting in the duct as well as flange connection shall be in the scope of the contractor.	Employer is requested to provide the details i.e. exact location, size and elevation of Terminal Points.	Details of existing duct is indicated in the drawing enclosed with chapter Project Information i.e. sub section-II, Part- A, Section - VI of technical specification.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
228	SECTION – VI, PART-B			SUB-SECTION-I-M1 FGD	1.09.00	4 of 49	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.	Specification requirement is clear in this regard. Bidders to Comply.
229	SECTION – VI, PART-B			SUB-SECTION-I-M1 FGD	3.03.09	7 of 49	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.	Refer Amendment to technical specification in this regard.
230	SECTION – VI, PART-B			SUB-SECTION-I-M1 FGD	5.04.00	15 of 49	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.	Refer Amendment to technical specification in this regard.
231	SECTION – VI, PART-A SECTION – VI, PART-B			SUB SECTION-III-A1 SUB-SECTION-I-M1 (FGD)	3.01.02 6.05.01	2 of 9 22 of 51	2x100% wet horizontal ball mills with each mill sized to meet 110% of the maximum total limestone requirement of three (03) units at Design point. There shall be 2X100% tube mills for grinding of limestone. Each mill shall be sized to meet 110% of the maximum limestone requirement of 3x660 MW units under the following conditions, all occurring together. (i) Load Design point flow (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.	Refer Amendment to technical specification in this regard.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
232	SECTION – VI, PART-B PART-A			SUB-SECTION-I-M1 FGD SUB-SECTION-III-A1 FGD	7.07.07 & 7.07.10 2.06.00	26 of 49 & 27 of 49 2 of 8	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 to ensure required pH of waste water….	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. 4410-109-POM-A-007, 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), so this point needs to be incorporated in the Terminal Point Chapter (Section-VI, Part-A, Sub-section IV, Terminal Points & Exclusions).	Specification requirement is clear. Bidder shall comply with the specification requirements.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
233	SECTION – VI, PART-B			SUB-SECTION-I-M1 FGD	13.01.00 & 13.03.07	31 of 49 & 32 of 49	- Additional Corrosion allowance of 1.50 mm on the minimum tank shell thickness - Additional Corrosion allowance of 3mm on the minimum tank shell thickness	Both clauses are contradictory to each other. Employer is requested to clarify which clause needs to be considered.	Refer Amendment to technical specification in this regard.
234	SECTION – VI, PART-B			SUB-SECTION-I-M1 FGD	16.01.03	37 of 49	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	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 Amendment to technical specification in this regard.
235	SECTION – VI, PART-A SECTION – VI, PART-E			SUB-SECTION-III-A1 FGD Drawing No. : 4410-109-pom-A-007, Rev-A (Scheme of Gypsum Dewatering System)	5.04.00 -	5 of 8 -	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. 2x100% Belt & Cloth wash water pump (going to belt filter)	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 not envisage 2x100% belt & cloth wash water pumps as indicated in the specification & drawings. Employer is requested to confirm on Bidders above clarification.	Specification requirement is clear in this regard. Bidders to Comply.
236	SECTION – VI, PART-A Section VI part B			Sub-section-III A-1 Sub section-I-M1	6.02.00 7.08.02	5 of 9 27 of 49	- The contractor shall provide 1x100% slurry pumps for pumping the slurry back to the absorber of any of the units in 8 hrs (max.). - 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 Amendment to technical specification in this regard.
237	SECTION – VI, PART-B			Sub section- I-M1	5.06.10	17 of 49	The raw gas inlet duct of the absorber shall be equipped with a flushing device which shall operate continuously as well as intermittently.	Bidder understands that this clause (flushing device) means emergency quenching, Employer to clarify on Bidders understanding.	Specification requirement is clear in this regard. Bidders to Comply.
238	SECTION – VI, PART-B			SUB-SECTION - I-M1 - FGD System	6.05.07	22 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 8. Employer is requested to confirm on Bidders understanding.	Specification requirement is clear in this regard. Bidders to Comply.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
239	SECTION – VI, PART-A			SUB-SECTION-I INTENT OF SPECIFICATION	1.01.00-d	1 of 18	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.	Bidder to comply the specification requirement.
240	SECTION – VI, PART-B			SUB-SECTION- I-M1 (FGD)	6.05.01	21 of 49	There shall be 2x100% tube mill for grinding of limestone.	Bidder understands that the offered mill are "Ball Mill" not "Tube mill" as mentioned in this clause.	Bidders understanding is correct. Refer necessary Amendment in this regard.
241	SECTION-VI PART-B			SUB-SECTION-I-M1 (FGD)	6.07.03	23 of 49	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.	Bidder to comply the specification requirement.
242	SECTION-VI PART-B			SUB-SECTION-I-M1 (FGD)	8.07.00	28 of 49	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 similar service.	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 practice in similar applications.	Refer necessary amendment in this regard.
243	SECTION-VI PART-B			SUB-SCTION-I-M1 (FGD)	12.03.00	31 of 49	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 in this regard. Bidders to Comply.
244	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.	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 in-take/ back draft louvres: ii) MCC and Switchgear rooms: Supply air fan and back draft dampers		
245	SECTION-VI PART-B			SUB-SECTION-I-M1 (FGD)	6.05.01	21 of 49	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.	Refer Amendment to technical specification in this regard.
	SECTION-VI PART-A			SUB-SECTION-V SALIENT DESIGN DATA AND SIZING	6.00.00	5 of 10	Bond index 13 kWh/t		
246	SECTION-VI PART-A			SUB-SECTION-VII MANDATORY SPARES	1.01.00	4 of 38	Booster fan impeller Liners: 3 sets Booster fan casing liners: 3 set	Same is not applicable, hence bidder shall not envisage any spares for these items.	Bidder to comply the specification requirement.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
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247	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.	Bidder to comply the specification requirement.
248	SECTION-VI PART-A			SUB-SECTION-VII MANDATORY SPARES	1.16.00	6 of 38	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 shall not envisage any spares for these items for water pumps.	Bidder to comply the specification requirement.
249	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.	Specification requirement is clear in this regard. Bidders to Comply.
250	SECTION-VI PART-B			SUB-SECTION-I-M2 (Limestone Handling Plant)	4.4.3 2.4.4	8 of 73 37 of 73	Provision for alternative manual operation shall also be made using declutchable hand wheel of 500 mm diameter. 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.	Specification requirement is clear in this regard. Bidders to Comply.
251	SECTION-VI PART-B			SUB-SECTION-I-M2 (Limestone Handling Plant)	4.4.3 2.3.3	8 of 73 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. 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.	Specification requirement is clear in this regard. Bidders to Comply.
252	SECTION-VI PART-B			SUB-SECTION-I-M6 (Limestone Handling Plant)	4.4.3 2.4.5	9 of 73 37 of 73	The diameter of the shaft shall not be less than 150 mm. 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.	Specification requirement is clear in this regard. Bidders to Comply.
253	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 propose 18 deg. inclination angle for the Belt conveyor selection.	Specification requirement is clear in this regard. Bidders to Comply.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
254	SECTION-VI PART-A			SUB-SECTION-III A1 FGD	3.01.06	3 of 8	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.	Bidders to comply specification requirement.
255	SECTION-VI PART-A			SUB-SECTION-III A1 FGD	16.01.00	7 of 8	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.	Bidders to comply specification requirement.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
256	SECTION-VI PART-A			SUB-SECTION-VII MANDATORY SPARES	1.03.00	4 of 38	Absorber Liner material: 15% 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.
257	SECTION-VI PART-C			GENERAL TECHNICAL REQUIREMENTS	30.00.00	42 of 82	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: 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: b) Air Compressor: < 90 dBA c) Crusher: < 102 dBA Employer is requested to confirm on Bidders understandsing.	Refer Amendment to technical specification in this regard.
258	SECTION-VI PART-B			SUB-SECTION-I-M2 (Limestone Handling Plant)	2.00.00	1 of 112	a) The limestone delivered to the power station shall be of size 250 mm & below. However occasionally 1-2% limestone of 400 mm lump size may also be encountered.	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	Bidder to provide Crusher meeting specification requirement. Bidder may consider sieve analysis as per general industry practice for lime stone
259	SECTION-VI PART-A			SUB-SECTION-III-A2 (Limestone & Gypsum Handling Plant)	2.01.26	5 of 7	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.	Bidders to comply specification requirement.
260	SECTION-VI PART-B			SUB-SECTION-I-M1 (FGD)	7.08.06	28 of 49	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. 5.06.23 mentioned in Sub-section-I M1 (FGD) under Technical Specification Section VI Part B. Employer is requested to confirm on Bidders consideration.	Bidders to comply specification requirement.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
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261	SECTION-VI PART-B			SUB-SECTION-I-M1 (FGD)	10.01.00	29 of 49	Coarse-screen(s) at suction-side of these pumps shall be provided.		Bidders to comply specification requirement.
262	SECTION – VI, PART-B			SUB-SECTION-I-M1 (FGD)	4.04.00Note (b)	10 of 49	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 from the date of commissioning.	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 mentioned 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.	Bidders to comply specification requirement.
263	SECTION – VI, PART-E			TENDER DRAWINGS	1.00.00	1 OF 2	List of applicable drawings /Details	Bidder request Employer to furnish the detail drawings of existing pipe /cable rack near ESP control room.	All the relevant drawings are enclosed with the tender.
264	SECTION-VI PART-B			SUB-SECTION-I-M1 (FGD)	6.07.03	23 OF 49	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. Employer is requested to confirm on above consideration.	Bidders to comply specification requirement.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
265	SECTION.VI, PART-A			SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	1.03.00	1 OF 3	**Equipment Cooling Water** **Normal make up to ECW tank:** 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.). **Emergency make up to ECW tank:** 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.).	Bidder request Employer to furnish the following details: - 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. - 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.	Bidder to note that piping header is available at C row (running along CD bay rack). Exact location will be finalized during detail engineering.
266	SECTION-VI, PART-A			SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	1.04.00 1.05.00 1.06.00	2 OF 3	**Process Water :** Employer shall provide Raw water tap off from 700NB header in raw water pump area near raw water reservoir for further connection by bidder. **Gypsum Wash Water (Clarified Water):** 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.). **Portable water:** 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.).	Bidder request Employer to furnish the Terminal Point coordinate for connection of Process water and markup this TP in the layout drawing. - 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. - Bidder request Employer to furnish the Terminal Point coordinate of "existing portable water pump discharge in CD bay rack" for connection of Portable water and markup this TP in the layout drawing.	Exact location will be finalized during detail engineering.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
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267	SECTION-VI, PART-A			SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	1.07.00	2 OF 3	Waste Water FGD waste water pipes shall be terminated at 5M away from the nearest Mixing tank of Employer in HCSD Silo area. Pressure at terminal point shall be 3kg/cm2(g) at 300mm above FFL. pH shall be 7.0 (approx.) and temperature shall be <50°C.	Bidder request Employer to furnish the Terminal Point coordinate of "existing 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.
268	SECTION-VI, PART-A			SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	1.09.00	2 OF 3	FIRE DETECTION AND PROTIECTION SYSTEM (i) Mechanical: Separate Hydrant and spray Hader (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.	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.	Bidder has wrongly mentioned that Separate Hydrant and spray Header (within 100 metre) available in plant area. Bidder to refer cl. No. 1.09.00 of technical specification , sub-section-IV "Terminal Point & Exclusion". Further, Co-ordinate point for hydrant & spray water header shall be furnished during detailed engg. However, one no. tapping each for hydrant & spray shall be provided around 50m vicinity.
269	SECTION-VI, PART-A			SUB-SECTION-VII MANDATORY SPARES	1.11.00	6 OF 38	Slurry Line Bends 3 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.
270	SECTION-VI, PART-A			SUB SECTION-III-A1 FGD	1.01.00	1 OF 8	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 area along with pipe connections between FGD area & Dewatering area, Bidder will use Employers Pipe Trestle/Rack, then further distribution within FGD area is in Bidders scope. Employer is requested to confirm on Bidders consideration.	Stipulations, as given under Clause 13.00.00 Sub Section- IIIA1 Section –VI, Part-A, shall be complied with w.r.t trestles.
271	SECTION-VI, PART-B			SUB-SECTION-I-M6 (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.	This clause is applicable for yard Piping.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
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272	SECTION-VI, PART-B			SUB-SECTION-I-M6 (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. Employer to confirm on Bidders understandsing.	Technical requirement are clear. Bidder to comply the same
273	SECTION-VI, PART-B			SUB-SECTION-I-M6 (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.	Bidder to comple the specification requirement.
274	SECTION-VI, PART-B			SUB-SECTION-I-M6 (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.	Bidders understanding is correct.

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275	SECTION – VI, PART-A			SUB-SECTION-III-A2 (Limestone & Gypsum Handling Plant)	1.01.00 (i)	1 of 3	Stacking Conveyor 3A/B will drop limestone to overground storage hopper provided within a shed via travelling trippers. One (1) number Traveling Tripper is mounted on each of the Stacking Conveyor 3A/B. The storage Capacity of Limestone Storage hopper shall be sufficient to store Limestone for minimum 10 days consumption considering all units at full load.	Bidder is requested for flexibility in selecting storage silo instead of storage shed. Employer is requested to check & confirm whether we can consider 7 days storage for crushed limestone storage (similar to Gypsum) instead of 10 days.	Bidder to comply the stipulations of the technical specifications
276	SECTION-VI PART-B			SUB-SECTION-I M1 (FGD)	3.03.08	7 of 49	The blades and frames of the dampers provided at the outlet of Booster fan in the untreated gas path shall be made of carbon steel. In the FGD outlet treated gas path the frame of the damper shall be made of STEN-1 or better material, the blades shall be made of SS317LMN or better material and the seals shall be made of Alloy C- 276 or better material.	Bidder clarifies that FGD outlet dampers are not applicable for this project. There is no damper in the FGD outlet treated gas path. Employer is requested to confirm the Bidder's understanding.	Refer Amendment to technical specification in this regard.
277	SECTION-VI PART-B			SUB-SECTION-I M1 (FGD)	6.03.01	20 of 49	A motorized bunker shut-off gate shall be provided at the inlet to each feeder.	Same is contradicting with Tender doc. Drawing no. 4410-109-POM-A-006 where motorized shut-off gates have been shown both at Weigh Feeder inlet and outlet. Employer is requested to confirm the requirement.	Specification requirement is clear in this regard. Bidders to Comply.
278	SECTION-VI PART-B			SUB-SECTION-I M1 (FGD)	17.01.03	40 of 49	All gates at Booster Fan discharge shall be provided with 2x100% pressurization fans to achieve 100% sealing efficiency.	Same is contradicting with Tender doc. Drawing no. 4410-109-POM-A-005 where individual Seal Air system has been shown for each of the dampers. Employer is requested to confirm the requirement where bidder shall follow the specification requirement or Tender drawing. If bidder shall follow the Tender drawing document (4410-109-POM-A-005) Common Seal Air Skid (consisting 2x100% pressurization fans) shall be envisaged for dampers as per bidder's proven practice.	Specification requirement is clear in this regard. Bidders to Comply.

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279	SECTION-VI PART-B			SUB-SECTION-I-M2 (Limestone & Gypsum Handling System)	2.00.00 (a)	1 of 112	The limestone delivered to the power station shall be of size 250 mm & below. However occasionally 1-2% limestone of 400 mm lump size may also be encountered.	Bidder shall not envisage the Crusher considering 400 mm lump size of limestone. Crusher shall be designed for maximum feed size of (-) 250 mm only. Employer is requested to provide the limestone particle size distribution as well to design the Crusher.	Bidder to provide Crusher meeting specification requirement. Bidder may consider sieve analysis as per general industry practice for lime stone
280	SECTION – VI, PART-A			SUB-SECTION-III-A1 (FGD)	16.02.00	8 of 8	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 shutoff. 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.	Common Seal Air Skid (consisting 2x100% pressurization fans) shall be envisaged for Booster Fan suction and discharge dampers as per bidder's proven practice.	Bidders to comply specification requirement.
281	SECTION – VI, PART-A			SUB-SECTION-III-A1 (FGD)	16.02.00	1 of 7	In Crusher house, Limestone from incoming Conveyor 1A will pass through dedicated Vibrating Feeder (VF-1) and dedicated Crushers (CR-1). Similarly Limestone from incoming Conveyor 2B will pass through dedicated Vibrating Screening Feeders (VF-2) and dedicated Crushers (CR-2) respectively. Each dedicated stream shall have a set of Rod gate and Rack & Pinion Gate before Vibrating Feeder.	Employer to clarify the requirement for having Vibrating screening feeder at Crusher upstream. Bidder shall not envisage any Vibrating screening feeder at Crusher upstream. Also bidder shall not recommend any Rod gate/ Rack & Pinion gate before Vibrating Feeders.	Bidders to comply specification requirement.
282	SECTION-VI PART-B			SUB-SECTION-I-M2 (Limestone & Gypsum Handling System)	2.00.00 (b)	1 of 112	For limestone handling system the nominal moisture content shall be taken as 20%.	Same shall be considered maximum 5% as per bidder's proven selection.	Bidder to comply the stipulations of the technical specifications

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Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
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283	SECTION-VI PART-B			SUB-SECTION-I M1 (FGD)	5.06.06	16 of 49	The mist eliminator wash piping shall be constructed of rubber lined carbon steel or glass fiber reinforced plastics. The mist eliminator spray headers shall be made of FRP or rubber lined Carbon Steel, corrosions and erosion resistant in the inner and outer side (Silicon Carbide coating on metal/FRP surface exposed to slurry).	Bidder shall envisage Polypropylene Wash pipe/ Wash header for the same as per bidder's proven practice.	Specification requirement is clear in this regard. Bidders to Comply.
284	SECTION-VI PART-B			SUB-SECTION-I M1 (FGD)	5.06.13	18 of 49	All metallic fasteners which are provided inside the absorber/absorber wet-dry interface ducting shall be of Alloy 59/ C276.	Bidder shall envisage Fluorothermoplastic fasteners for Mist Eliminator and Mist Eliminator Wash nozzles fixing as per bidder's proven practice.	Bidders to comply specification requirement.
285	SECTION-VI PART-B			SUB-SECTION-I M1 (FGD)	5.06.13	18 of 49	All internal members shall be lined with minimum 2 mm Alloy 59/ C276.	Bidder shall envisage FRP material for Mist Eliminator Wash pipe supports as per bidder's proven practice.	Bidders to comply specification requirement.
286	SECTION-VI PART-B			SUB-SECTION-I M1 (FGD)	5.06.15	18 of 49	The other bridges (supports) shall be linedwith minimum 2 mm Alloy 59/ C276.	Bidder shall envisage FRP material for Mist Eliminator Wash pipe supports as per bidder's proven practice.	Bidders to comply specification requirement.
287	SECTION-VI PART-B			SUB-SECTION-I M1 (FGD)	3.03.01	6 of 49	A Pneumatic operated multi louver damper with seal air arrangement shall also be provided by the Contractor in the clean gas duct after GGH.	Bidder clarifies that GGH is not applicable for this project. There is no damper in the clean gas duct after GGH. Employer is requested to confirm the Bidder's understanding.	Refer Amendment to technical specification in this regard.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
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288	SECTION-VI PART-B			SUB-SECTION-I M1 (FGD)	3.03.07	7 of 49	A damper in the bypass duct is being provided by the Employer for quick opening to allow bypass to come into operation in case of emergency.	Same is contradicting with Tender doc. Drawing no. 4410-109-POM-A-005 where Motorized Guillotine damper is shown in bypass duct. Bidder clarifies that they shall not envisage any Guillotine gate damper at the bypass damper for isolation. Same shall be Quick acting Multi-louvre damper as per clause no. 3.03.07 mentioned in Sub-section-I M1 (FGD) under Technical Specification Section VI Part B. 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. Further In case of single point tapping, one Guillotine gate shall be provided additionally at the tapping from existing duct coming from ID Fan.	Quick acting Multi louvre biplane damper are envisaged in the bypass duct to existing Chimney and are in the Bidders scope. For Guilotine gates Please Refer Amendment to technical specification.
289	SECTION – VI, PART-A SECTION – VI, PART-B SECTION – VI, PART-A			SUB-SECTION-III-A1 FGD SUB-SECTION-I-M1 FGD SUB-SECTION-III-A2 LIME STONE & GYPSUM HANDLING SYSTEM	2.06.00 7.04.09 1.02.00	2 of 8 25 of 49 2 of 7	- 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. - Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided **by the Employer**. Dewatered Gypsum discharged from the vacuum belt filter shall be taken by Conveyor 6A/B to the storage shed. The storage shed shall be sufficient to store gypsum equivalent to gypsum generation of minimum 7 days (Generation of all three units to be considered).	Bidder understandss that Gypsum transfer conveyors (from Vacuum Belt Filter outlet to Gypsum storage area) are in Bidders scope NOT in Employer scope. Terminal Point is not mentionded for Gypsum in the chapter (Section-VI, Part-A, Sub-section-IV). Employer is requested to confirm on Bidders understandsing.	Refer Amendment to technical specification in this regard.

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290	SECTION-VI, PART-A SECTION-VI, PART-A			SUB-SECTION-III-A4 FGD ECW & AUXILIARY WATER SYSTEM SUB-SECTION-IV TERMINAL POINTS & EXCLUSIONS	1.02.00 1.04.00	2 OF 2 1 OF 3	<u>Consumptive water/ process water/ raw water for FGD system</u> Consumptive water/ process water for FGD system shall be provided from the raw water reservoir inside the plant. Complete raw water system from the reservoir upto the end consumption point includes the following: a) 2x 100% raw water pumps complete with valves, drives and accessories for FGD system of all the three units. <u>Process Water</u> Employer shall provide Raw water tap off from 700NB header in raw water pump area near raw water reservoir for further connection by bidder.	There is a contradiction in the specification for raw water terminal point.Bidder understand that employer shall provide raw water terminal point from tap off of raw water 700NB header for consumptive water/process water/raw water for FGD system.. Hence there is no requirement of raw water pump for FGD area. Emplyoer is requested to confirm Bidder understanding. Employer is requested to indicate raw water terminal point co-ordinates and suggestive route if any. Also, provide pipe sleepers/trestle arrangement drawing of existing area from where raw water shall be route to FGD area.	Raw water pump to provide process water for FGD is in bidder's scope of work as per technical specifications. Only tap-off for connection pump suction pipe shall be provided by NTPC. Exact routing of piping shall be finalised during detailed enginnering.
291	SECTION-VI, PART-E			Drawing No. : 4410-999-POC-F-001, Rev-A			Yellow mark up along the road at E 7905.0 and E 7800.0 of FGD Area for absorber	Bidder understand that yellow mark up along road is road embarkment area. Employer is requested to confirm Bidder understanding as no legend is indicated in Tender drawings. Also, Employer is requested to mark up the area with NE co-ordinates (like NE mark up of Gypsum & Limestone storage/handling area) in FGD Area 1 & 2 for Bidder understanding of total area available for FGD Facilities. Bidder understand that there is no existing underground facilities in area allocated for FGD facilities. Employer to provide drawings If any existing underground facilities at allocated FGD area.	Bidder understanding is correct regarding yellow mark up. For co-ordinates Bidder may refer GLP. Exact co-ordinates shall be finalised during detail Engineering. Bidder understanding is correct regarding underground facilities.

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292	SECTION-VI, PART-B			SUB-SECTION-I-M1 (FGD)	1.06.01	4 OF 49	The location of FGD System and associated facilities have been indicated in the tender drawings No. 9578-999-POM-F-001 & General Layout Plan	There is no drawing with drawings No. 9578-999-POM-F-00 in Tender Specification. Employer is requested to provide above drawing to Bidder.	Refer Amendment in this regard.
293	SECTION-VI, PART-A			SUB-SECTION-II PROJECT INFORMATION			General Arrangement - Back end arrangement (Layout of ID System) Plan & Elevation	These drawing are not readable. Employer is requested to submit readable copy and AutoCAD file for these drawings.	ID SYSTEM DRAWING AGAIN ATTACHED at Annexure-II
294	SECTION-VI, PART-E			Drawing No. : 4410-999-POM-A-001, Rev-A			Borewell 2 - N 11755.0 E 7870.0	Borewell 2 is temporary or permenant. Employer to confirm.	Borewell 2 is temporary.
295	SECTION – VI, PART-A			SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM	2.02.00	2 OF 9	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.
296	SECTION – VI, PART-A			SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM	4.00.00 (d)	5 OF 9	d) Cables required for interfacing PLC control system with Employers DDCMIS (both SG and BOP) located in CER shall be in bidder's 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.
297	SECTION – VI, PART-A			SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM	6.03.00	6 OF 9	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: a) Start Push Button b) Stop Push Button c) ON Running Lamp d) OFF Lamp 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.
298	SECTION – VI, PART-A			SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM	6.05.00	6 OF 9	The minimum quantity per unit of furniture envisaged in FGD control room is as mentioned below: a) Chair-4 nos. b) Printer table- 1 no c) Computer table- 2 no. d) Key pad- 1 no. e) Locker set -1 no	Bidder understands that these furniture shall be applicable for single control room consist of three unit, 3x660 MW. 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. 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 North Karanpura (3x660MW) project, the quantity of furniture to be supplied shall be thrice 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 to comply with the specification.

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299	SECTION – VI, PART-A			SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM	6.07.00	7 OF 9	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. 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.
300	SECTION – VI, PART-A			SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM	9.01.00	7 OF 9	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 for all three unitts and common system 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. 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.**
301	SECTION – VI, PART-A			SUB-SECTION-III-C (C&I) CONTROL AND INSTRUMENTATION SYSTEM	9.02.00 (4)	9 OF 9	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. The Bidder logic is only given for a possible starting point only.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.
302	SECTION – VI, PART-A			SUB-SECTION-VII, MANDATORY SPARES	Clause 4.00.00, sub-clause 7.3.3 and Clause 5.00.00, sub-clause 1.05.00	21 OF 38 and 25 OF 38	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 to comply with the specification requirement.

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303	SECTION – VI, PART-B			SUB-SECTION-III-C1, BASIC DESIGN CRITERIA	4.01.00	4 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.
304	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.
305	SECTION – VI, PART-B			SUB-SECTION-III-C2, MEASURING INSTRUMENTS	2.04.00	7 OF 30	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. Refer amendment in this regard.
306	SECTION – VI, PART-B			SUB-SECTION-III-C2, MEASURING INSTRUMENTS	7.00.00	14 OF 30	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 and stated limit switches is not specifically for Fire Alarm Control system. 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.
307	SECTION – VI, PART-B			SUB-SECTION-III-C2, MEASURING INSTRUMENTS	8.00.00	16 OF 30	Coriolis Flow Transmitter : Viscosity range of Fluid is 0-500cst for HFO.	Bidder understands that this clause is applicable for gypsum/reagent slurry density 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.

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Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
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308	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. 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.
309	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. 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 to employer's approval during details engineering.	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.
310	SECTION – VI, PART-E			SCHEME FOR UNINTERRUPTIBLE POWER SUPPLY SYSTEM-CONFIGURATION-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.
311	SECTION – VI, PART-E			SCHEME OF FGD-ABSORBER SYSTEM (SINGLE UNIT)	- 4410-109-POM-A-005		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.
312	SECTION – VI, PART-E			SCHEME OF FGD-ABSORBER SYSTEM (SINGLE UNIT)	- 4410-109-POM-A-005		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 to comply with the specification requirement.
313	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: a) 3x660 MW : Two 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: a) OWS (placed in FGD control room)-FOUR (4 Nos) b) OWS cum EWS (placed in FGD control room)-ONE (1 No) c) OWS (placed in central control room of each generating unit)-TWO (2 no.). Bidder to refer amendment in this regard.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter								
314	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 indicate the Location of Employers Existing HT switchgears room (i.e. Column No., Bay no., Level of TG Building for each units)	HT Switchgear is located in main plant AB bay.
315	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 avaiilability 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 undesrand that spare cable trays (HT & Control) available in the employers nearest trestle from Employers Existing HT Switchgear building to Proposed FGD area. 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. So Bidder not envisiged any new cable trestle for laying of necessary cables from Employers Existing HT Switchgear building to Proposed FGD area. Bidder request Employer to indicate the existng trestle / cable route whrere non availability of spare cable tray in employer's trestle (Drg no 0011 -999-POC-F-001).	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
316	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 wish to clarify that DG set sizing shall be as per sub-section -II-E-11 (Diesel Generator, Cl. No. 4.04.00, Pg. 3 of 19) 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
317	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		
318	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 wish to clarify 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 requested to clarify the same.	Please refer amendment-01 of Technical Specification(Section VI)

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
319	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. Emplpyer is requested to confirm the same.	Bidders understanding is correct.
320	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 wish to clarify 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 requested to clarify the same.	Bidders understanding is correct.
321	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 caluse 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. Refer Amendment to technical specification in this regard.
322	SECTION – VI, PART-A			SUB-SECTION-III-C (C&I)	6.03.00	6 of 8	For each equipmen/drives/pumps wherere Local Operation is envisaged in addition to control system as mentioned in respective Mechanical Sections, Bidder to consider Local Push button station comprising following: a) Start Push Button b) Stop Push Button c) ON Running Lamp d) OFF Lamp e) MCC Disturbance Indicating Lamp	Bidder did not envisage any local operation based on their past experience in FGD system, however Bidder has considered local Push Button station (latched type Emergency push bottons as per cl. no. 27.00.00 of SECTION – VI, PART-B, SUB SECTION-II-E-10 LT SWITCHGEARS & LT BUSDUCTS, Pg. 28 of 58) for all drives. 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.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
323	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: a) Bidder request Employer to provide the electricity per unit charges to estimate the electricity cost for construction power. b) Bidder request Employer to provide the distance / route of cable from LT SWGR to work site. 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 DIS-COM.Refer subsection-IIIB,part-A,Construction power. b)Location of construction power feeders shall be provided during detail engineering. c)Bidder's understanding is correct.
324	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.	Bidders to comply specification requirement.
325	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. 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 understanding is in order b) Construction of power ring main is not envisaged as per scope. However, necessary power supply arrangement (beyond the employers 2 nos 415V LT feeders) for construction work of the package to be arranged by bidder
326	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.	Bidders to comply specification requirement.
327	SECTION – VI, PART-D			Erection Condition of contract	36.05.00	20 of 53	Bidder shall install CCTV cameras at all Strategic Locations in the plant area which shall be linked to safety control room	Bidder requests Employer to provide the details nos. of such strategic location requiring CCTV camera	Bidders to comply specification requirement.
328	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 to comply specification requirement.
329	SECTION – VI			SUB-SECTION-IV-D (Civil Works-North Karanpura Super Thermal Power Project-3x660 MW)	Site Levelling (Clause-10.00.00- page 27 of 114)		Bidder shall ensure that road access and drainage facilities for each block is available when site levelling in that block is completed.	Bidder undestands that roads and drains mentioned here is specific for access to the various blocks of FGD from the Main Plant Roads and drains(which shall be provided by Owner).	Bidders understanding is correct. Roads in the scope of bidder are as shown in tender drawing 4410-999-POC-F-001 titled "Layout Plan Of FGD System".

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
330	SECTION – VI			SUB-SECTION-IV-D (Civil Works-North Karanpura Super Thermal Power Project-3x660 MW)	Site Levelling (Clause-10.00.00- page 27 of 114)		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 levelling of that block.	Bidder undestands that block mentioned is specific to FGD amenities. Bidder proposes that Site levelling for the area shall be done only after the construction of the FGD blocks for that area and till that time, only WBM roads to facilitate the construction of the block shall be provided. Final RCC roads and drains shall be executed only after site levelling of that area.	Bidder understanding is correct.
331	SECTION – VI			SUB-SECTION-IV-D (Civil Works-North Karanpura Super Thermal Power Project-3x660 MW)	Lime and Gypsum Handling and Associated Buildings Storm Water Drainage System (Clause-14.00.00-page 31 of 114)		The invert level 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.	Bidder undestands that drain mentioned here is specific only for FGD amenities and for planning of such drains for FGD specific areas, main plant drain drawings as well as area drainage study report shall be shared by Employer	Main plant drain drwg will be made available at detailed engineering stage. Area drainage study is not available.
332	SECTION – VI			SUB-SECTION-IV-D (Civil Works-North Karanpura Super Thermal Power Project-3x660 MW)	GLP (Drawing No. 4410-999-POC-F-001)		Storage/Laydown area/Area for dumping of excavated material	No area has been earmarked for laydown/storage/ excavated material dumping other than the areas identified for FGD. Bidder request Elployer to please earmark areas at site for laydown/storage/ excavated material dumping.	Bidder to manage with in the space identified for his works as per tender drgs.
333	SECTION – VI			SUB-SECTION-IV-D (Civil Works-North Karanpura Super Thermal Power Project-3x660 MW)	GLP (Drawing No. 4410-999-POC-F-001)		Underground substructures, sewer pipes, water pipes, cables etc around the FGD	Bidder request Employer to please provide the drawings for underground pipes, cables, amenities , utilities etc around the FGD area .	Required drawings will be made available at detailed engineering stage, if available.
334	SECTION – VI			Subsection-IV-D Foundation System and Geotechnical data	1.00.00	77 of 114	Site Levelling & grading had been carried out and achieved Finished ground level (FGL) is RL(+) 460.0m, i.e there is maximum filling of 1.0m and maximum cutting of 1.6m in FGD area.	Bidder understand that Uniformed Finished ground level (including tree cutting, their disposal etc)will be arranged by Employer (at NTP) for the area's allocated for entire FGD area including material handling, storage facilities for FGD(Space for FGD mentioned in the layout drawing) Employer is requested to confirm on Bidders understanding.	Site levelling works should be in Bidder's scope as per tender drg , titled"Layout Plan Of FGD System" no. 4410-999-POC-F-001
335	SECTION – VI, PART-B			Subsection-IV-D Civil Works	39.00.00	65 of 69	Sand aggregate for Construction	In case of non-availability of river sand, Bidder understands that mechanical sand/crushed sand may be allowed for concrete work.	Manufactured sand made from crushing of stones meeting the requirement of IS:383 can be used for concrete work.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
336	SECTION – VI, PART-A			Subsection-III-D Civil Works	1.00.00	2 of 4	Uniform Finished Ground level (FGL) in FGD Absorber area shall be made available by the owner at a level specified in layout plan of FGD system	Bidder understand that Uniformed Finished ground level will be arranged by Employer (at NTP) for the area's allocated for conmplete FGD system including limestone & gypsum handling system instade of only Absorber area. Employer is requested to confirm on Bidders understanding.	Site levelling works should be in Bidder's scope as per tender drg , titled"Layout Plan Of FGD System" no. 4410-999-POC-F-001
337	VI	A	I	INTENT OF SPECIFICATION	1.03.01	3 of 18	Wet limestone based Flue gas desulphurization(FGD) for 2X 800 MW unit……Common Gypsum Dewatering System	We understand this is typographical error. Plant Configuration is 3x660 MW. Owner to Confirm	Refer Amendment to technical specification in this regard.
338	VI	A	I	INTENT OF SPECIFICATION	2.00.00 (d)	4 of 18	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.	Bidder understands that the Ash Based products shall be used only where the Owner Plant is already in operation and ash based products are readily available in the vicinity of the plant. Owner to confirm.	Specification requirement is clear in this regard. Bidders to Comply.
	VI	A	III-D	CIVIL WORKS	14	94 of 94	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.		

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
339	VI	A	III-A1	FGD	6.02.00	6 of 8	The contractor shall provide 1x100% slurry pumps for pumping the slurry back to the absorber of any of the units in 8 hrs (max.)	There is contradiction in the quantity of Pumps for Pumping the slurry back to absorber. Owner to clarify.	Refer Amendment to technical specification in this regard.
	VI	B	I-M1	FGD	7.08.02	27 OF 49	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		
340	VI	B	I-M1	FGD	5.04.00	15 of 49	Gypsum Bleed Pump ……The Pumps shall be designed to meet the stipulation of Clause No. 9.00.00 of this sub-section	Bidder understands that this is a typographical error. The Pumps shall be designed to meet the stipulation of Clause No. 8.00.00 of this sub-section. Owner to review and confirm.	Refer Amendment to technical specification in this regard.
341	VI	B	I-M1	FGD	3.01.00	5 of 49	Short temp excursion temperature of inlet gas (for approx. fifteen (15) minutes at a time) (deg. C) : 300	As per standard design & experience, 10 to 15 mins of short temperature excursion will be considered, which is sufficient enough to take care of the system during emergency situation. Request Owner to reconsider the same	Specification requirement is clear in this regard. Bidders to Comply.
	VI	B	I-M1	FGD	4.03.00	9 of 49	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		
342	VI	B	I-M1	FGD	5.06.24	19 of 49	It should be possible to discharge the absorber sump into the emergency drain tank within 2 hours.	Bidder proposed system can discharge slurry of absorber recirculation tank from normal level upto pump trip level in 2 hours. However, from pump trip level to bottom of the tank, the slurry will be drained to absorber sump (by gravity) and time required for the same will be as per industry practice. Request Owner to accept the same.	Bidders understanding is correct.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
343	VI	B	I-M1	FGD	10.01.00	29 of 49	SLURRY & PROCESS WATER TANKS All the slurry tanks (slurry tank, secondary hydro cyclone feed tank, vacuum receiver tank, waste water tank, lime neutralization tank 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 Bidder.	Inline with the tender specification, clause no.13.01.00, Sheet no. 33 51, Additional corrosion allowance of 1.5 mm shall be considered for process water stoarage tanks. However, slurry tanks (slurry tank, reclaim water tanks, secondary hydro cyclone feed tank, vacuum receiver tank, waste water tank, lime neutralization tank etc.) shall be considered with additional corrosion allowance of 3 mm. Owner to review and confirm.	Refer Amendment to technical specification in this regard.
	VI	B	I-M1	FGD	13.01.00	31 of 49	Process Water Storage Tanks & Pumps All the process water storage tank(s) 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,		
344	VI	A	V	Salient Design Data	3.00.00	2 of 10	Flue Gas Analysis at Design Point & Guarantee Point	Owner shall recheck and confirm the flue gas analysis as the sum is exceeding 100%.	Refer Amendment to technical specification in this regard.
345	VI	A	V	Salient Design Data	3.00.00	2 of 10	Under Design Point : (iv) SO2 (% v/v wet) : 0.087 (vi) Inlet SO2 (mg/Nm3-wet) : 2407	As per the Flue gas composition at FGD system inlet @design point, SO2 is 0.087 (%v/v Wet) which is equal to 2483 mg/Nm3 (wet basis). However, Inlet SO2 (mg/Nm3-wet) mentioned is 2407 mg/Nm3. Owner to review and confirm.	Refer Amendment to technical specification in this regard.
346	VI	A	V	Salient Design Data	3.00.00			Owner to confirm the quantity of HCL & HF in Flue gas composition	Refer Amendment to technical specification in this regard.
347	VI	A					General Arrg. -Back End Elevation : 0-00-020-76722 Rev. 2 (Layout of ID System-Elevation)	Bidder request owner to provide the CAD file of drawing as diemension in drawing is not visible.	Both the drawings attached again in pdf format. CAD format cannot be provided.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
348	VI	B	I-M2	LIMESTONE HANDLING PLANT	1.05.00	77 of 112	Limestone storage area dust extraction system: a) For dust control in limestone storage shed during stacking and handling of limestone, fans, ducting and bag filters with collection hopper shall be provided. The dust collected in the dust collection hoppers shall be discharged to the reclaim conveyor below the shed. 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.	Based upon experience, bidder propose Dry fog dust suppression system for this locations. Request Owner to accept the same.	Dust Extraction system is envisaged in Lime Stone Handling System to avoid addition of moisture to Limestone. Bidder to comply the stipulation of the technical specifications
349	VI	A	III-A2	LIMESTONE & GYPSUM HANDLING PLANTS	General scope of work	General scope of work	General scope of work	Bidder understand that mobile equipment's such as dozers, trucks etc. are excluded from the scope of Bidder. Owner to review & confirm.	Confirmed. Mobile equipment's such as dozers, trucks etc. are not included in the scope of Bidder
350	VI	A	III-A2	LIMESTONE & GYPSUM HANDLING PLANTS	2.01.01	3 of 7	Two (2) numbers Truck unloading system for unloading of limestone from trucks complete with drives, accessories all mechanical, electrical civil & structural works, including enclosure for dust containment during unloading.	Request owner to confirm the capacity of the limestone carrying truck to be considered for the design.	Gross weight 60 MT for limestone carrying truck shall be considered for design. Also Refer amendment in this regard.
351	VI	A	III-A2	LIMESTONE & GYPSUM HANDLING PLANTS	1.01.00	2 of 7	(i) ….. The storage Capacity of Limestone Storage hopper shall be sufficient to store Limestone for minimum 10 days consumption considering all units at full load.	Bidder propose above ground silo with bucket elevator for total 10 days storage capacity instead of reclaiming storage hopper for limestone storage. Request Owner to accept the same.	Bidder to comply the stipulation of the technical specifications
352	VI	A	V	SALIENT DESIGN DATA	6.00.00	5 of 10	Table-3 LIMESTONE CHARACATERSTICS	Request owner to provide the Hard Groove Index (HGI) of Limestone in the Limestone characteristics.	Bidder is requested to design the system considering the available data in the specification & considering worst HGI for Limestone specified.
353	VI	E	-	LIMESTONEFLOW DIAGRAM	-	-	Belt feeder below each crusher is indicated in flow diagram.	The requirement of belt feeders below crushers shall be finalized by the bidder based on Crusher house layout. Please review and confirm.	Bidder to comply the technical specifications
354	VI	E	-	LIMESTONE & GYPSUM HANDLING PLANTS & LIMESTONE FLOW DIAGRAM	1.01.00	2 of 7	(vii) Conveyors 5A/B shall drop limestone in to Limestone Silos of FGD System through fixed Tripper on the first silo in the path. Alternatively diverter Plough is also acceptable in place of fixed tripper.	In Limestone flow diagram only fixed tripper is indicated to feed the limestone silo however in scope of supply, option of diverter plough is also indicated. Bidder understand that either of fixed tripper or diverter plough can be used. Please confirm.	Confirmed
355	VI	A	IV	Terminal points and exclusions	General scope of work	General scope of work	General scope of work	For Degree of Protection test, type test report shall be provided for review. Conducting test may impact cost & delivery schedule and it also required confirmation from vendor.	Bidder to comply with specification requirement.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
356	VI	B	I-M4	Fire Detection & Protection System	1.02.00	1 of 18	General Description …… 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, equipment and installation shall be got approved from TAC accredited professional(s)-India. 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.	Bidder would like to clarify that Fire Detection and Protection Systems will be as per NFPA guidelines. Request Owner to Review and confirm.	Bidder to comply with specification requirement.
	VI	A	III-A3	Fire Detection & Protection System	4.00.00	3 of 5			
357	VI	B	I-M4	Fire Detection & Protection System	3.02.00	1 of 18	Areas to be covered by HVW Spray System (i) All transformers for FGD System having oil capacity above 2000Ltrs & located with-in plant boundary.	As per CEA Guidelines High velocity water spray system will be provided only if the transformer rating is 10 MVA and above. Bidder propose the same criteria. Owner to review and accept the same.	Bidder to comply with specification requirement.
358	VI	B	I-M4	Fire Detection & Protection System	5.02.00	2 of 18	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.	Bidder would like to clarify that Lime stone/Gypsum is a non-combustible material and hence no fire protection / detection system would be required. Owner to review and accept the same	NTPC agree with bidder's concern that fire protection is not required for Gypsum & lime conveyor. However, fire detection & alarm system has been envisaged for conveyor of gypsum/ lime handling system. Bidder to comply with specification requirements.
359	VI	B	I-M4	Fire Detection & Protection System	3.01.00	1 of 18	HVW and MVW spray system It shall consist of : spray pumps, pressurisation arrangements, water main network, ……	As per terminal points of specification, tapping point required for spray water will be provided at 150 NB header with 8kgf/cm2 pressure. So the spray pumps will not be required. Please review and confirm.	Bidder to refer relavent amendment in this regard.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
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360	VI	A	V	Salient Design Data	7.01.00	7 of 10	Design Philosophy for Air Conditioning 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%	Small isolated Control rooms with small cooling capacity requirement (upto 15 TR Total Cooling Load) and hence these rooms will be catered by Hi-Wall Split AC Unit / Cassette AC Unit as per Owner's specification requirement. However these rooms cannot be provided with RH Control (50±5%) because Hi-Wall Split AC Unit / Cassette AC Unit do not have built-in heater & humidifier and separate Heater & Humidifier cannot be provided for these rooms because Hi-Wall Split AC Unit / Cassette AC Unit are non-ducted type system. Although there will be no RH control for these rooms however Cooling load calculation and equipment selection will be based on 50% RH.	As per sub-section-III-A3 , part-A of tech. specification section-VI, air cooled condensing unit with AHU shall be provided for FGD control building. For other area, Bidder to refer cl. No. 7.01.00(15) of technical specification , sub-section-V salient design data . For heat load calculation of ac area, Inside condition shall be taken as 24 deg c and Relative humidity of 50% ± (Plus or Minus) 5%.
361	VI	B	I-M3	Air Conditioning & Ventilation System	3.02.00	2 of 27	(iii) Battery Rooms & Oil rooms and fumes/odour generating areas - Combination of Supply air fan & Exhaust air fans.	Battery Rooms, Oil Rooms and Other fumes / odour generating areas shall be negatively ventilated by means of exhaust air fans / roof exhausters and intake louvers.	Bidder's understanding is correct.Bidder to refer relevent amendment in this regard.
	VI	A	V	Salient Design Data	7.02.02	8 of 10	3.....Battery Rooms and Other fumes / odour generating areas shall be negatively ventilated by means of exhaust air fans / roof exhausters and intake louvers.	Owner to review and confirm	
362	VI	A	V	Salient Design Data	7.01.00	7 of 10	8…….. Required electrical contacts in Control panel of A/C Plant and further wiring upto fire alarm panels shall be done by Bidder.	Bidder proposes to provide Required electrical Dry contacts in Control panel of A/C Plant to receive fire alarm signal from Fire alarm panel. However, please note that as the Fire alarm panel is not in bidder scope and the location of these panels are unknown, so wiring from HVAC Control Panel to Fire Alarm Panel shall be excluded from bidder scope of work.	Regarding Electrical dry contacts, it shall be finalised during detail Engineering. Bidder understanding is not correct regarding fire alarm panel, please refer Section VI, Sub-Section IIIA-3, Clause No. 4.00.00 (1.5). Bidder to comply with specification requirement.
	VI	A	V	Salient Design Data	7.02.02	9 of 10	5. .....Required electrical contacts in Control panel of A/C Plant and further wiring upto fire alarm panels shall be done by Bidder.		
363	VI	B	I-M1	Flue Gas Desulphurisaion System	15.03.00	35 of 49	**Elevators** **(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.	Car inside enclosure including inner side of door shall be of stainless steel plate. However the grade of the stainless steel shall be as per Manufacturer's Standard. Owner to confirm.	Bidders to comply the specification requiremen

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
364	VI	B	I-M1	Flue Gas Desulphurisaion System	15.03.00	35 of 49	**Elevators** **(ii) Door Construction:** Hollow metal construction from 16 guage thick steel sheet spray painted	The thickness of the doors and car walls shall be as per Manufacturer's Standard.	Bidders to comply the specification requiremen
365	VI	B	I-M1	Flue Gas Desulphurisaion System	15.05.00	36 of 49	**Elevators** Provide sound reducing material below machines in machine room.	Please review the need for Extra sound reducing material below machines in the machine room. However the noise levels will be guaranteed as per the applicable standards.	Bidders to comply the specification requiremen
366	VI	B	I-M1	Flue Gas Desulphurisaion System	15.06.00	36 of 49	**Elevators** Provide special corrosion resistant treatment on all elevator components. The protective treatment shall be subject to owner's approval.	The corrosion resistant treatment on all the elevator components shall be as per the Manufacturer's Standard. However the same shall be submitted to the Owner for information purpose.	Bidders to comply the specification requiremen
367	VI	B	I-M1	Flue Gas Desulphurisaion System	15.08.00	36 of 49	**Elevators** Fireman's switch shall be provided for each elevator	Please note that the Fireman's switch shall be provided for each elevator only at 1st landing level.	Specification requirement is clear in this regard. Bidders to Comply.
368	VI	E	-	Tender Drawings	1.00.00	6 of 14	-	Request to provide CAD copy of Layout of FGD area (4410-999-POM-A-001)	CAD format Drawing cannot be provided.
369	General	-	-	-	-	1&2 of 3	-	Request to provide CAD copy of ID fan to chimney sectional view drawings and GLP drawing	CAD format Drawing cannot be provided.
370	-	-	IV	Terminal points & Exclusions	1.00.00			Request to provide the drawing indicating all the terminal points.Since as mentioned in the specification, no drawings are available along with tendor documents indicating C row.	Bidder to reffer the general layout plan. Further, exact location will be finalized during detailed engineering.
371	VI	B	I-M6	Piping	2.02.04	3 of 16	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)	Bidder propose to conduct the analysis as required by ASME B 31.1 Piping Code & not only based on long piping crtieria metnioned in Bid specification	Specification requirement is clear in this regard. Bidders to Comply.
372	VI	B	I-M1	Absrober	5.01.00	13 of 49	IV)The slurry recirculation pumps shall have motor driven knife gate valve at pump suction and discharge side	Bidder propose to use the Butterfly valve instead of Knife gate valve in Tender spec as per Bidder's standard design	Specification requirement is clear in this regard. Bidders to Comply.
373	VI	B	V-QM2	Lime & Gypsum Handling	1.05.06	3 OF 9	Zero Speed Switch, Under Belt Switch and Chute Blockage Switch:	For Degree of Protection test, type test report shall be provided for review. Conducting test may impact cost & delivery	Bidders to comply the specification requirement
			V-QE2	LT SWITCHGEARS & BUSDUCTS	SQE _10	1 OF 3, 2 OF 3, 3 OF 3			

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
			V-QE12	HT SWITCHGEARS	QA TABLE FOR HT SWITCHGEAR	1 OF 2	Degree of Protection test	schedule and it also required confirmation from vendor.	
			V-QE14	VFD	VFD PANEL	5 OF 5			
374	General							Owner is requested to clearly identify and provide the following information for each project: 1. Storage Area 2. Pre-Assembly yard 3. Space for Labor Colony 4. Space for Site Constrcution Office	All areas & information will be provided as per the bidding document and specific location for the item not specified shall be mutually discussed after award.
375	VI	A	III-D	Civil Works	1.00.00	2 OF 4	**1.00.00 SCOPE OF CIVIL WORKS** The work to be performed under…… The nature of work shall generally involve earthwork in excavation & deep underground excavation, extensive de-watering,	The nearest existing strom water drainage facility shall be used by the bidder for the de-watering faclities. Owner to confirm.	Noted. However, muck deposition in the existing drains due to dewatering shall be removed by the bidder.
376	VI	A	III-D	Civil Works	1.00.00	2 OF 4	**1.00.00 SCOPE OF CIVIL WORKS** The work to be performed under…… Disposal of surplus excavated materials	Bidder request Owner to provide sufficient area for the same. Area alloted for disposal of surplus excavated material /stack pile location shall be as nearer to the site and to be indicated by Owner.	Bidder to Comply with the specification requirer
377	VI	A	III-D	Civil Works	2.00.00 Point no-4	3 OF 4	**2.00.00 CONSTRUCTION FACILITIES** The following are also in the Bidder's scope of work: 4. Providing all arrangements for the supply of construction water including bore-wells, water tankers etc.	Bidder request Owner to provide a Borewell facility near by the Site layout for the arrangement of construction water by further tapping or trasporting to the specified contrsuction loaction by Bidder.	Bidder to Comply with the specification requirer
378	VI	A (1)	III-B	Electrical Equipment/ System	1.09.00	3 of 6	Complete lighting system for internal and external areas for the plant, buildings, chimney and equipment in the bidder's scope.	Bidder understands that lighting requirements is only applicable for areas pertaining to FGD plant. Owner to review and confirm.	Bidder to provide complete lighting system for areas under bidder's scope

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
379	VI	E (2)		Tender drawings	1.14.00	5 of 40	DWG NO.0000-999-POI-A-019B -Rev-A,Scheme for 24V DC power supply system	Owner to confirm that the 2 nos. of 415V supply (one (1) no.from Existing 415V Unit Service Swgr and one (1) no.from Existing 415V Unit Emergency Service Swgr) to the 24V DC system (By Bidder) will be arranged by the Owner. Kindly confirm. Bidder request Owner to furnish the details and location of the Existing switchgear's for our further engineering .	Bidder may refer to Electrical SLD 4410-109-POE-J-001/RevA. It is further clarified that no supply shall be extended from existing UES board for FGD. Existing HT swgr is located inside main plant building.
380	VI	B	III-C5	PLC Based Control System	9.06.01.07	21 of 27	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 to D.C battery at all load conditions.	As per Vol VI, Part-B, Sub-Section C5, cl.no.9.05.00 and as per Drg.no.0000-999-POI-A-019C (Scheme for Uninterruptible Power Supply System-configuration-B) , the UPS is of 1x100% charger & inverter configuration. Owner to kindly clarify and confirm the UPS configuration.	It is confirmed that as per clause 9.05.00, Part-B, Sub-Section C5 and tender drawing no. 0000-999-POI-A-019C, configuration-B UPS is envisaged fro FGD system .
381	VI	B (2) & E(2)	II-E1	General Electrical Specification, Tender drawings	2.05.00	4 of 7, 1 of 40	The Control Philosophy shall be as follows: (b) The motor feeders shall be controlled from the DDCMIS only . DWG NO.0000-151-POI-A-013-Rev-A "Standard configuration Diagram for PLC based Offsite Control Systems"	Bidder understands that all the motors in the proposed FGD will be controlled by FGD PLC/DCS. Owner to confirm.	Bidder's understanding is correct. Please refer Refer Amendment to technical specification in this regard.
382	VI	B (2)	II-E6	Cabling, Earthing & Lightning Protection	2.01.00 to 2.01.07	2 of 69	Design & Constructional feature	As these clauses in the tender specification refers to Boiler and other offset areas which are irrelevant to proposed FGD system, same shall not be applicable. Owner to review and confirm.	Bidder to refer relevant portion specific to bidders scope.
383	VI	B (2)	II-E6	Cabling, Earthing & Lightning Protection	4.04.14 (4)	11 of 69	In switchyard, control cables of each bay shall be laid on separate racks/trays.	Switchyard is not part of prposed FGD system, same shall not be applicable. Owner to confirm.	Bidder's understanding is in order.
384	VI	B (2)	II-E7	HT Cables	3.01.00	4 of 7	19/33 KV Grade Power Cables	These grade Power cables are not applicable. Kindly confirm	All the HT cable sizes and grade shall be as per tender SLD
385	VI	B (2)	II-E1	General Electrical Specification	2.08.00	6 of 7	DC Voltage: 220V/ 110V		
386	VI	B (2)	II-E9	HT Switchgear	3.00.00(i)(5)	7 of 39	Control Supply Voltage: 240V DC unearthed		

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
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387	VI	B (2)	II-E10	LT Switchgears & LT Busducts	3.01.02 & 3.01.03	4 of 58	DC SYSTEM 1) System Voltage 240VDC 2-Wire, Unearthed CONTROL SUPPLY VOLTAGE 1) Trip & closing coil of circuit breaker 240V DC/120V DC 2) Spring charging motor 240V DC/120V DC	The DC voltage level shall be 220V DC as indicated in the Electrical SLD. Request owner to confirm	Battery Voltage shall be 220V DC. However, operating DC voltage will be 240V as board is charged from charger normally in float mode.
388	VI	B (2)	II-E9	HT Switchgear	4.2.00 (b)	9 of 39	Outgoing breakers shall be suitable for switching transformers and motors at any load. They shall be capable of being used for frequent direct-on-line starting of squirrel cage induction motors of following ratings : 1) 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) 2) 6.6 kV Above 200 kW 3) 11 kV Above 1500 kW	Bidder understand that the following voltage levels shall be followed: 1). 3.3kV : Above 200kW up to 1500kW 2). 11kV : Above 1500kW Owner to review and confirm.	Bidder's understanding is correct. Please refer Refer Amendment to technical specification in this regard.
389	VI	B	II-E1	General Electrical Specification	1.06.00	1 of 7	The voltage level for motors shall be as follows: a) Upto 0.2 KW : Single phase 240V AC / 3 phase 415V AC b) Above 0.2 KW and upto 200 KW : 3 phase, 415V AC c) Above 200 KW and upto 1500 KW : 3 phase, 3.3 kV AC d) Above 1500 KW : 11 Kv The bidder may adopt 415V/3.3 KV for the drives rated in the range of 160-210 KW.		
390	VI	B (2)	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.	As per Vol VI, Part-B, Sub-Section E9, cl.no.4.3.00, contactors may be offered for outgoing motor feeders for drives with frequent start/stop. As per Vol VI, Sub-Section E1, cl.no.2.05.00 (b), motor feeders will not be controlled from Switchgear SCADA. Owner to clarify the same.	Please refer Refer Amendment to technical specification in this regard.

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391	VI	B (2)	II-E10	LT Switchgears & LT Busducts	1.01.00 (f) & (i)	1 of 58	(f) ESP consumption for 100 % BMCR operation shall be considered and further this load shall be uniformly divided among ESP Switchgears. (i) For Main Plant (TG & SG areas) and Service Building, each Lighting DB shall have 1x100% transformer. For all other areas, each Lighting DB shall have 2x100% transformers.	ESP system, Lighting DB in Main plant areas is not part of Bidder scope. The same is not applicable. Owner to confirm.	Bidders understanding is correct.
392	VI	B (2)	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.	For FGD package, Bidder proposes the LV switchboard shall be as per the Owner's vendor list.	This clause is deleted. Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI)
393	VI	B (2)	II-E10	LT Switchgears & LT Busducts	5.00.00	12 of 58	In order to establish the compliance with the requirements of this technical specification, prototype panels shall be made and offered for the Employer's inspection and approval before the start of manufacturing of the panels for this project.	This requirement is difficult to comply. Request Owner to review and confirm.	Bidder to comply with Technical Specification.
394	VI	B (2)	II-E10	LT Switchgears & LT Busducts	31.01.00	31 of 58	Three phase Bus trunking system conforming to IEC 61439-6/IS 8623 (Parts 1 & 2) shall be provided for connecting the Main and Standy DG sets to Unit Emergency Switchgear.	This is not applicable to the FGD system. The same has not been considered by the Bidder.	This clause is deleted. Please refer AMENDMENT TO TECHNICAL SPECIFICATION (SECTION VI)
395	VI	B (2)	II-E15	Lighting	3.03.03	5 of 17	Emergency DC lighting is to be provided, through self contained DC emergency fixtures with four hours back-up duration, at strategic locations, in auxiliary/ offsite buildings wherever DC supply system is not available.	As per bidder standard recommendation back up duration for 2 hours is sufficient enough , battery with 4 hr backup not readily available with OEM's. Request Owner to reconsider the same.	Technical Specifications are clear. Bidder to comply with technical specification equirements
396	VI	B (2)	II-E15	Lighting	4.07.00	11 of 17	The sensors shall be recess mounted, programmable type suitable for lighting load of 6A with variable off delay settings. The detection area shall be minimum 5 metres for standard room height of 3mt. All the calibrated settings shall be stored in non-volatile memory of PIR sensor which shall be unaffected by power supply fluctuations.	Bidder understand this is applicable for proposed FGD Control Room only. Request Owner to confirm.	It is applicable for Control room, as well as any meeting/conference room if any

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

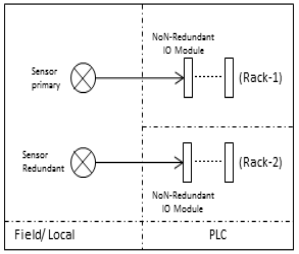
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397	VI	B (2)	II-E16	Battery	1.00.00, 9.00.00	1 of 14, 11 of 14	DC health monitoring system shall be offered integral with each battery set for Main Plant & Switchyaard batteries. DC health monitoring system	Bidder understand this is not aplicable to FGD package/FGD plant area. Owner to check and confirm	Bidders understanding is correct.
398	VI	E(1)	-	Electrical Single Line Diagram for FGD Package)	Drg.no.4410-109-P0E-J-001- Rev A	14 of 14	Electrical Single Line Diagram for FGD Package (Drg.no.4410-109-P0E-J-001 Rev A)	Owner to furnish the existing Station boards and Unit boards details for Bidder's reference.	Bidder to refer Electrical Single Line Diagram for FGD Package (Drg.no.4410-109-P0E-J-001- Rev A). Boards are located in main plant area (AB Bay). Further details shall be furnished during Detailed engg.
399	VI	E(1)	-	Electrical Single Line Diagram for FGD Package	Drg.no.4410-109-P0E-J-001- Rev A	14 of 14	Electrical Single Line Diagram for FGD Package (Drg.no.4410-109-P0E-J-001 Rev A)	As per as per Single line Diagram (11KV FGD Motor's are fed from Existing spare feeders of Unit Switchboards) Bidder understand that the required 11KV feeder for FGD Motor's shall be provided by Owner. Request Owner to confirm.	Bidder to refer Electrical Single Line Diagram for FGD Package (Drg.no.4410-109-P0E-J-001- Rev A). Maximum one motor from each unit board shall be fed from owners 11kV Unit switchgear.
400	VI	A	III-C	Interfacing with employer's DDCMIS	9.00.00	8 of 9	-	Bidder understand that the required logic modification to be done in Boiler control System(Logic modification, signal exchange with FGD, graphics creation (if any) is not in the scope of bidder. However bidder will provide necessary inputs during detail engineering.	It is clarified that logic modification, graphic creation in boiler control system is not in the scope of the bidder. However, signal exchnage between boiler control system and FGD control system shall be in the scope of bidder.
401	VI	B	III-C2	SPECIFICATION FOR ELECTRONIC TRANSMITTERS	2.0.1	3 of 30	16. Adjustment/calibration / maintenance: From hand held HART calibrator/ centralized PC based system (as applicable).	Bidder understand that there is no HART Management System (HMS) /centralized PC based system envisaged. Smart Transmitter will be communicated with Hand Held HART Calibrator.	Bidder's understanding is correct. Refer amendment in this regard.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

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Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
402	VI	B	III-C5	PLC BASED CONTROL SYSTEM	3.01.01	8 of 27	Input used for interlock/protection shall be dual redundant. Each of the redundant binary & analog inputs shall be wired to separate input modules……	Bidder understand that for interlock and protection the input sensors will be dual redudant. Each of this sensors will be connected to a non-redundant IO moduels located in differenent racks as shown below,  The same will be followed for tripple redundant sensors. Dual redundant IO modules are not required to be considered.	Bidder's understanding is correct.
403	VI	B	III-C5	PLC BASED CONTROL SYSTEM	3.01.03	8 of 27	All single analog & binary inputs including the limit switches of valves/dampersMCC/SWGR check-backs of all drives & information related signals shall be wired to single (i.e. non-redundant) input modules.	For monitoring status of motor feeders, MCC, PCC and SWGR, now a days it is prevalent to use soft communication. This will reduce the cabling cost and commissioning time considerable also this will provide more data about motor feeder to operator for better monitoring.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
404	VI	B	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.	Hence bidder request NTPC to accept intelligent MCC concept.	
405	VI	E	-	Scheme of Absorber System	Drawings No. 4410-109-POM-A-005	11 of 14	Flow measurement at FGD inlet, FGD Outlet and Stack.	In the "Scheme of Absorber System", flue gas flow measurement is indicated at FGD inlet, outlet and at stack(CEMS), Bidder suggest as the flow is going to remain same in the flue gas outlet and at the Chimeny , it is not necessary to measure flow at the FGD outlet and at chimeny as indicated. Hence bidder suggest to measure flow only at FGD inlet and at the Chimney(CEMS). Owner to confirm.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.
406	VI	B	IV-D	Civil Works	3.14.03	12 of 114	The Minimum thickness of shell (for RCC Chimney)shall not be less than 500mm	The minimum thickness of the shell shall be arrived as per requirements of the design code IS : 4998 (Part-I) 1975	Bidder to comply to the requirements of technical specification.
407	VI	B	IV-D	Civil Works	3.09	8 of 114	Cage ladders (min. 450mm Wide) shall be provided for access of roof of Single storey MCC rooms etc.,	Access to roof of all MCC buildings shall be through Cage ladder or RCC Stair case. Please clarify.	Cage ladder to be provided for access to roof of single storey MCC room. For multi storey MCC room RCC stair case to be provided.
					6.08	24 of 114	Access to RCC Roof of MCC Building shall be through RCC Staircase		
408	GENERAL							Bidder understands that the trestles in customer scope (if any) can be used for Duct Support in case of space constraint for routing the duct till the Absorber in FGD Space identified for the bidders in case required. Owner to confirm.	No support from the structure/ buildings under NTPC's scope shall be allowed.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter								
409	VI	B	IV-D	CIVIL WORKS	7.00.00	24 of 114	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.	No areas are mentioned below in the specification . Owner to clarify	For scope of area paving refer clause no. 1.00.00, Sub-section-IIID Civil works, Section-VI, Part-A of technical specification
410	VI	B	IV-D	CIVIL WORKS	4.0	19 of 114	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 buildings shall be provided with open surface brickdrains, Bidder understands that the floor wash shall be connected to these open surface brick drains or it needs to be connected to a sump pit outside the building from which it shall be connected to overall plant drainage. Owner to Confirm	The peripheral drains around the buildings are meant for carrying the surface rain water and also the water from rain water down comers to the nearest branch drain from the location of the building. The waste water generated during flushing and cleaning of the equipment shall be collected and re-used/treated as per clause 7.00.00, sub-section-III-A1 FGD, Section-VI, Part-A of technical specification
411	SECTION-VI / Part-B			SUB-SECTION-I-M1 (FGD)	04 of 49	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:** It is possible to meet guaranteed noise level of 85 dBA for all equipments except for Ball Mill and crushers. The guaranteed values for thesesequipments are • Ball Mill : 90 dBA • Crusher : 100 dBA Kindly Confirm	**Refer Amendment to technical specification in this regard.**
412	SECTION-VI / Part-B			SUB-SECTION-I-M1 (FGD)	05 of 49	3.01.00 Sl. no: 5	**Flue Gas Velocity:** Maximum flue gas velocity through the Absorber (m/s)- Not more than 4 m/s at design point	**Deviation:** As per our FGD design practice, maximum gas velocity through the Absorber shall be 4.0-4.5m/s. Kindly confirm.	**Bidder shall comply the specification requirements in this regard.**
413	SECTION-VI / Part-B			SUB-SECTION-I-M1 (FGD)	05 of 49	3.01.00 Sl. no: 6	**Recirculation Slurry pH:** Not Less than 5.5 under all operation conditions	**Deviation:** Based on our FGD design practice, slurry pH in the Absorber is between 5 and 6.5. FGD will be designed for the same. Kindly confirm.	**Bidder shall comply the specification requirements in this regard.**
414	SECTION-VI / Part-B			SUB-SECTION-I-M1 (FGD)	13 of 49	5.01.00 Sl. no: iv	The slurry recirculation pumps shall have motor driven knife gate valve at pump suction and discharge side.	**Deviation:** 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 the specification requirements in this regard.**

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter								
415	SECTION-VI / Part-B			SUB-SECTION-I-M1 (FGD)	14 of 49	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:** 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.	**In case for the Absorber design offered if only vertical agitators will be provided, then one complete agitator assembly (including motor) for each unit can be offered as a werehouse spare in addition to the mandatory spares.**
416	SECTION-VI / Part-B			SUB-SECTION-I-M1 (FGD)	16 of 49	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: (i) temperature (ii) velocity (iii) dust content	**Clarification:** 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 MHPS' experiences. The deviation from average is generally 15-20% and MHPS designed and delivered FGD plants based on the deviation from the average for approx. ±15%. Bidder requested to change deviation from "±10%" to "±20%".	**Bidder shall comply the specification requirements in this regard.**

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter								
							(iv) slurry injection and distribution.		
							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.		
417	SECTION-VI / Part-B			SUB-SECTION-I-M1 (FGD)	16 of 49	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 the specification requirements in this regard.**
418	SECTION-VI / Part-B			SUB-SECTION-I-M1 (FGD)	19 of 49	5.06.24	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 the specification requirements in this regard.**
419	SECTION-VI / Part-B			SUB-SECTION-I-M1 (FGD)	24 of 49	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	Specification requirement is clear in this regard. Bidders to comply the specification requirement.
420	SECTION-VI / Part-B			SUB-SECTION-I-M1 (FGD)	27 of 49	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. Bidder will offer agitator without emergency flushing system Please confirm.	Bidder shall comply the specification requirements in this regard.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter								
421	SECTION-VI / Part-B			SUB-SECTION-I-M1 (FGD)	31 of 49	12.02.00	All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality.	**Clarification:** As per proven practice, all the pipes handling slurry shall be provided with FRP material. Please confirm.	**Bidder shall comply the specification requirements in this regard.**
422	SECTION-VI / Part-B			SUB-SECTION-I-M1 (FGD)	29 of 49	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.	
	SECTION-VI / Part-B			SUB-SECTION-I-M1	31 of 49	13.01.00	**Process Water Storage Tanks & Pumps:**	Kindly confirm the additional corrosion allowance to be considered for the process water tank.	Refer Amendment to technical specification in this regard.
				(FGD)			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		
423	SECTION-VI / Part-A			SUB-SECTION-V (Salient Design Data)	02 of 10	3.00.00	**FGD Guarantee Point & Design Point :**	**Clarification:** HCl and HF content in Flue gas has got implication on Limestone consumption, FGD Equipment sizing, Recirculation flow rate and waste water quantity. Bidder request owner to provide HCl and HF Content in Coal.	Refer Amendment to technical specification in this regard.
424				I-M1			**Booster Fan** :	We understand from the tender that 44 % margin to be applied over the summation of P1 & P2 where	Bidders understanding is correct in this regard.
							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	P1 is pressure requirement for the FGD system as arrived from the tender sizing conditions for booster fan	
								P2 is 100 mm wcl to take care of pressure loss due to future installation of De-Nox system.	
	VI/B				4.01.00	8 of 49		Kindly clarify Bidder understanding.	

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter								
425	VI/B			I-M1	4.04.00	10 of 49	**Booster Fan** : Fan rotational speed : 600 rpm (max)	The Booster Fans for the FGD project 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).	Refer Amendment to technical specification in this regard.
426	VI/B			I-M1	4.04.00	10 of 49	**Booster Fan** : 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 the FGD project 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 : "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." 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.	Refer Amendment in this regard.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
427	Section-VI, Part A			Sub Section- III- A1 – FGD	Page 4 of 8	4.01.03	4.01.03 . . . Guillotine gates shall be provided at the **inlet**& outlet **of the each Booster fan.**	As per the first 3 clauses (i.e., 4.01.03, 16.02.00 & Scheme of FGD Absorber system), FGD Booster Fan Inlet Gates are to be supplied by the bidder. Whereas, as per Clause no: 3.03.01, the FGD Booster Fan Inlet Guillotine Gates are being provided by the Employer i.e., NTPC will provide. Clause no: 3.03.01 is contradicting with the first 3 clauses referred above. Kindly clarify the scope of supply of FGD Booster Fan Inlet Gates.	Refer Amendment to technical specification in this regard.
							&		
					&	&			
							16.02.00. Motorized Guillotine type gates with 2x100% seal air fans shall also be provided at **suction**& discharge **of each Booster Fan.**		
					Page 8 of 8	16.02.00	&		
				&					
	&						Terminal point "FGD Scope" is mentioned before Booster Fan Inlet Gates.		
				Scheme of FGD- Absorber System	&	&			
	Part-E								
	Tender Drawings / Section-VI			&	-	Scheme of FGD- Absorber System			
							&		
	&			Sub-Section-I-M1 (FGD)		&			
							3.03.01. . . Guillotine gate type damper **is being provided by the Employer**before the suction of each Booster fan.		
	Section-VI, Part-B					3.03.01			
					&				
					Page 6 of 49				
428	Section-VI, Part-B			Sub-Section-I-M1 (FGD)	Page 2 of 49	1.03.02	1.03.02. . . .Further, **Quick opening Bi-plane motorized/pneumatic damper** along with 2x100% seal air fans **shall be provided in the by-pass duct**.	As per the clause no. 1.03.02, FGD Bypass Damper is to be supplied by the bidder. Whereas, as per Clause no: 3.03.07, the FGD Bypass Damper is being provided by the Employer i.e., NTPC will provide. Clause no: 3.03.07 is contradicting with clause no: 1.03.02 referred above. Kindly clarify the scope of supply of FGD Bypass Damper (Damper between ID fan and existing chimney).	Refer Amendment to technical specification in this regard.
							&		
					&		3.03.07. **A damper in the bypass duct is being provided by the Employer** 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.		
						&			
					Page 7 of 49	3.03.07			

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
	Part-E			Scheme of FGD-Absorber System	-	Scheme of FGD- Absorber System	There is **no Damper** in the duct from Absorber Outlet to Wet Stack Inlet.	As per the Scheme of FGD Absorber system mentioned in Part-E of tender specification, there is a Separate Wet Stack for FGD operation. Also, no damper is applicable in the duct connecting Absorber Outlet and New Wet Stack.	
	Tender Drawings / Section-VI							Hence, we understand that the damper mentioned in Clause no: 3.03.01 is not applicable and in-line with the P&ID (scheme drawing) since separate wet stack is provided for FGD operation. Since there is no Damper in the FGD outlet treated gas path (connecting Absorber outlet and separate wet stack), we understand that clause no: 3.03.08 is also not applicable.	
				&		&	&	Kindly clarify.	
	&								
429				Sub-Section-I-M1 (FGD)		3.03.01	3.03.01. . . A Pneumatic operated multi louver damper with seal air arrangement shall also be provided **by the Contractorin the clean gas duct after GGH.**		Bidder to comply the specification requirement. Refer Amendment to technical specification in this regard.
	Section-VI, Part-B				&				
							&		
					Page 6 of 49				
						&	3.03.08. . . In the FGD outlet treated gas path the frame of the damper shall be made of STEN-1 or better material, the blades shall be made of SS317LMN or better material and the seals shall be made of Alloy C- 276 or better material.		
					&	3.03.08			
					Page 7 of 49				

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
430	Section-VI, Part A			Sub Section- III- A1 – FGD	Page 4 of 8	4.01.03	4.01.03 . . . One (1) no **FGD by pass gate** shall be provided in the existing duct connecting to existing chimney.	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 3 to 4 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 lost 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 (duct from ID Fans to existing chimney). Globally, only damper is being supplied in this duct and Guillotine Gate is not required.	Refer Amendment to technical specification in this regard.
				&			&	Kindly accept.	
	&								
				Sub-Section-I-M1 (FGD)	&	&	1.03.02. . . **Motorized Guillotine type gates** shall be provided at . . . . . **(ii) in the bypass duct. Further, Quick opening Bi-plane motorized/pneumatic damper along with 2x100% seal air fans shall be provided in the by-pass duct.**		
	Section-VI, Part B								
					Page 2 of 49	1.03.02	&		
							3.03.07. **A damper in the bypass duct** is being provided by the Employer 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.**		
						&			
					&	3.03.07			
					Page 7 of 49				

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
431	Section-VI, Part A			Sub Section- VII Mandatory Spares	Page 4 of 38,	1.02.00 Gates in Flue Gas System	1.02.00 → 2. Actuator (1 no. of each type & 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: 4 of 38.	Refer Amendment in this regard.
						&			
					&	"ELECTRICAL" → Electrical Actuators		Hence, we are not considering the same electrical actuators for FGD Gates under "Electrical Actuators → 1. Actuators (1 no of each type and rating)" in Page no: 35 of 38 – to avoid duplication which also increases the cost. Please confirm.	
							&		
					Page 35 of 38				
							Electrical Actuators → 1. Actuators (1 no of each type and rating)		
432	VI-Part-A			1A	25	4.01.06	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Wet limestone Grinding mills as per clause 4.01.02(d) above but is a manufacturer of dry Grinding mills for power or cement industry of minimum 20 T/h capacity..... .... first660 MW unit completely from such qualified manufacturer. For subsequent units 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.	**Clarification:** Since Wet Limestone Grinding system requirement for this tender and NTPC bulk tender is similar. Bidder requested Customer to amendment the Provenness criteria of Wet Limestone Grinding system in line with NTPC Bulk tender as follows "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 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". Please confirm	**Bidder to refer Amendment in this regard.**

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
433	IV, Part-B			II-E6	22 OF 69	9.00.00.b)	Separate switchgear room shall be provided for each unit. For TG building, all HT Boards shall be provided in HT Switchgear room & all LT boards shall be provided in LT switchgear room	**Clarification:** For FGD,HT MCC,LT MCC's , PCC's will be placed in a single building. MCC's of common system like Gypsum & Limestone handling will be placed in any one of the control room (Common for all the units). Kindly confirm.	Number & location of MCC's shall be finalised during detailed engg. based on final loads & their distance.
434	IV, Part-B			II-E1	4 OF 7	2.03.00	MCCB shall be provided for 100A, 125A, 160A, 200A, 250A. The motor feeders for 110 kw and above Air circuit breaker controlled.	**Clarification:** Feeders upto 200A, will be of SFU Controlled. From 200 to 630A shall be of MCCB Controlled. Above 630A shall be ACB Controlled. Kindly confirm.	Bidder to comply with technical specification requirement.
435	Part E			-	Page 14 of 14	Drg No- 4410-109-POE-J-001	11 KV FGD motors	3.3 kv& 415V FGD Motors are only envisaged for FGD and hence 11kv motors are not considered.	Bidder to comply with technical specification requirement.
436	VI-Part-A			1	3 of 18	1.03.01	Wet limestone based Flue gas desulphurization (FGD) for 2X 800 MW unit...	**Clarification:** We understand that this line must be "Wet limestone based Flue gas desulphurization (FGD) for 3x660MW units..." Kindly confirm.	Refer Amendment to the Technical specification.
437	VI-Part-A			1	3 of 18	1.03.02	....One (1) numbers of elevator for Limestone Grinding System building.	**Clarification:** We understand that this elevator is for the access to the various levels of Limestone Day (24 hours storage) silo and hydro cyclone.	**Bidder to comply with technical specification requirement.**
	VI-Part-A			III-A1	3 of 8	3.01.08	...one (1) number passenger cum goods elevator of minimum capacity of 1000 kgs for easy access & movement of man/materials. etc		
	VI-Part-A			III-A1	6 of 8	8.01.00	....One (1) number passenger cum goods elevator of minimum capacity of 1000 kgs in Limestone Grinding System	Kindly confirm.	

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
438	VI-Part-B			IV-D	8 of 114	3.07.00	The Gypsum storage shed shall be RCC framed structure with structural steel work shed with....	**Clarification:** We understand that the bottom side retaining wall only is RCC. The remaining portion is structural steel work shed with... Kindly confirm.	**Bidder to refer separate amendment in this regard.**
439	**Clarification:** 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 shall be through cage ladder as per requirement	**Clarification:** RCC staircase will be provided for roof access for FGD Control room/MCC buildings. Cage ladder may be allowed for access to roofs of all other buildings with roof sheeting. Kindly accept	**Bidder to comply with technical specification re-quirement.**
440	VI-PART-B			VI-D CIVIL WORKS	-	-	Access to operating floors/platforms of Absorbers, ball Mill Building, Gypsum dewatering building etc.	**Clarification:** It is proposed to provide steel staircases for access to operating floors of all buildings except FGD Control room/MCC building. Kindly confirm.	**Bidder to comply with technical specification re-quirement.**
441	VI-PART-B			VI-D CIVIL WORKS	-	-	**Ball Mill Building:**	**Clarification:** Type of construction of Ball Mill building is not mentioned in the technical specification. Bidder proposes to use structural steel building with roof sheeting and side cladding (sheeting and cladding with permanently colour coated sheeting). 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). However, roof shall be of RCC as per technical specification re-quirement.**
442	SECTION-VI, PART-B			SUB SECTION-I-M2	1 OF 112	2.00.00	For LHP/GHP both the streams shall be considered to be operating simultaneously.	As per our understanding two streams of conveyors (1 working+1 standby) shall be provided at Rated capacity 150 MTPH each.	Bidder`s understanding is in order

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
443	SECTION-VI, PART-B			SUB SECTION-I-M2	2 OF 112	2.02.00	The intake and onward discharge capacity to be 150 TPH per Box Feeder.	Kindly confirm the capacity of each Apron Feeder & Box Feeder unit. As per our understanding, rated capacity for both Apron Feeder & Box Feeder shall be 150 MPTH and 1 no. each (as per option-I or option-II considered) shall be operating to meet the rated capacity of 150 MTPH.	Bidder to comply the stipulation of the technical specifications
	SECTION-VI, PART-A			SUB SECTION-III-A2	1 OF 7	1.01.00	**Each Apron feeder shall be of 75 MTPH rated capacity**. The rated capacity of conveyor 1A/B shall be 150 MTPH. Alternatively two numbers **bulk receiving unit along with surface feeders etc. each rated for 75TPH capacity** shall be provided.		
444	SECTION-VI, PART-A			SUB SECTION-III-A2	1 OF 7	1.01.00	In Crusher house, Limestone from incoming Conveyor 1A will pass through dedicated Vibrating Feeder (VF-1) and dedicated Crushers (CR-1). Similarly Limestone from incoming Conveyor 2B will pass through dedicated **Vibrating Screening Feeders** (VF-2) and dedicated Crushers (CR-2) respectively.	Whether Vibrating Feeder or Vibrating **Screening** Feeders is to be considered. We understand that in case of Vibrating Feeder, 100% feed from the feeder shall pass directly to the Hammer Mill Crusher. Kindly confirm.	Vibrating Screening Feeder shall be provided. Also Refer amendment in this regard.
445	SECTION-VI, PART-A			SUB SECTION-III-A2	2 OF 7	1.01.00	Stacking Conveyor 3A/B will drop limestone to **over ground storage hopper** provided within a shed via travelling trippers. One (1) number Traveling Tripper is mounted on each of the Stacking Conveyor 3A/B.	We have considered over ground limestone **stockpile** with 80% of the total storage capacity and underground hopper with 20% of the total storage capacity. Kindly confirm.	Refer amendment in this regard.
446	SECTION-VI, PART-A			SUB SECTION-III-A2	5 OF 7	2.01.18	**Two numbers limestone sampling units** one each for conveyors 1A/B & 5A/B for sampling of as received limestone and crushed limestone being fed to the FGD System complete with all accessories and electrical, civil, structural works, supporting structures, approach/maintenance platforms etc.	We propose to provide only one number Limestone Sampling Unit at limestone crusher house for sampling of uncrushed limestone. LSU for crushed limestone is not envisaged. Kindly confirm whether same is acceptable.	Refer amendment in this regard.
447	SECTION-VI, PART-B			SUB SECTION-I-M2	2 OF 112	2.02.00	The Box Feeder should be a robust, proven, above the ground for unloading from trucks/ **self-tipping trucks or from loader shovels**.	We are considering that only self tipping trucks shall feed to the BRU/Box Feeder and therefore requirement of truck tippler is not envisaged for this project. Self Tipping trucks/loader shovels etc. shall be in customer's scope. Kindly confirm.	Also Refer amendment in this regard.
							Travelling Tripper		

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

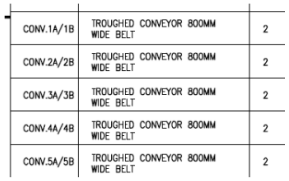
Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
448	SECTION-VI, PART-B			SUB SECTION-I-M2	3 OF 112	2.02.03	(b) Type : Motor driven rail mounted, **two way chute discharge**	The mobile trippers of Limestone inside shed shall be two way feed, i.e. one way feeding to itself i.e. conveyor and side chute feeding to bunker slot on one side. Meaning we shall consider bunker slot on one side. Kindly confirm.	Confirmed
449	SECTION-VI, PART-B			SUB SECTION-I-M2	3 OF 112	2.02.03	Design Capacities & Margins:- 1. Crushers 2x50% 2. Vibrating **screening** feeders 2x50%	As per our understanding Duty Requirement for Crushers & Vibrating **Screening** Feeder (or Vibrating Feeder based on confirmation) shall be 1x100% i.e. 150 MTPH each (Rated Capacity). Kindly confirm.	Refer amendment in this regard.
450	SECTION-VI, PART-A			SUB SECTION-III-A2	6 OF 7	2.01.27	Service water, **cooling water** and potable water system for complete limestone handling plant including Pumps ,drives, sumps, piping etc and all mechanical, electrical and civil works.	We propose to provide air cooled scoop couplings (if applicable) for crushers and hence cooling water shall not be required. Kindly confirm.	Refer amendment in this regard
451	SECTION-VI, PART-A			SUB SECTION-III-A2	5 OF 7	2.01.22	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 limestone crusher house.	As mentioned in the flow Diagram **Rack & Pinion type elevator** shall be provided with applicable mandatory spares. Kindly confirm the type and quantity of the elevator.	Refer amendment in this regard
452	4410-000-2-POM-A-002			Limestone Flow Diagram			**Dust Suppression** & Dust Extraction both systems are mentioned for LHP. CW DS SW DW DE	We understand that only Dust Extraction system is envisaged for Limestone Handling Plant and Plain Water Dust Suppression system for Gypsum Stockpile. Kindly confirm.	Refer amendment in this regard

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

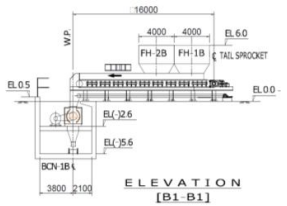
Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
453	4410-000-2-POM-A-002			Limestone Flow Diagram			**800 mm Belt Width** is envisaged for all conveyors i.e. in uncrushed as well as crushed zone.  	Conveyor Belt Width shall be 800 mm for uncrushed zone & 650 mm for crushed zone as per technical specifications. Kindly confirm.	Confirmed Also Refer amendment in this regard.
454	SECTION-VI, PART-B			SUB SECTION-I-M2	2 OF 112	2.02.01	Shell Thickness : 12 mm (min.)	Shell Thickness for drive pulleys shall be min. 12 mm. For other pulleys it shall be as per pulley calculations.	Specification requirement is clear. Shell thickness of all pulleys shall be 12 mm. Bidder to comply the technical specifications
455	SECTION-VI, PART-B			SUB SECTION-I-M2	2 OF 112	2.02.01	Belt ratings shall be selected in such a way that there are only two (2) ratings of belting.	Type of belting shall be 2 ratings per belt width. Also, belt rating for High Angle Conveyor (if used) shall be excluded from the limitation of 2 types of rating. Kindly confirm.	Bidder to comply the stipulations of the technical specifications
456	SECTION-VI, PART-B			SUB SECTION-I-M2	2 OF 112	2.02.01	Belt ratings..... only two (2) ratings of belting. This however excludes **sealing belt** (for sealing slots of tripper floor) and belting of belt feeders.	We have not considered **sealing belt** for travelling tripper for limestone as well as Gypsum. Kindly confirm.	Sealing Belt shall not be considered for Lime stone storage shed ,however sealing belt shall be provided in Tripper for sealing for sealing above Limestone storage Silos.
457	SECTION-VI, PART-B			SUB SECTION-I-M2	3 OF 112	2.02.06	Crushers, **wagon tipplers**, apron feeders, **side arm j-rail hoists (travel and hoisting)**, elevators, rack and pinion gates, all the drives in sampling units, various pumps of.....	Wagon Tippler, Side Arm J-Rail Hoists are not envisaged for this project. Kindly confirm.	Refer amendment in this regard.
458	SECTION-VI, PART-A			SUB SECTION-III-A2	5 OF 7	2.01.23	..... two (2) number of suspended magnets on each conveyor 1A/B complete with handling arrangement, reject chutes, reject trolleys, supporting arrangement and all mechanical, electrical, civil, structural works and accessories.	In view of provision of ILMS, MD we propose that suspended magnets may not be required. Kindly confirm. We not have envisaged any pent house and if SM are to be provided kindly confirm the location for the same.	Refer amendment in this regard.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

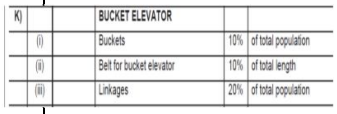
Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter								
459	SECTION-VI, PART-E			Layout Plan of FGD System : Drg No.: 4410-999-POC-F-001 Lime Stone Flow Diagram 4410-000-2-POM-A-002	1 OF 2	1.00.00	-	After studying the scheme as indicated in the plant layout and the flow diagram, we find some of the conveyor profiles are not feasible to achieve. As the scheme is indicative as mentioned in flow diagram we understand that bidders have the freedom to optimize the scheme by addition/deletion/ relocation of the facilities, use High Angle Conveyor, Bucket Elevator however maintaining the overall functionality & philosophy of the LHP & GHP system. Kindly confirm.	Bidder to comply the scheme as outlined in referred Tender Drawings
460	-			-	-	-	-	Kindly confirm whether the following arrangement shall be acceptable:- Box Feeder/Apron Feeder shall feed uncrushed limestone directly to Hammer Mill Crusher placed at ground level. Crushed limestone shall then be stacked using travelling tripper and be sent to limestone silo using paddle feeder and onward conveyor/bucket elevator arrangement. It would however affect the provision of equipments such as ILMS, MD etc. before crusher. 	Bidder to comply the stipulations of the technical specifications

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

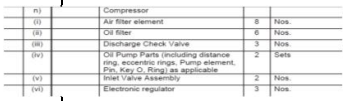
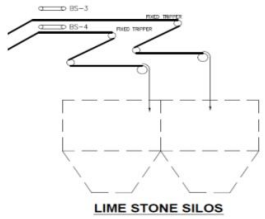
Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter								
461	SECTION-VI, PART-A			SUB-SECTION-VII MANDATORY SPARES	12 OF 38	2.00.00		Mandatory spares for Bucket Elevator have been specified, however the requirement/specification of Bucket Elevator is not given in the tender specifications/flow diagram. Whether Bucket Elevator could be used for uncrushed as well as crushed limestone zone. Also, shall the spares be required to be provided even if Bucket Elevator is not considered in the scheme. Kindly confirm.	Refer amendment in this regard.
462	4410-000-2-POM-A-002			Limestone Flow Diagram	-	-	-	If bucket elevator is provided to feed limestone from the paddle feeder & its associated conveyor, interchangeability to feed to the 2 bucket elevator for each stream may not be feasible. Kindly confirm if the same shall be acceptable??	Bucket Elevator is not envisaged. Bidder to comply the stipulations of the technical specifications
463	SECTION-VI, PART-A			SUB SECTION-III-A2	5 OF 7	2.01.25	Four (4) numbers of electronic type belt scales on conveyors 1A/B & 5A/B for continuous weighing, complete with all mechanical, electrical, civil, structural works and accessories.	It may not be feasible to provide belt scale to measure limestone feed to silo. Whether belt weigh feeder be acceptable and whether interchangeability of feeding to the 2 silo will be required from the bucket elevator. Kindly confirm.	Bucket Elevator is not envisaged. Bidder to comply the stipulations of the technical specifications
464	-			-	-	-	-	Whether High Angle Conveyor could be used for uncrushed as well as crushed limestone zone.	High Angle Conveyor is not envisaged. Bidder to comply the stipulations of the technical specifications
465	-			-	-	-	-	Angle of repose considered for Limestone 37 degree and for Gypsum 45 degree. Kindly confirm.	Angle of repose considered for Limestone 37 degree and for Gypsum 35 degree.
466	SECTION-VI, PART-A			SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	12 OF 14	5.00.00	Guaranteed power consumption of conveyors and associated equipments (vibrating screen, crushers, belt feeders, paddle feeders) of a single stream for limestone and gypsum handling at rated capacities.	We shall consider duty factor as 1 for LHP & GHP as the same has not been mentioned in tender document for LHP & GHP.	Refer amendment in this regard.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
467	-			-	-	-	-	For equipments with 50% duty requirement (if applicable) the guaranteed capacity shall be the rated capacity. Kindly confirm.	Please note that the statement is not applicable for the package.
468	SECTION-VI, PART-A			SUB-SECTION-VII MANDATORY SPARES	12 OF 38	2.00.00		Requirement of mandatory spare - "Compressor" is for the dust extraction system for limestone. Kindly confirm.	Refer amendment in this regard.
469	SECTION-VI, PART-A			SUB SECTION-III-A2	6 OF 7	2.01.27	Service water, cooling water and potable water system for complete limestone handling plant including Pumps ,drives, sumps, piping etc and all mechanical, electrical and civil works.	We shall be taking portable water & service water tapping from nearest resource and hence shall not be considering any separate pumping station for LHP & GHP. Kindly confirm that the same is acceptable.	Portable water and service water shall be provided by employer at one point as defined in Terminal Points & Exclusions. Further distribution for LHP & GHP is in bidders scope.All pumps and pipes shall be provided by bidder if required.
470	4410-000-2-POM-A-002			Limestone Flow Diagram	-	-	-	As per the scheme shown we understand that each fixed tripper i.e. conv. 5A/5B shall feed to both the silo. Kindly confirm. 	Refer amendment in this regard.
471	4410-000-2-POM-A-002			Limestone Flow Diagram	-	-	Rack & Pinion Elevator - Quantity 2 nos., Capacity 1 T each	As per our scheme requirement of only 1 rack & pinion elevator in crusher house shall be sufficient. Kindly confirm whether elevator is envisaged for any other location.	Refer amendment in this regard.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter								
472	VI –PART-B			IV-D	8 OF114	3.07.00	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.	We understand that gypsum storage shed proposed to be constructed is of steel structure and not of RCC frame work .Kindly confirm.	Bidder to refer separate amendment in this regard
473	VI –PART-B			IV-D	8 OF114	3.07.00	Gypsum storage shed.	We understand the hollow (tubular) section can be used for the construction of gypsum shed. Please confirm.	No Tubular sections are al-lowed for construction of gypsum shed.
474	VI-PART-A			III-A2	7 of 7	3.01.00(d)	Two numbers (02) motorized travelling tripper on conveyors 6A/B for feeding the gypsum to the storage shed	We understand that intermediate supporting trestles can be provided for the support of motorized travelling trippers inside the gypsum shed. Please confirm	Confirmed, supporting trestles are in bidders scope.
475	VI-PART-A			III-A2	3 OF7	2.01.00(b)	Two number bulk receiving units for ROM Limestone of size (-)250 mm each rated for 75TPH along with access ramp ----------	Please furnish the permissible longitudinal slope to be adopted for the construction of approach ramp.	Shall be finalised with successful bidder during detail engineering.
476	VI-PART-A			III-A2	4OF7	2.01.14	Two (2) numbers motorized travelling trippers each of 150TPH rated capacity on----------	We understand that intermediate supporting trestles can be provided for the support of motorized travelling trippers inside the lime	Confirmed, supporting trestles are in bidders scope.
477	VI-PART-A			III-A2	5OF7	2.01.16	One number of covered storage shed for crushed limestone storage hopper including civil, structural, architectural & electrical works.	Please furnish the construction details for the lime stone shed.	Shall be finalised with successful bidder during detail engineering.
478	VI-PART-A			III-A2	5OF7	2.01.16	One number of covered storage shed for crushed limestone storage hopper including civil, structural, architectural & electrical works.	We understand that hollow (tubular) section can be used for the construction of lime stone shed. Please confirm.	Bidders understaning is not correct. Bidder to comply with the specification requirement. Bidder is requested to read the specification in totality.
479	VI –PART-B			Annexure-c	77 OF114	3.07.00	Onus of correct assessment/ interpretation and understanding of the existing subsoil condition / data is on the Bidder. The natural ground reduced levels (RLs) of FGD Area as per topographical survey drawing varies from RL 459.0m to 461.6m----------	Please furnish the topographical survey drawing for the proposed lime stone and gypsum handling area. .	Specification requirement is clear in this regard.
480	VI –PART-B			IV-D	32 OF114	14.00.00	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.	Please furnish HFL (highest flood level) of plant.	The plant finished ground level is above HFL. Bidder has to connect the drains to Main Plant drain .

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter								
481	VI/A (1)			III-C	82 of 94	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? If yes, kindly provide the Detailed specification for VMS.	Bidder's understanding is not correct. Vibration transmitters shall be considered for vibration monitoring of all critical HT drives in Bidder's scope & same shall be hardwired to FGD PLC system. However, bidder to refer Clause 1.02.07, sub section I-M2, PART B and Clause 2.01.11, sub section III-A2, PART-A of technical specification wherein Vibration Monitoring System is envisaged for each mill and crusher. Bidder to comply with the specification rrequirement. For detailed specification of VMS refer amendment.
482	VI/A (1)			III-C	84 of 94	2.06.01	Contractor shall depute Technical Experts of the OAM /OEM/OES/ (Original Analyzer 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	We presume that the CEMS Equipment supplier (OAM/OEM/OES/System integrator etc.) is eligible for delivering the services of Comprehensive AMC (CAMC). Kindly confirm.	Bidder's understanding is correct. However, as envisaged in the specification clause 2.06.01, technical expert of Original Analyser Manu-facturer/Original Equip-ment Manufactur-er/Original Equipment supplier, fully qualified to perform the required du-ties, supervision of maintenance, repair etc. for supplied systems, shall be deputed to site for de-livering the services of Comprehensive AMC (CAMC).
483	VI/A (1)				87 of 94	6.05.00	The minimum **quantity per unit of furniture** envisaged in FGD control room is as mentioned below:	As per the description given in the specification, there is only one FGD Control room common for all the Units. We presume the quantity of furniture indicated in this clause is common for all the Units.	Bidder's understanding is not correct. Bidder to supply minimum quantity of furniture as mentioned in the specifi-cation on per generating unit basis. For example: In case of North Karanpura (3x660MW) project, the quantity of furniture to be supplied shall be thrice 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 to comply with the specifica-tion.
				III-C					
						Drawing No. 0000-151-POI-A-013	Standard Configuration Diagram for PLC based Offsite Control systems	Kindly clarify and confirm.	
	VI/E (2)			C (Control & Instrumentation					
					1 of 40				

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter								
484	VI/A (1)			III-C	86 of 94	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. Kindly confirm.	Bidder's understanding is correct. However, bidder to refer the relevant clauses of specification where equip-ment/drives/pumps for which Local Operation is envisaged has been men-tioned. Bidder to provide local push button stations accordingly.
485	VI/A (1)			III-C	88 of 94	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 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.	Kindly provide the Tentative route length distance between the following: (i) RIO Panel and employer DCS. (ii) RIO Panel and 24 V DC feeder (Customer provided) (iii) FGD RIO Panel & FGD Control room for all the projects. 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.	It is clarified that i) RIO panel and employ-er's DCS are placed at the same location i.e. Central Equipment Room (CER). Tentative route length between RIO panel (Placed in CER) and em-ployer's DCS shall be 200 meters approximately for all projects. ii) Tentative route length between RIO panel (Placed in CER) and 24 V DC feeder (NTPC scope) shall be 200 meters approxi-mately for all projects. iii) For route length be-tween 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 be-tween FGD control room and Employer's CCR/CER". Other FGD RIO panel loca-tion shall be finalized dur-ing detailed engineering
486	VI/A (2)			VII	57of 69	1.07.03	MANDATORY SPARES: 5.00.00 CONTROL AND INSTRUMENTATION 1.07.00 PLC CONTROLS SYSTEM 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.

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	Section / Part / Chapter				Clause No.	Page No.			
487	VI/B (3)			III-C1	5 of 98	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: *"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 to comply with the specification.
488	VI/B (3)			III-C4	51 of 98	5.00.00	Marshalling/Termination system cabinets Notes: 4. For connection between field JB and DDCMIS marshalling cabinet	Customer is requested to consider Cable termination at marshalling cabinet or any other equivalent methodology being followed by the manufacturer for several projects in the past may also be permitted to be adopted in this project. Kindly confirm.	Bidder's proposal is not acceptable. Bidder to comply with the specifica-tion.

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	Section / Part / Chapter				Clause No.	Page No.			
489				III-C5	57 of 98	PLC BASED CONTROL SYSTEM		Bidder's in-house manufactured DCS which is field proven in power plants gives the Customer following advantages:	It is clarified that in addi-tion to the specification requirements, bidder's proposal is also acceptable subject to: i) Proposed DCS based control system for FGD fully meets functional re-quirements as mentioned in the specification. ii) Proposed DCS based control system for FGD is as per bidder's standard and proven practice. iii) The DCS based control system shall be reviewed and approved by employer during detailed engineer-ing.
	VI/B (3)							(i) Better immunity to noise.	
							PLC BASED CONTROL SYSTEM	(ii) Scalable and Flexible system	
								(iii) Comprehensive Diagnostics	
								(iv) Centralised alarms, events and historian	
								(v) Faster inter communication	
								(vi) Unified Information Management,	
								(vii)Common engineering platform & Unified diagnostics,	
								(viii) Single family hardware solution,	
								Reduction of hardwired interface or soft links,	
								(ix) Ergonomic and user friendly man-machine interface.	
				III-C5	58 of 98	1.04.00		(x) Effective spares and inventory management.	
	VI-B (3)							(xi) Better response time.	
								(xii) Single window for future expansion.	
								(xiii) Better Spares Management & Inventory reduction. etc.	
								(xiv) Supports renovation and modernization.	
								Hence Customer is requested to accept DCS based controls also for FGD.	
							Contractor shall provide independent control systems for safe, efficient and reliable operation of each of the plant auxiliary systems.		
490	VI/B (3)			III-C5	60 of 98	2.03.00	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.	Bidder's in-house manufactured DCS has Flash EPROM for non-volatile configuration which does not require battery backup.	Bidder's proposal is ac-ceptable in view of bid-der's proposal to supply DCS based control system for FGD.
								Customer is requested to consider this option.	

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	Section / Part / Chapter				Clause No.	Page No.			
491	VI/B (3)			III-C6	86 of 98	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 certifi-cates has been men-tioned. Bidder to comply with the above mentioned clause while submitting the type test certificates for NTPC approval.
492	SEC VI / PART B			I M1	6 OF 49	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 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, testd and Quality plan such that it meets the plant operation requirements.
493	SEC VI / PART B			IV D	39 OF 114	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.
494	SEC VI / PART B			IV D	39 OF 114	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.
495	SEC VI / PART B			I M1	6 OF 49	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.	Please provide the material code to be followed for alloy C-276.	Specification requirement is clear in this regards. Bidder shall comply the specification requirements.

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	Section / Part / Chapter				Clause No.	Page No.			
496	SEC VI / PART B			I M1	6 OF 49	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.	Kindly furnish the following specifications for chimney liners. 1. Permissible tolerances on thickness of clad sheet and base material. 2. Permissible tolerances on flatness for clad sheet and base material. 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. 4. Indicate any special requirements applicable for welding and fabrication of chimney at site. 5. Indicate any restriction in size of base metal and clad plate to be used for fabrication of flue cans. 6. Mention tensile and yield strength of the cladded material to be achieved.	Specification requirement is clear in this regards. Bidder shall comply the specification requirements.
497	SEC VI / PART B			IV D	2 OF 114	2.03.00	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.	Bidders understanding is correct.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

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	Section / Part / Chapter				Clause No.	Page No.			
	VI/B			IV-D	31 of 114	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.		
498	VI/B			IV-D	41 of 114	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 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 75 mm/hr. Refer amendment issued separately.
499	VI/B			IV-D	24 of 114	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).
500	VI/B			IV-D	25 of 114	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...	(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.	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.
							All facility buildings shall be provided with 750 mm wide plinth protection all around...		
							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...	(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.	
501	VI/B			IV-D	25 of 114	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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	Section / Part / Chapter				Clause No.	Page No.			
502	VI/B			IV-D	19 of 114	4.02.00	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 referred clauses are contradictory. Kindly clarify the weight of zinc coating to be considered for galvanising.	Specification requirement is clear in this regard. However Zinc coating reffered in Clause No. 4.02.00 is applicable for galavanised MS pipes rain water downcomer only. For all structural steel members glavanisation shall be as per clause No. 26.00.00 unless noted otherwise.
	VI/B			IV-D	45 of 114	26.00.00	The weight of the zinc coating shall be at least 610 Gms. / m2 unless noted otherwise.		
503	SEC-VI/PART-B			IV-D	77 OF 114	1.01.0	However, site levelling in Hopper, Crusher House, Lime & Gypsum storage area etc. shall be done under this package and as per Topographical survey drawing existing ground levels are varying from 461.9m to 465.6m and FGL to be achieved in this area shall be as indicated in GLP. Bidder...	Finished ground level (FGL) indicated in GLP (drawing no 4410-999-POC-F-001, titled "Layout plan for FGD system" is tentative only. Bidder can decide the suitable FGL by optimizing the earthwork during detailed engineering. Please confirm.	FGL indicated in the GLP is final. Bidder to comply with the specification requirement.

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	Section / Part / Chapter				Clause No.	Page No.			
504	SEC-VI/PART-B			IV-D	82 OF 114	1.02.03 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.
505	Section –VI, Part-A			Sub Section-III-A1	Page 7 of 8	10.00.00	Buildings	Please clarify whether various Equipment Cooling Water Auxiliaries of FGD system are to be kept in Pump house or shed.	It should be a shop-fabricated 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 for easy access & movement of man/materials etc. The shop-fabricated building shall be sufficiently ventilated.

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	Section / Part / Chapter				Clause No.	Page No.			
506	SECTION- VI/PART E & Drg No. 4410-109-POE-J-001			----	---	GENERAL NOTE NO 6	NO OF MOTORS/FEEDERS SHOWN IN THE SLD IN TYPICAL AND FEEDING ARRANGEMENT SHOWN AT VARIOUS LOAD CENTRE IS INDICATIVE IN NATURE SHOWING THE FUNCTIONAL REQUIREMENT. HT/LT SWITCHGEAR: Feeding arrangement	1. Customer to confirm that all the 11 KV motors required in this tender shall be fed from customer switchboards as shown in the tender drawing. only 3.3 KV motor shall be fed from FGD switchboard. 2. Since 11KV FGD switchgear is fed from 3 I/C of 16 MVA rating each as per the key diagram, Customer to confirm the rating of 11 kV FGD switchgear. Customer to also inform the operational philosophy of these 3 I/C & 2 B/C. Customer shall clarify the sizing criteria of 11/3.45KV FGD transformer as the transformer can feed the entire switchboard through B/C.	1.Bidder to refer Electrical Single Line Diagram for FGD Package (Drg.no.4410-109-P0E-J-001- Rev A). Maximum one motor from each unit board shall be fed from owners 11kV Unit switchgear. 2. Bidder may refer to clause no 2.00.00 of chapter E1 for sizing cri-teria of respective equipment.
507	SECTION- VI/ PART A			III-B	03 OF 6	1.09.00	Lighting Masts	Number of Lighting Masts is not specified in the specification. Please confirm the minimum number.	The same shall be decid-ed during detailed engineering
508	SECTION- VI /PART B			II-E16	01 OF 14 11 of 14	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.	Bidders' understanding is correct.
509	SECTION- VI /PART C				74 OF 82		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.	PA system is not in the scope of the contractor.
510	VI/A			III-A1 FGD	8 OF 8	17.00.00	Contractor shall provide separate air receivers of adequate capacity for meeting the instrument and service air requirements. In case higher pressure/flow requirements are envisaged for instrument & service air Contractor shall make its own arrangement	Customer is requested to provide the quantity and capacity of IA / SA air receiver. Bidder has considered one 2 M3 of air receiver for complete station for Instrument air & Service air application each. 1.) Customer to inform the maximum Flow & Pressure that shall be available from customer existing system. Please provide existing P&ID and sizing of air compressor.	Specification requirement is clear in this regard. Bidder to comply the specification requirement.

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								Bidder understands that IA / SA requirement for FGD shall be provided from customer existing system. Hence Bidder has not considered standalone compressed air system for FGD.	Bidder to note that piping header is available at C row (running along CD bay rack). Exact location will be finalized during detail engineering. Pressure available is approx 5-7 kg/cm2.
								2.) Customer to inform the T.P details for IA/SA for further distribution for FGD purpose.	
	SEC VI, PART-B			I-M1	33 OF 49	14.09.00	Contractor shall provide motorized hoists and trolleys for all items requiring maintenance and weighing 500 kg or more.	Referred clauses are contradictory w.r.t selection of electric or manual hoist. We shall follow clause 2.02.12 of sub-section V/Section VI Part A for selection of electric or manual hoist.	Bidder to comply with the specification requirement. 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.
							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.		

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511	SEC VI, PART-B			I-M2	25 OF 112	1.02.00	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.	Kindly confirm.	
	Section-VI, PART-B			I-M2	5 OF 112	2.02.12	Hoists		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.
							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 take-up pulley and take-up weight	Manual for both travel & lift.	
512	Section-VI, PART-B			I-M1	33 OF 49	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.		Specification requirement is clear in this regards. Bidder shall comply the specification requirements.
								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.	
513	Section-VI, PART-A			Sub-Section-VII	11 OF 38	H	Mandatory Spares of Limestone & Gypsum Handling:	1) Mandatory spares of Electric hoists have been mentioned under the referred clause/ area only.	Bidder shall comply with the specification requirements given under the clauses referring to the equipment under the sub section VII.
							ELECTRIC HOISTS	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.	
								2) Further, no spares are mentioned for chain pulley blocks. We understand that no spares shall be provided for chain pulley blocks (if applicable). Please confirm.	
514	Section-VI, PART-B			I-M2	26 OF 112	1.02.00 (d)	Festoon arrangement of feeding power to trolley assembly.	We propose to provide DSL type current feeding arrangement instead of festoon arrangement, as better hook approach can be achieved in case of DSL. Please accept.	DSL type current feeding arrangement is also acceptable.
	Section-VI (TS)					Two (2) limestone slurry tanks, each tank sized to meet 12 hrs total limestone slurry		Please clarify the capacity of storage tank.	Specification requirement is clear with regard to capacity. Further refer to Amendment to the technical

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515	Part-A			3.01.04	3 of 8		storage requirement for two units at Design point,	Capacity of Slurry storage requirement shall be for all units	capacity. Further refer to Amendment to the technical specification for number of units.
	Sub-Section-III-A1								
	Flue Gas Desulphurisation System								
516	Section-VI (TS)			5.01.00	4 of 8		The employer envisages a common gypsum dewatering system for the two (2) units.	Please clarify the capacity of storage tank.	Refer Amendment to the Technical specification.
	Part-A							Capacity of Slurry storage requirement shall be for all units	
	Sub-Section-III-A1								
	Flue Gas Desulphurisation System								
517	Section-VI (TS)			28.00.01	8 of 8		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.	Bidder understands that the end point of Stack is 150m far from ground. Please clarify the meaning of 150 metre height.	Bidders understanding is correct in this regard.
	Part-A								
	Sub-Section-III-A1								
	Flue Gas Desulphurisation System								
518	Section-VI (TS)			18.00.05	8 of 8		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.	Bidder would like to apply external piping from wet stack to absorber reaction tank in order to drain the condensate without storage/neutralizing tank. Bidder have experience applying to previous project.	Specification requirement is clear in this regard. Bidders to comply the specification requirement.
	Part-A						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.		
	Sub-Section-III-A1							Please confirm.	
	Flue Gas Desulphurisation System								
519	Section-VI (TS)			18.00.06	8 of 8		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.	Specification requirement is clear in this regard. Bidders to comply the specification requirement.
	Part-A							Therefore, detail design data shall be provided in detail design stage.	
	Sub-Section-III-A1								
	Flue Gas Desulphurisation System								

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
520	Section-VI (TS) Part-A Sub-Section-III-A1 Flue Gas Desulphurisation System			18.00.05	8 of 8		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 clarify that the word “Both” means “All” the stack	Refer Amendment to technical specification in this regard.
521	Section-VI (TS)			1.00.00(g)	1 of 5		Air Conditioning System: Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of air conditioning system as per manufacturer's standard practice.	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. Control and monitoring of air conditioning and ventilation system from FGD control system is also acceptable.
	Part-A			2.00.00(g)	2 of 5		Ventilation System: Contractor shall provide microprocessor/PLC/GIU based control system for control and monitoring of ventilation system ….		
	Sub-section-III-A3								
	Plant Utilities								
522	Section-VI (TS)			1.00.00, 1.5 b&c	4 of 5		b) All Conveyors and Cable Galleries shall be provided with Linear Heat Sensing Cable 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.	Bidder has wrongly mentioned the clause reference no. However, bidder to refer cl. No. 4.00.00 {1.5-(b) &(C) }. “ All conveyor and cable galleries shall be provided with Linear Heat Sensing Cable detector and All cable galleries shall also be provided with Multisensor type detector.”
	Part-A						c) All cable galleries shall be provided with Multisensor type detectors.	Also please clarify above requirement for the conveyor area related to cable rack.	
	Sub-section-III-A3								
	Plant Utilities								
523	Section-VI (TS)			1.00.00,1.4	4 of 5		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.	Bidder understands that, “Five 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.	Bidder has wrongly mentioned the clause reference no. However, Bidder to refer relevant amendment.
	Part-A							Please confirm.	
	Sub-section-III-A3								
	Fire Fighting System								

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
524	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 available capacity for FGD system.	No emergency load of FGD area is envisaged in main plant DG. Please refer drg No 4410-109-POE-J-001. All emergeny FGD load is to be fed from FGD emerency MCC and DG set under bidders scope. No interconnection with main plant DG shall be permitted.
525	Section-VI (TS) Part-A Sub-section-III B Electrical System/Equipment			1.08.00	2 of 6	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.		The Cable tray, supports and tray earthing for contractor cables on employer cable **trestle** shall be supplied by employer also. (Not limited to employer cable vault). 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 to get itself acquainted with existing electrical of plant.
526	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.
527	Section-VI (TS) Part-B Sub-section-I-M1 Flue Gas Desulphurisation			3.02.00	6 of 49	The duct from Absorber outlet to wet stack inlet shall be made of cladded sheet of minimum 2mm thickness of either Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8mm thick mild steel base metal.		Please confirm whether alternative material such as Borosilicate block / Acid brick / Fiber Glass Reinforced Plastic can be used in place of Titanium or C-276 alloy.	Specification requirement is clear in this regard. Bidders to comply the specification requirement.
528	Section-VI (TS)			3.01.00	5 of 49	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		There is a different requirement for design pressure.	Refer Necessary amendment in this regard.
	Part-B							Therefore, please clarify whether +660 and -150mmwc or +660 and -660mmwc.	
	Sub-Section-I-M1					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			
	Flue Gas Desulphurisation System								
				16.01.03	37 of 49				

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION: Section / Part / Chapter				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
529	Section-VI (TS)			15.01.00	34 of 49	(ii) Design/Construction/Installation Codes		IS: 14665(all parts) supersedes IS: 4666, IS: 1860 and IS: 3534. Hence we will refer only IS: 14665(all parts).	Specification requirement is clear in this regard. Bidders to comply the specification requirement.
	Part-B					Latest addition of IS:14665(all parts) and also meeting any additional requirements of IS:4666, IS:1860 and IS:3534		Please confirm	
	Sub-section-I-M1								
	Flue Gas Desulphurisation System								
530	Section-VI (TS)			15.06.00	36 of 49	Provide Special corrosion resistant treatment on all elevator components. The protective treatment shall be subject to Employer's Approval.		Please clarify the type of corrosion resistant treatment to be provided over the elevator components room if there is any specific requirement as such.	Same will be duscussed with the successful bidder during the detail engg. Stage.
	Part-B								
	Sub-section-I-M1								
	Flue Gas Desulphurisation System								
531	Section-VI			3.01.00	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.)		In clause no. 3.01.00 it is mentioned that UAF type ventilation should be provided for Switch gear rooms.	Bidder has wrongly mentioned the clause reference no. However, Bidder to refer relevant amendment.
	Part-B			3.02.00				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.	
	Sub-section--I-M3					MCCs and Switchgear room etc.			
	Air Conditioning and Ventilation System					Supply air fan Back draft dampers			
532	Section-VI (TS)			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 handling plant and inert gas protected areas. Short term fire …….		As Inert gas system is not specified in scope of work in FGD area, the Bidder does not need consider inert gas system. Please confirm.	Bidder's understanding is correct. Amendment will be issued in this regard.
	Part-B					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…			
	Sub-section-I-M4								
	Fire Detection & Protection System								
				5.18.00.ii)					
					14 of 18				
533	Section-VI (TS)			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 refer relevant amendment.
	Part-B								
	Sub-section-I-M4								
	Fire Detection & Protection System								

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
534	Section-VI (TS) Part-B Sub-section-I-M7 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.
535	Section-VI (TS) Part-B Sub-section-I-M7 MDL			542 640	21 of 24 23 of 24	MQP for Chimney Elevator MQP of Elevator(Rack & Pinion)		Both Elevators are same. Please confirm.	Bidder understanding is correct.
536	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 rating is 1000KVA or above.		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.
537	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. (FPR is normal practice in current industry for BUS Duct) Please confirm.	Bidder to comply Technical Specification
538	Section-VI (TS) Part-B Sub-section-II E4 LT Power Cables			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. Please confirm	Bidder understanding is correct
539	Section-VI (TS) Part-B Sub-section-II E5 LT Control Cables			2.14.02	3 of 6	cables shall be armoured type if laid in CHP area or directly buried.		Same with above.	Bidder understanding is correct

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
540	Section-VI (TS) Part-B Sub-section-II E6 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. So, Sub zero level cable vault/trenches can be provided below control building/switchgear rooms in FGD system. Please confirm.	Bidder understanding is correct
541	Section-VI (TS) Part-B Sub-section-II E6 Cabling Earthing & Lightning Protection			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. 2. In case of applying armoured Cable, Bidder shall use Cable gland instead of using flexible conduit (with Box connector) for Equipment connection. Please confirm	Bidder to comply with technical specification
542	Section-VI (TS) Part-B Sub-section-II E6 Cabling Earthing & Lightning Protection			3.02.05	5 of 69		Cable trenches shall be provided only in Switchgear/MCC rooms.	Same with above.	Bidder understanding is correct
543	Section-VI (TS) Part-B Sub-section-II E7 HT Cables			2.16.04	4 of 6		All cables shall be armoured type if laid in CHP area or directly buried.	Same with above.	Bidder understanding is correct
544	Section-VI (TS) Part-B Sub-section-II E9 HT Switchgear			1.00.00	1 of 39		Motor Feeder: KW Rating/ [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.) Please confirm.	Bidders understanding is not correct. Feeder sizing shall be done as per motor name plate kw rating at 50 deg C

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION: Section / Part / Chapter				Clause No.	Page No.	SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
545	Section-VI (TS) Part-B Sub-section-II E10 LT Switchgear & LT Busduct			1.04.00	2 of 58	Standardization 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. 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. Please confirm.	Selection table of clause 43.01.00 to be referred
546	Section-VI (TS) Part-B Sub-section-II E10 LT Switchgear & LT Busduct			43.01.00	45 of 58	Feeder Module, Other than Motor Selection Table (415 V AC)		Bidder understands Protection for LV MCC Feeder Module as below. Please confirm. - Feeder rating 0 ~ 99Amp : Fuse Protection - Feeder rating 100 ~ 400Amp : MCCB Protection - Feeder rating 400 ~ 1120Amp : ACB Protection	Selection table of clause 43.01.00 to be referred
547	Section-VI (TS) Part-B Sub-section-II E10 LT Switchgear & LT Busduct			43.02.00	45 of 58	Motor Module Selection table	Bidder understands Protection for Motor Module on LV MCC as below. Please - Motor rating 1.1 ~ 110 kW : Fuse Protection - Motor rating 110 ~ 200 kW : ACB Protection (MCCB is not used for Motor Module)		Selection table of clause 43.02.00 to be referred
548	Section-VI (TS) Sub-section-II-E11 Diesel Generators			3.00.00 (i) 8.02.03	2 of 19 10 of 19	Fuel service tank 8 hours running 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. 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
549	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. 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

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
550	Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators			6.01.01	4 of 19	All DG sets shall be controlled independently through separate control panel.	Please confirm that DG set shall be supplied to cover for all the units. (1W + 1S / 3units)		Min 1 (one) number of DG set common for entire FGD plant shall be provided by bidder for meeting emergency process loads envisaged for FGD plants. Refer tender SLD
551	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. Please clarify.		Bidders have to remotely connect all the DG Sets with their FGD control system. Refer amendment
552	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 Any earth fault protection is not considered. We considered only 1 master trip relay for common fault both electrical & Please confirm.		Bidder to provide electrical protections as per technical specifications. Refer amendment
553	Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators			7.11.00	8 of 19	Suitable 4 to 20mA transducer with dual output shall be provided in control panel for voltmeter & frequency meter for Owner's use.	Our understanding is not clear in this regards. Please provide the requirement of these transducer in owner's panel.		Refer amendment
554	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

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
555	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 to comply with technical specification requirements
556	Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators			8.06.00(j)	11 of 19	Necessary foundation bolt and base channels for the engine, alternator, fuel service tank and for all other equipment include this packae.	As the DG set shall be supplied with specially designed AVM pad, foundation bolts is not applicable in LT (415 V) DG set. Please confirm if Bidder can proceed with above understanding.		Technical specifications are clear. Bidder to comply with technical specification requirements
557	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 Please confirm.		Technical specifications are clear. Bidder to comply with technical specification requirements
558	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 to comply with technical specification requirements
559	Section-VI (TS) Part-B Sub-section-II-E11 Diesel Generators			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 to comply with technical specification requirements

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
560	Section-VI (TS)			14.01.00 & 15.01.00	18 of 19 & 19 of 19	Vibration 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.		Technical specifications are clear. Bidder to comply with technical specification requirements
	Part-B					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.	Please confirm.		
	Sub-section-II-E11								
	Diesel Generators								
561	Section-VI (TS)			1.01.00	1 of 30	OUTDOOR TRANSFORMER	Bidder suggests indoor service can also be applied for LV Transformer (11kV/0.4kV or 3.3kV/0.4kV) for this PJT.		Refer Amendment in this regard.
	Part-B						Please confirm.		
	Sub-section-II E12								
	Outdoor Transformers								
562	Section-VI (TS)			1.01.00	1 of 2	All work shall be carried out as per the following standard/codes as applicable	Since IS 4722 is not applicable for traction equipment, it shall not be applicable for Elevator motor.		Bidders understanding is correct. Reference std. as applicable shall be followed in line with the specification
	Part-B					IS:4722, IS:325	Please confirm.		
	Sub-section-II-E13								
	Elevator Electrical								

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
563	Section-VI (TS)			3.02.02	4 of 17	Emergency AC Lighting System	Bidder understands “Main Plant” means TG & SG Area. So, Emergency AC Lighting System is not applied for FGD Plant Area.		Emergency AC lighting system mentioned in areas as per technical specifications to be provided. Refer amendment.
	Part-B					This system shall be provided for certain important areas in the main plant.	Please confirm.		
	Sub-section-II E15								
	Lightning								
564	Section-VI (TS)			3.03.04	5 of 17	For Coal Handling plant./FGD Plant Area	Please confirm that ‘Strategic locations’ where emergency DC lighting system shall be supplied for FGD Plant Area are as below.		Bidder understanding is correct. However strategic location also include each floor of TP and TP staircase(if any)
	Part-B					100W, 220V DC Lighting fixture shall be provided in underground portion of conveyor, each switchgear room, control room, office room, pump house, ~~	- FGD SWGR Room		
	Sub-section-II E15						- FGD Control Room & Office, Control equipment rooms		
	Lightning						- Staircases for FGD Elec & control BLDG		
							- Pump House		
565	Section-VI (TS)			4.00.00.10.(I)	8 of 17	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
	Part-B								
	Sub-section-II E15								
	Lightning								

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
566	Section-VI			4.00.00	3 of 5	HVW Spray System:	Please clarify spray pumps to be provided for spray system or tapping will be provided from nearby existing header		Co-ordinate points for hydrant & spray water header shall be furnished during detailed engg. However, one no. tapping each for hydrant & spray shall be provided around 50m vicinity. However, Bidder to refer relevant amendment.
	Part-A			1.2,1.3		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.			
	Sub-section-III-A3					MVW Spray System:			
	Fire Detection & Protection 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			
567						HVW AND MVW SPRAY SYSTEM			
						General			
	Section-VI Part-B Sub-section-I-M4 Fire Detection & Protection System			3.01.00	1 of 18	It shall consists of Spray Pumps, Pressurization arrangements, water mains network, deluge valves, alarm valves, flow switches, isolation valves, Y type strainers.			

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
	Section-VI			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 handling plant and inert gas protected areas. Short term fire …….			
568	Part-B					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…	NTPC to note Inert gas system is not specified in scope of work in FGD & ZLD area. Hence we have not considered inert gas system.		Bidder's understanding is correct. Amendment will be issued in this regard.
	Sub-section-I-M4,			5.18.00.ii)					
	Fire Detection & Protection System				14 of 18				
	Section VI / Part –B/			2.02.12(i)	5 of 112	More than 2.0 tonne or more than 10.0 m lift or hoists coming outside buildings- Motor driven for both travel & lift.			
	Sub section-I-M2								
569	Section VI / Part –B					Contractor shall provide motorized hoist and trolleys for all items requiring maintenance and weighing 500 kg or more.	NTPC to clarify the minimum weight of item for which motorized hoist is to be considered as there is ambiguity.		Specification requirement is clear in this regard. Bidders to comply the specification requirement pertaining to the area specified.
	/Sub section-I-M1								
				14.09.00	33 of 49				

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
570	Section VI / Part –B /Sub section-II-E13			1.01.00	1 of 2	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/IEC 60034	Since IS 4722 is not applicable for traction equipment, it shall not be applicable for Elevator motor.		Bidders understanding is correct. Reference std. as applicable shall be followed in line with the specification
571	Section-VI (TS) Part-B Sub-section-II E15 Lightning			4.00.00.10.(I)	8 of 17	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
572	Section-VI (TS) Part-B Sub-Section IV-D Civil Works			12.00.00 (Roads)	30 of 114	Concrete pavement for roads shall be min. 250mm thick slab	Please clarify which particular specification about roads needs to be followed.		Bidders to comply to the requirements of technical specifications.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
573	Section-VI (TS) Part-B Sub-Section IV-D Civil Works			12.00.00	31 of 114	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.		Bidders to comply to the requirements of technical specifications.
574	Section-VI (TS) Part-B Sub-Section IV-D Civil Works			21.00.00	41 of 114	RCC paving of min. 150mm thick with M25 grade concrete	Please clarify which particular specification about roads needs to be followed.		Bidders to comply to the requirements of technical specifications.
575	Section-VI (TS) Part-B Sub-Section IV-D Civil Works			29.02.00	48 of 114	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. For finising schedule,Bidder shall comply
576	Section-VI (TS) Part-B Sub-Section IV-D Civil Works			31.03.00	56 of 114	All steel surfaces should be provided with two component moisture curing zinc silicate primer coat, followed by polyamide curved epoxy (with MIO content) intermediate & aliphatic isocyanate curved acrylic final coat, all in shop	What separate paint is required other than the primer, intermediate & final coat already provided in the shop? Please clarify.		For steel sections and structures which are to be transported on sea, anticorrosive paint before shipment shall be provided to take care of sea worthiness.
577	Section-VI (TS) Part-B Sub-Section IV-D Civil Works			31.07.00	57 of 114	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, anticorrosive paint before shipment shall be provided to take care of sea worthiness.
578	Section-VI (TS) Part-C Sub-Section IV General Technical Requirement			28.01.00	40 of 82	The scope of service under training of Employer's engineers shall include a training module covering upto six (6) man months in the areas of Operation & Maintenance.	Please clarify more detail requirement for training schedule such as plant visit, visit to Manufacture's work and product.		Please refer Annexure-VII of Section-VI, Part-C of Technical Specification.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
579	General Queries			-	-	-		Please confirm questions below. a. Can any additional cable / piping / ducting load be taken from the existing structures? b. Shall NTPC clear the FGD area of all debris prior to the contractor's start of work? c. What is the lead distance for disposal of excavated debris?	Bidder understanding is not correct. No any load to be taken from Existing structure. Area specified for FGD shall be cleared for debris however if some debris will be in the area before start of fgd work same will have to be cleared by bidder. Bidder to comply the technical specification.
580	SECTION-VI SUB-SECTION-II-E1			Page 4	1.12.00		The responsibility of coordination with electrical agencies /TAC/Pollution control board and obtaining all necessary clearances shall be of the contractor.	Please specify what clearances to be obtained.	Specification requirement is clear. Bidder to comply the technical specification.
581	SECTION-VI SUB-SECTION-IV-D							Geological information shall be provided. Owner to clarify the details of earthquake liquefaction, collapsible soil layer if any, and the bearing capacity of natural base foundation.	Geological study has not been done. However, available geotechnical data has already been provided in the tender documents. Further, liquifaction potential, collapsible soil etc. to be assessed by the Bidder
582	SECTION-VI SUB-SECTION-IV-D							Owner to clarify the type of building foundation? Whether it is natural base,pile foundation, or compound foundation	Available geotechnical data has already been provided in the tender documents. Type of foundation (open foundation/pile foundation), founding depth etc to be assessed by the Bidder based on requirement of bearing capacity/functional requirement of super structure/foundation.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
583	SECTION-VI SUB-SECTION-IV-D							Site building photos if any.	Shall be provided to successful bidders.
584	SECTION-VI SUB-SECTION-IIIC							Owner to clarify the arrangement of CEMS for absorber inlet. Whether it shall monitor the SO2, O2, ash concentration, temperature, pressure, volume Nox, CO2, moisture etc.	It is clarified that CEMS system as specified under clause 2.03.00, sub section IIIC, Section-VI, Part-A is envisaged for stack emission monitoring. Further, minimum requirement of measurements/ instruments at absorber inlet and absorber outlet are specified in the tender drawings. In case additional measurements/ instruments are required as per the standard and proven practice of bidder, the same shall be provided with in this contract without any extra cost.
585	SECTION-VI SUB-SECTION-IIIC							Owner to clarify the arrangement of CEMS for absorber outlet. Whether it shall monitor the SO2, O2, ash concentration, temperature, pressure, volume Nox, CO2, moisture etc.	It is clarified that CEMS system as specified under clause 2.03.00, sub section IIIC, Section-VI, Part-A is envisaged for stack emission monitoring. Further, minimum requirement of measurements/ instruments at absorber inlet and absorber outlet are specified in the tender drawings. In case additional measurements/ instruments are required as per the standard and proven practice of bidder, the same shall be provided with in this contract without any extra cost.
586	SECTION-VI SUB-SECTION-IIIC							Owner to clarify whether the Mercury Analyser is required for absorber inlet.	Mercury analyser is not envisaged at absorber inlet. However, in case Mercury analyser is required at absorber inlet, as per the standard and proven practice of bidder, the same shall be provided with in this contract without any extra cost. Bidder to further refer clause 2.03.00, PART-A, Sub Sec IIIC, of technical specification wherein flue gas analysers envisaged under CEMS is mentioned. Bidder to comply with the spcification requirement.
587	SECTION-VI SUB-SECTION-IIIC							Owner to clarify whether fire fighting system is requried for control building, power distribution room, Electric room, cable interlayer etc.	Bidder's understanding is correct
588	SECTION-VI SUB-SECTION-IIIC							Owner to clarify whether CCTV system is required? If yes, pls provide detail specification for CCTV.	It is clarified that CCTV system is not in the scope of the bidder.
589							On the discharge of Sump pump for Limestone Grinding area Sump NRV is envisaged	As these pump are expected to handle leakoff slurry, pump shall be provided without NRV on pump discharge	

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
590							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.	Reffered drawing not related to FGD North Karanpura.
591							Level Control Station For Tank	We understand common Level control station to be provided for both process water tanks. Owner to confirm.	
592	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.
593	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.
594	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 confirm.	NOT RELEVANT TO NKSTPP FGD
595	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.	NOT RELEVANT TO NKSTPP FGD
596	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	specification requirement is clear in this regard. Bidder to comply the specification.
597	VI, Part-A, Sub-Section-IV 1.00.00			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	Valves at terminal points are in Bidders scope.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
598	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 dicharge duct for FGD tapping. NTPC to clarify for twin flue chimney what shall be tapping point. ii) In case tapping is from common duct NTPC to clarify whether isolation damper is required at tapping point Or Not.	Specification detail menmtioned by Bidder is not correct. However specification requirement is clear in this regard. Bidder to comply the specification.
599	Section-VI/ PART-A /Sub section-IV-2.00.00			3 of 3			Exclusions	Please provide list of Exclusions.	specification requirement is clear in this regard. Bidder to comply the specification.
600	Section-VI/ PART-A /Sub section-III-A4			1 of 3			Hot secondary water pipe from the PHE's, dicharging 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. ii) Process water may be used before OR after process water storage tank as per layout requirement.	Specification detail menmtioned by Bidder is not correct. However specification requirement is clear in this regard. Bidder to comply the specification.
601	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 technocommercial discussions.	We understand NTPC will provide finalised basic layout before submission of commerecial bid & it will be provided to bidders well in advance before submission of commerecial bid. Please clarify.	Clause not found in Technical specification. Not RELEVANT TO NKSTPP FGD
602	Section-VI/ PART-A /Sub section-III- 1.06.00			3 of 5			All the first fill and one years topping requirements of consumbales 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. Ii) We understand consumbales required for maintenanace of equipments of equipment are to be supplied. Chemical required for the process are excluded from bidders scope. NTPC to clarify.	specification requirement is clear in this regard. Bidder to comply the specification.
603	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…..	Linesrs used in the FGD system are standard lines & shall be installed as per standrd duidelines of manufactures without supervision of supplier.	Bidder to comply the specification requirement.
604	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 : Sr. No 2 : Design Inlet Gas Temp : 150 deg.	We understand design inlet gas temp to absorber is 150 deg C.Please clarify.	specification requirement is clear in this regard. Bidder to comply the specification.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
605	Section-VI/ PART-B /Sub section-I- M1-3.01.0, Sr. No-1			5 of 51			The Entire Flue Gas system , Flue Gas Ducts, Absorber shall be designed to meet following conditions : Sr. No 1 : Design Iinternal pressure at 67% yield strength : +660 & -150 mmwc or Maximum concievable 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…… NTPC to clarify design pressure on -ve side to be considred for duct design.	Refer necessary amendment in this regard.
606	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 minimm 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.
607	Section-VI/ PART-B /Sub section-I- M1-3.03.07			7 of 51			Quick 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 opeining time for …….	i) As quick opening biplane damper is to be provided, Guillotine gate damper will be redundant, in view of this it is praposed to provide only quick opening biplane damper in bypass duct. ii) In case if bypass guillotine gate type damper is to be provided in the existing duct. It is praposed that opening time of biplane damper shall be same as that of guillotine gate type of damper.	Bidder to comply the specification requirement. Please also refer Amendment to the technical specification.
608	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	Bidder to comply the specification requirement. Please also refer Amendment to the technical specification.
609	Section-VI/ PART-B /Sub section-I- M1-4.01.01-(iv) & 4.01.02-(vii)			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.
610	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 schem envisaged in the technical specification Gypsum bleed pump shall be utilised 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 purpuse. NTPC to review & clarify.	Bidder to comply the specification requirement.

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FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
611	Section-VI/ PART-A /Sub section-VI-5.00.00-xiv			21 of 24			xiv)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 Auxilary Cooling water pump shall not be used therefore , power consumption of Auxilary 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. May please refer amendment.
612	Section-VI/ PART-A /Sub section-VI-7.00.00			23 of 24			The contractor shall gurantee 98% availability of FGD plant including…….. For a continuous period of 120 days. An availability guarantee test shall be consucted to assure this level of availability for a period of 240 days as per the procedure below.	Please clarify if availablity test is for 120 days Or 240 days.	Specification requirement is clear. Bidder shall comply with the specification requirements.
613	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.** This is a standard proven design for FGD absorber. Owner is requested to modify this clause accordingly.	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.
614	Section-VI/ PART-B /Sub section-I-M1-3.02.07			6 OF 49			…… The chimney flue liner cladding shall be made of 2mm thick Titenium(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.	Bidders to comply the specification requirement.
615	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 Equipments. Owner to confirm bidder understanding is correct.	Bidders to comply the specification requirement.
616	VI, Part-C 30.00.00			42 of 83			Noise Level:- …..shall not exceed 85 dBA. However Ball Mills the noice levels as per following shall also be acceptable: a) Ball Mill < 90 dBA	i) As per clause no 9.01.00, Sr. No-6, on page no 21 of 26, Section VI, PartA, Sub Section V, Noise level for Air Compressor is 90 dB. ii) It is proposed that noise level for Crusher shall be < 102 dBA Owner to clarify.	Refer Amendment in this regard.
617	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.	Required drawings will be made available at detailed engineering stage, if available.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
618	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 confirm bidder understanding is correct.	Stipulations, as given under Clause 13.00.00 Sub Section- III-A1 Section –VI, Part-A, shall be complied with w.r.t trestles. -Bidder shall comply with technical specification requirement clause no: - 1.08.00.2 Sub Section- III-B, Section –VI, Part-A.
619	General						ID fan Performance Curves	Owner to provide ID fan performance Curve.	Noted. ID fan performance Curve will be provided to the successful bidder.
620	General						Code & Standard	As equipment may be proccurent from China, i) Equivalnet GB standard shall be followed for Design of equipment of FGD System like structure, pumps, supports etc. ii) Material shall be as per equivalent Chinese code.	Specification requirement is clear. Bidder shall comply with the specification requirements.
621	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, storage, grinding, slurrification and dosing system for **FGD and ZLD** systems is proposed . This would reduce footprint and contain capital costs. Please clarify & confirm.	Bidders to comply the specification requirement.
622	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. Also please clarify all the waste water sources leading to ZLD, such process wastes, cooling water wastes, if any.	NOT RELEVANT TO NKSTPP FGD
623	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.	NOT RELEVANT TO NKSTPP FGD
624	SECTION – VI, PART-A SUB-SECTION-IV Terminal Points & Exclusions Cl 1.07.00			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 Query is not relevant to NKSTPP FGD. However Specification requirement is clear.
625	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. Please clarify the exact flow rate to be considered for designing the ZLD.	Specification requirement is clear in this regard. Bidder to comply the specification. ZLD is not applicable for North Karanpura FGD.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
626	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 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.	NOT RELEVANT TO NKSTPP FGD
627	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.	NOT RELEVANT TO NKSTPP FGD
628	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.	ZLD is not applicable in case of FGD North Karanpura.
629	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.	ZLD is not applicable in case of FGD North Karanpura.
630	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.	ZLD is not applicable in case of FGD North Karanpura.
631	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.	ZLD is not applicable in case of FGD North Karanpura.
632	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.	ZLD is not applicable in case of FGD North Karanpura.
633	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,	ZLD is not applicable in case of FGD North Karanpura.
634	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.	ZLD is not applicable in case of FGD North Karanpura.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
635	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.	ZLD is not applicable in case of FGD North Karanpura.
636	SECTION – VI, PART-B SUB-SECTION-I-M7 ZLD 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.	ZLD is not applicable in case of FGD North Karanpura.
637	SECTION – VI, PART-B SUB-SECTION-I-M7 ZLD Cl 3.02.05 (6)			20 of 32			Additional required equipment for Vapour Compressor : 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.	ZLD is not applicable in case of FGD North Karanpura.
638	Process Flow Diagram ZLD			3 of 3				The scheme shows steam driven crystalizer, whereas write up calls for MVR. Please clarify.	ZLD is not applicable in case of FGD North Karanpura.
639	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.	Not relevant to NKSTPP FGD
640	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.	ZLD is not applicable in case of FGD North Karanpura.
641	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.	ZLD is not applicable in case of FGD North Karanpura.
642	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.	ZLD is not applicable in case of FGD North Karanpura.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
643	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.	Shall be provided to during detail Engineering.
644	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.	Shall be provided to during detail Engineering.
645	Technical Specification,Section-VI,Part-A, Subsection-III-A3,Fire Fighting System, Clause no:1.00.00(point no 1.2,1.3) & Technical Specification,Section-VI,Part-B, Subsection-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.	Refer Amendment in this regard.
646	Technical Specification,Section-Vi,Part-A, Subsection-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.	Reffered clause not found.
647	Technical Specification,Section-Vi,Part-A, Subsection-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.	It is proposed to provide pedestal instead of Trench. Wherever pedestal is not possible,Trench will be provided. Please confirm.	Reffered clause not found.
648	Technical Specification,Section-VI,Part-B, Subsection-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. Please confirm.	Reffered clause not found.
649								R-Infra consider the various areas which are mentioned in the Plotplan dedicated for FGD system . No other area has considered by us. Owner to confirm.	Confirmed.
650								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.Bidder to reffer clause no. 1.09.00, Part-A,section-VI, Sub-section-IV, Terminal Point & Exclusions for FDPS.
651	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.	Sub Section I-M6 is related to Piping. However for for clause No. 2.02.01, Sub section I-M2 bidder to comply with technical specification.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
652	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, if required, shall be provided to successful bidders. However Limestone delivery to North karanpura plant is through Truck.
653	General							What shall be the belt conveyor system capacity, belt width and belt speed to be selected. Please clarify.	Specification requirements is clear. Bidders to comply the specification requirement.
654	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.
655	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.
656	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.	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.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.
657	Section-VI, Part-A, Sub Section-III-C, Cl: 4.00.00 (d), (e) & Section-VI, Part-E, Drawing no: 0000-101/102-POI-A-021			5 of 8 & Sht 1 of 3			d) Cables required for interfacing……. Shall be in bidder's scope. e) Cables for connectivity of CEMS……. Shall be in bidder scope. & 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. Owner to confirm.	Refer amended tender drawing in this regard.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
658	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 North Karanpura (3x660MW) , 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.
659	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". Owner may please confirm concurrence	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 minimum quantity of OWS and OWS cum EWS as follows: a) OWS (placed in FGD control room)-(N+1) where N is the total number of generating units per project under this package. b) OWS cum EWS (placed in FGD control room)-ONE (1) c) OWS (placed in central control room of each generating unit)-TWO (2). Bidder to refer amendment in this regard.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
660	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: a) Chairs- 4nos b) Printer Table- 1no c) Computer Table- 2nos - e) Locker set - 1 no	The following is understood from the Tender documents: 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. 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. 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. 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. 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. 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 North Karanpura (3x660MW) project, the quantity of furniture to be supplied shall be thrice 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 to comply with the specification. 3) Bidder's understanding is correct.
661	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 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	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 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.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
662	Section-VI, Part-A, Sub Section-III-C, Cl: 9.02.00 & Section-VI, Part-B, III-C1, Basic design Criteria, Cl: 3.05.01			8 of 8 & 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. & 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. Owner may please confirm.	Bidder's understanding is correct. 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: 1) The FGD plant operation shall be made available through Ethernet link following TCP/IP standard. The system shall be OPC compliant. Bidder to comply with the above specification requirement. It is further clarified that to achieve the above FGD OWS shall be located in respective unit (s) CCR. Refer amended tender drawing 0000-151-POI-A-013 in this regard.
663	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. 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. Owner may please confirm.	Refer amendment in this regard.
664	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	Bidder proposes to provide relay based control system for ventilation system in line with standard and proven practice of OEM.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.
665	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.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
666	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. 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 to comply with the specification.
667	Section-VI, Part-B, III-C2, Measuring Instruments, Cl: 10.00.00, S.No-8 & Cl: 11.01.00, S.No-8			19 of 34 & 23 of 34			Under Common requirments for analyzer Instruments, it is specified that calibration from Remote is required.	Bidder clarifies that the Auto & Manual claibration from local is envisaged for bidder supplied analzers. Owner may please confirm.	Bidder's understanding is not correct. Specification requirement are clear. Bidder to comply with the specification requirement.
668	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. Owner may please confirm concurrence.	Bidder's proposal is acceptable.
669	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. 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.
670	Section-VI, Part-E, Drawing no: 0011-109-POMI-A-001 and 001 (a)			1 of 1			Typical scheme for blower and slurry recirculation 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, Vibration monitoring system and Temperature elements for motor and Fan/pump.
671	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. Owner may please confirm concurrence.	Bidder’s proposal is also acceptable.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
672	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.	Bidder to refer amdt.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
673	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.	Bidder's query is not relevant to this project
674	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.	Bidder's query is not relevant to this project
675	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.	Bidder to comply specification requirement
676	Part- B-II Elect 1 clause no 2.01.01 Technical requirement			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 fully draw out type.	We understand from the Bid Clause that All ACDBs ,DCDBs,Solenoid Valve DBs shall be fixed type.M/s NTPC to confirm .	Technical speciifcation is ample clear. Bidder to comply specification requirement
677	Part- B-II Elect 1 clause no 2.04.00 Technical 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	This clause is deleted. Please refer amendment of Technical Specification(Section VI)
678	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.	Bidder to refer Cl 7.00.00 of Chapter E1, Part-B in this regard
679	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.	Technical specifications are clear. Bidder to comply with the technical specifications requirements
680	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. Bidder to comply technical specification

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
681	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 to 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
682	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.	The query does not pertain to North Karanpura Project.
683	SUB-SECTION-II-A8 PROJECT INFORMATION-NABINAGAR-I 3X660 MW			-			Topographical survey drawing is missing	NTPC to submit the soft copies(Autocad drawing) of topographical survey drawings.	The query does not pertain to North Karanpura Project.
684	SUB-SECTION-II-A8 PROJECT INFORMATION-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 for the project site shall be as follows: a) The basic wind speed “Vb” at ten	NTPC to furnish basic wind speed "Vb" at 10m height above the mean ground level.	The query does not pertain to North Karanpura Project.
685	SUB-SECTION-II-A8 PROJECT INFORMATION-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 substructures,	Item description is incomplete.	The query does not pertain to North Karanpura Project.
686	SUB-SECTION-II-A3,A4,A6,A7 & A11 PROJECT INFORMATION-			-			Bore log details for following projects are missing, 1. Solapur STPP, Stage-II (2x660MW), 2. Gadarwara STPP, Stage-I (2x800MW), 3.Nabinagar TPP (4X250 MW), 4. DARLIPALLI STPP, Stage-I (2X800 MW), 5. Tanda STPP, Stage-II (2x660MW)	NTPC to furnish the borelog details of missing project.	The query does not pertain to North Karanpura Project.

CLARIFICATION No.- 01 (TECHNICAL)

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE NORTH KARANPURA SUPER THERMAL POWER PROJECT (3X660 MW)

Bidding Document No.: CS-4410-109-2 **Document No.: CS-4410-109-2-CLRF-TECH-01**

Sl. No.	ENQUIRY SPECIFICATION						SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATION	NTPC CLARIFICATION
	Section / Part / Chapter				Clause No.	Page No.			
687	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 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.	NTPC to furnish the exisitng Sewer layout drawing.	Bidder to comply Sewage Layout drg of plant area shall be shared with successful bidder at detailed Engg. Stage.
688	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	NTPC to confirm the type of pipe to be used for sewage disposal.	Bidder to comply to clause15.00.00 for sewage works.
689	SECTON -VI TECHNICAL SPECIFICATION, Clause: 12.00.00			30			Specification pertaing to road shoulder(shoulder width, subgrade materials used and their thickness) is missing.	NTPC to furnish the shoulder specification.	Bidder to provide 12m and 6m wide concrete roads without shoulders as per tender drg. titled"Layout Plan Of FGD System"No. 4410-999-POC-F-001
690	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.	For sewage pumping, an underground RCC sump of one day storage with submersible pumps , complete with all fittings and fixtures
691	Sec-VI Part-D ,ECC			Clause no. 28.04.00	Page no. 12		Site laboratory for Civil Work	Bidder through its civil work subcontractors will set up a temporary field quality Lab to conduct normal civil work tests at site. However, customer to allow bidder/it's subcontractors to take back those field quality lab equipment after completion of work at site. Please confirm.	Noted

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
1.	SECTION – VI, PART-B	SUB-SECTION-III-C2 MEASURING INSTRUMENTS	18 to 30 of 30	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	23 of 38	Main clause 5.00.00	Clause no. 1.01.01, 1.01.02, 1.01.03, 1.01.04, 1.02.00, 1.03.00, 1.07.00	Clause no. 1.01.01, 1.01.02, 1.01.03, 1.01.04, 1.02.00, 1.03.00, 1.07.00 (Main clause 5.00.00 CONTROL AND INSTRUMENTATION) replaced as per attached C&I **Annexure-II.**
3.	SECTION – VI, PART-A	SUB-SECTION-VII, Mandatory Spares	23 of 38	Main clause 5.00.00	---	New Clause no. 1.01.05, 1.11.00 added in mandatory spare main clause 5.00.00 as per attached C&I **Annexure-II.**

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
4.	SECTION – VI, PART-A	SUB-SECTION-VII, Mandatory Spares	35 of 38 18 of 38	ELECTRICAL ACTUATORS	ELECTRICAL ACTUATORS Mandatory spare 4.00.00 FIRE DETECTION AND PROTECTION SYSTEM	Mandatory spare of ELECTRICAL ACTUATORS replaced as per attached C&I **Annexure-II.** New Clause no. 7.5, 7.6 added in mandatory spare main clause 4.00.00 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, PART-B	SUB-SECTION-IIIC-8 ELECTRIC ACTUATORS	1 to 4 of 4		SUB-SECTION-IIIC-8 ELECTRIC ACTUATORS	NEW CHAPTER ADDED as per attached C&I **Annexure-III**.
7.	SECTION – VI, PART-B	SUB-SECTION-III-C2 MEASURING INSTRUMENTS	2 of 30	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	9 of 30	3.05.00	3.05.00 TEMPERATURE TRANSMITTER (TT)	3.05.00 TEMPERATURE TRANSMITTER (TT) updated as per attached C&I **Annexure-IV.**

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
		INSTRUMENTS				
9.	SECTION – VI, PART-B	SUB-SECTION-III-C2 MEASURING INSTRUMENTS	30 of 30	New clause 12.00.00	--	New clause 12.00.00 Vibration Monitoring System (VMS) added as per attached C&I **Annexure-IV**.
10.	SECTION – VI, PART-B	SUB-SECTION-III-C2 MEASURING INSTRUMENTS	30 of 30	New clause 13.00.00	--	NEW clause 13.00.00 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 NEW CHAPTER ADDED as per attached C&I **Annexure-V**.
12.	SECTION – VI, PART-B	SUB-SECTION-III-C5 PLC BASED CONTROL SYSTEM			SUB-SECTION-III-C5 PLC BASED CONTROL SYSTEM	CHAPTER replaced with SUB-SECTION-III-C5, DDCMIS as per attached C&I **Annexure-VI**.

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
13.	SECTION – VI, PART-B	SUB-SECTION-IIIC-10 POWER SUPLY			---	SUB-SECTION-IIIC-10 POWER SUPPLY SEPARATE CHAPTER for POWER SUPPLY ADDED as per attached C&I **Annexure-VII**.
14.	SECTION – VI, PART-A	SUB-SECTION-III-B	1 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			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-A	SUB-SECTION-III-A1, FGD	7 OF 8	10.01.00	….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)/analyser room for analysers. The buildings must be complete…….

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
18.	SECTION – VI, PART-B	SUB-SECTION-IIIC-11 Containerised cabin (Portable room)				SUB-SECTION-IIIC-11 CONTAINERISED ROOM (PORTABLE CABIN) SEPARATE CHAPTER ADDED as per attached C&I **Annexure-X.**
19.	VI/B	II-E12	4 of 30	1.01.00(s) (3)	LV Phase Terminal 3.45 KV- Busduct **(Non-Segregated)**	LV Phase Terminal 3.45 KV- Busduct
20.	VI/A	VII	36 of 38	-	-	List of Mandatory spares for Transformers (**Annexure-E0)**
21.	VI/F	DE14	-	-	-	Data sheet format for Dry type indoor transformer (**Annexure-E3)**
22.	VI/E				Electrical Single Line Diagram for FGD Package 4410-109-POE-J-001 **rev A**	Electrical Single Line Diagram for FGD Package 4410-109-POE-J-001 **rev B (Annexure-E4)**
23.	VI/B	II-E1	4 of 7	2.05.00		Contractor shall make necessary provisions for owners's HT switchgear control from owners DDCMIS/Contractor's FGD DDCMIS/ PLC (as decided during detailed engineering). Necessary control wiring for this purpose also shall be in contractor's scope.
24.	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	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**

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
					class-IE3, conforming to IS 12615, or IEC:60034-30.	**minimum design efficiency of 95 %. Tolerance on efficiency value applicable as per IEC 60034.**
25.	VI/B	II-E2	2 of 9	3.01.00 d)	Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.	Motor operating through variable frequency drives shall be suitable for inverter duty **with VPI insulation**. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.
26.	VI/B	II-E2	2 of 9	3.01.00 e)	-	Motors operating through variable frequency drives shall also meet the requirements mentioned in subsection for VFD.
27.	VI/B	II-E2	4 of 9	7.04.00	Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.	Motors rated above 1000KW shall have insulated bearings/**housing** to prevent flow of shaft currents.
28.	VI/B	II-E2	7 of 9	10.02.03	The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only	The following type test reports shall be submitted for each type and rating of LT motor of above **100 KW** only
29.	VI/B	II-E2	5 of 9	7.11.00	The spacing between gland plate & center of terminal stud shall be as per Table-I.	The spacing between gland plate & center of **bottom** terminal stud shall be as per Table-I.
30.	VI/B	II-E2	9 of 9	Table - 1	Minimum distance between centre of stud and gland plate in mm Above 125 KW-upto 200 KW 203	Minimum distance between centre of **bottom terminal** stud and gland plate in mm Above 125 KW-upto 200 KW **385**/203 **(For Single core cables only)**

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
31.	VI/B	II-E3	5 of 11	3.06.01	A continuous 65 x 8 mm galvanised mild steel earth bar shall be provided along the entire run of each busduct.	A continuous 65 x 8 mm galvanised mild steel or **aluminium** earth bar shall be provided along the entire run of each busduct.
32.	VI/A	III-B	5 of 6	1.15.00	-	**Variable Frequency Drive (VFD)** 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 alongwith 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).
33.	VI/B	II-E18	-	-		**VARIABLE FREQUENCY DRIVE** (VFD) chapter added as **Annexure -E2**
34.	VI/B	II-E12	2 of 30	1.01.00 (n) 5 Method of neutral earthing and Vector group	REPLACE EXISTING TABLE.	ATTACHED TABLES—Annexure E1
35.	VI/B	II-E12	3 of 30	1.01.00 (p)	REPLACE EXISTING TABLE.	ATTACHED TABLES—Annexure E1

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
36.	VI/B	II-E12	4 of 30	1.01.00 (r)	REPLACE EXISTING TABLE.	ATTACHED TABLES—Annexure E1
37.	VI/B	II-E12	5 of 30	1.01.00 (t)	REPLACE EXISTING TABLE.	ATTACHED TABLES—Annexure E1
38.	VI/B	II-E6	6 of 69	3.05.01	Tender drg. no 0000-211-POE –A-51-RA of cable lug attached at the end of this chapter (Drawing was missing)	Tender drg. no 0000-211-POE –A-51-RA of cable lug attached at the end of this chapter **(Annexure E5)**
39.	VI/B	II-E15	10 of 17	4.00.00 (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 & 2x10W fluorescent lamps.	**DELETED**
40.	VI/B	II-E4	4 of 6	2.14.04	Cables shall be armoured type if laid in CHP area or directly buried.	**All Cables shall be armoured type.**
41.	VI/B	II-E4	4 of 6	2.14.06	NA	**Same cable sizes to be used for same type of application & rating of motor i.e if there are three pumps for one application, all three pumps motor should be provided with same cable sizes.**
42.	VI/B	II-E4	5 of 6	4.00.00.c	The standard drum length for power cables shall be **1000 meters**; however for cable sizes of 1C X 630mm2, 3C X 150mm2 and 3C X 240mm2 (sizes if applicable) standard drum length shall be 750 meters. The length per drum shall be subjected to a maximum tolerance of	The standard drum length of LT power cable with a maximum tolerance of +/- 5% may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter for single core cable

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
					+/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths	excluding 630 sq.mm size, and 750 meter for multicore cable & single core 630 sq.mm
43.	VI/B	II-E7	4 of 7	2.16.04	Cables shall be armoured type if laid in CHP area or directly buried.	**All Cables shall be armoured type**
44.	VI/B	II-E7	5 of 7	4.01.03	The standard length for HT power cables shall be 1000 meter for all single core cables and 750 meters for 3 core cables. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drum with shorter lengths. One drum length of each cable size can be of non standard length (not less than 250 meter) so as to match the ordered quantity. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/-2% and the payment shall be made based on the actual cable length supplied within this limit.	The standard drum length for HT power cables with a maximum tolerance of +/- 5%, may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter for single core cable, and 750 meter for multicore cable.
45.	VI/B	II-E6	2 of 69	2.01.01	Interplant cabling….. one route. All buried cables shall be armoured	Interplant cabling….. one route.. **Cables crossing Railway line (if applicable) shall be laid underground through nearest culvert. Necessary statutory clearance if required shall be taken**

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
						by Bidder All HT, LT and Control cables shall be armored.
46.	VI/B	II-E5	3 of 6	2.14.02	Cables shall be armoured type if laid in CHP area or directly burried	**All Cables shall be armoured type.**
47.	VI/B	II-E5	4 of 6	4.00.00.c	The standard length for HT power cables shall be 1000 meter. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths	The standard drum length for control cables with a maximum tolerance of +/- 5% may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter.
48.	VI/B	II-E12	21 of 30	5.00.00	(a) The Contractor shall carry out a comprehensive……. (b) The Contractor shall carry out all type..... (c) The bidder shall indicate the charges for each of these type…… (d) The equipment checks to be carried out by the…… (e) The requirements of site tests are……. (f) The makes of all major bought out items shall be…….. (g) Each transformer shall be completely assembled…… (h) The type tests shall be carried out in presence…….	(a) The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last Ten years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. In case the Contractor is not able to submit report of the type test(s) conducted within last Ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval. Type test report of following is also need to be

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					(i) In case the contractor has conducted such…… (j) Following components to be supplied shall be…….. (k) All acceptance and routine tests as per the specification……included in the equipment price	submitted: (a) All type test on OLTC as per IEC 60214 (wherever applicable) (b) Neutral Grounding Resistors (c) Tank Vacuum and Pressure test (b) 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. (c) Each transformer shall be completely assembled with all fittings & accessories meant for the particular transformer before offering for inspection & testing by Employer.
49.	VI/B	II E-2	4 of 9	7.10.00	3.3 KV motors shall be offered with dust tight phase separated double walled(metallic as well as insulated barrier) Terminal box. Employer shall provide termination kit for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.	3.3 KV motors shall be offered with dust tight phase separated double walled(metallic as well as insulated barrier) Terminal box. **Contractor** shall provide termination kit for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.

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50.	VI/B	II E-02	4 of 9	7.07.00	Each bearing of HT motor shall be provided with dial type thermometer **with adjustable alarm contact and** preferably 2 numbers duplex platinum resistance type temperature detectors.	Each bearing of HT motor shall be provided with dial type thermometer and min. 2 numbers duplex platinum resistance type temperature detectors.
51.	Amendment No. 01 to technical specification (Section-VI) Sl. No. 175, Page 67				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.	**Configuration and height of chimney(s) shall be as specified in mechanical portion of technical specification.** There shall be one flue (liner) for each unit. 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.
52.	VI/B	IV-D	3.14.01 Para 3	11 of 114	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.	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 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.

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53.	VI/B	IV-D	3.14.01 Para 4	11 of 114	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.
54.	VI/B	IV-D	3.14.01 Para 5	11 of 114	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.	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 **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.

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55.	VI/B	IV-D	3.14.01 Para 6	11 of 114	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 reasonably implied and necessary to complete the job in all respects.
56.	VI/B	IV-D	3.14.02 Para 7	12 of 114	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.

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57.	VI/B	IV-D	3.14.03 Para 1	12 of 114	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.
58.	VI/B	IV-D	3.14.03 Para 2	12 of 114	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.
59.	VI/B	IV-D	3.14.03 Para 6	12 of 114	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.	DELETED

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60.	VI/B	IV-D	3.14.03 Para 9	13 of 114	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.
61.	VI/B	IV-D	3.14.03 Para 14	13 of 114	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 2/3rd 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.
62.	VI/B	IV-D	3.14.04 Para 5	13 of 114	Clean-out door shall be provided below the flue for the removal of ash.	DELETED

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63.	VI/B	IV-D	3.14.07 Para 5	14 of 114	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**.
64.	VI/B	IV-D	3.14.08 Para 2	14 of 114	**Thermal insulation (Applicable in case of Titanium / C-276 Flue Liner)**	**Thermal insulation (Applicable in case of Titanium / C-276 Flue Liner)**

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					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 100°C. **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.** 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 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 100°C. 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 galvanized wire mesh using MS galvanised pins and speed washer.

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					the joints of the first layer. The insulation shall be wrapped on the outer-most surface with galvanized wire mesh using MS galvanised pins and speed washer.	
65.	VI/B	IV-D	3.14.09 (i)	15 of 114	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.
66.	VI/B	IV-D	3.14.09 (ii)	15 of 114	All exposed surfaces of steel wind strakes shall be painted with epoxy phenolic coating system having total 240 microns DFT. 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. 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	DELETED

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					hours (from the application of primer coat) by airless spray technique. 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 ΔE) 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.	
67.	VI/B	IV-D	3.14.09 (iii)	15 of 114	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.
68.	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	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

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					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 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..	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 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..
69.				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.**
70.				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.**

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71.	SECTION-VI/ Part-A	V SALIENT DESIGN DATA	7.01.00 (15)	8 of 10	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, ZLD control room (if provided) and /or FGD cum ZLD control room (as the case may be) 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 TR 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.
72.	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.
73.	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.
74.	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	Over and above, contractor shall provide all the cables so as to complete the system.

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					shall provide all the cables so as to complete the system.	
75.	VI/A	III-A3	2.00.00 (C)	2 of 5	**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, 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. Note: The above list of Buildings is indicative only. Any Building under this package which are of enclosed type, shall be provided by Mechanical ventilation.
76.	VI/B	I-M4	5.05.00 (2)	4 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
77.	VI/B	I-M4	5.16.00 (i) c)	13 of 18	Upon detection of fire either by QB detector or LHSC detector, the spray system shall be initiated.	The clause stands deleted

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					It shall also initiate spray system for the two adjacent zones after a time delay settable at site.	
78.	VI/B	I-M4	5.05.00 (1)	4 of 18	Mounting arrangement have been indicated in tender drawing.	Mounting arrangement will be provided as per proven practice.
79.	VI/B	I-M3	4.00.00, (Air Cooled D-X type) Technical Requirement of Air Conditioning and Ventilation System	2 OF 27	Motor Rating: 10% more than the power required by the compressor at 50 deg C design ambient temperature	The referred details for Motor rating in this clause stands deleted.
80.	VI/E				**LIME STONE FLOW DIAGRAM** **4410-000-2-POM-002 Rev. B**	**LIME STONE FLOW DIAGRAM** **4410-000-2-POM-002 Rev. C attached at Mechanical Annexure-IA &IB**
81.	VI/E	IIIA-2	1.01.00	1 of 7	**SYSTEM DESCRIPTION** **LIMESTONE HANDLING PLANT** (i)Two (2) no. Truck Hoppers (TH-1 &2) each having 60 Ton capacity along with apron feeders (AF-1 & AF-2) shall be provided to unload limestone from self-tippling trucks.	**SYSTEM DESCRIPTION** **LIMESTONE HANDLING PLANT** (i)Two (2) no. Truck Hoppers (TH-1 &2) each having 90 Ton capacity along with apron feeders (AF-1 & AF-2) shall be provided to unload limestone from self-tippling trucks. Apron feeders receiving

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					Apron feeders receiving Limestone from TH-1, TH-2, shall drop coal on to conveyors 1 A/B .Each Apron feeder shall be of 150 MTPH rated capacity. The rated capacity of conveyor 1A/B shall be 150 MTPH. Alternatively two numbers bulk receiving unit along with surface feeders etc. each rated for 150 TPH capacity shall be provided The feeders shall feed to conveyor 1A/B located at ground level.	Limestone from TH-1, TH-2, shall drop coal on to conveyors 1 A/B .Each Apron feeder shall be of 150 MTPH rated capacity. The rated capacity of conveyor 1A/B shall be 150 MTPH. Alternatively two numbers bulk receiving unit along with surface feeders etc. each rated for 150 TPH capacity shall be provided. The individual feeder shall feed to conveyor 1A or 1B respectively located at ground level.
82.	VI/B	III-A2	1.01.00	2 of 7	**SYSTEM DESCRIPTION** **LIMESTONE HANDLING PLANT** (V) Conveyor 2A/2B shall feed limestone to Stacking conveyor 3A/3B or Conveyor 5A at Junction House (JH-1). Conveyor 2B shall feed limestone to Stacking conveyor 3B or Conveyor 5B at Junction House (JH-1). (VI) Two (2) number paddle feeders (PF-1, PF-2), each of 150 MTPH rated capacity shall be installed below ground to reclaim the stored limestone and feed to underground conveyors 4A/B. Conveyor 4A/B shall drop limestone on to Conveyor 5A/B at Crusher house.	**SYSTEM DESCRIPTION** **LIMESTONE HANDLING PLANT** (v)Conveyor 2A/2B shall feed limestone to Stacking conveyor 3A/3B at Junction House (JH-1). (VII) Two (2) number paddle feeders (PF-1, PF-2), each of 150 MTPH rated capacity shall be installed below ground to reclaim the stored limestone and feed to underground conveyors 4A/B. Conveyor 4A/B shall drop limestone on to Conveyor 5A/B at Junction House (JH-2).

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					(VII)Stacking Conveyor 3A/B will drop limestone to **storage hopper (One fourth (1/4 th) of total stipulated crushed limestone storage shall be considered in the hopper, if applicable, and hopper length shall be equal to stockpile length placed along the tripper centerline**) provided within a shed via travelling trippers. One (1) number Traveling Tripper is mounted on each of the Stacking Conveyor 3A/B.	(VII)Stacking Conveyor 3A/B will drop limestone to **storage hopper (One fourth (1/4 th) of total stipulated crushed limestone storage shall be considered in the below ground hopper, and hopper length shall be equal to stockpile length placed along the tripper centerline**) provided within a shed via travelling trippers or Conveyor 5A/B. One (1) number Traveling Tripper is mounted on each of the Stacking Conveyor 3A/B.
83.	VI/B	III-A2	1.01.00	2 of 7	(VIII)Conveyors 5A/B shall drop limestone in to Limestone Silos of FGD System through fixed Tripper on the first silo in the path. Alternatively diverter Plough is also acceptable in place of fixed tripper.	Add New Clause : (VIII) Conveyor 5A/B shall drop limestone on to Conveyor 6A/B at Junction House (JH-3). (IX) Conveyors 6A/B shall drop limestone in to Limestone Silos of FGD System through fixed Tripper on the first silo in the path. Alternatively diverter Plough is also acceptable in place of fixed tripper.

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SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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84.	VI/A	III-A2	1.02.00		**SYSTEM DESCRIPTION** **GYPSUM HANDLING PLANT** (I)Dewatered Gypsum discharged from the vacuum belt filter shall be taken by Conveyor 6A/B to the storage shed. The storage shed shall be sufficient to store gypsum equivalent to gypsum generation of minimum 7 days (Generation of all three units to be considered). (II)One number of motorized travelling tripper on each of conveyor 7A/B shall drop the gypsum to the storage shed.	**SYSTEM DESCRIPTION** **GYPSUM HANDLING PLANT** (I)Dewatered Gypsum discharged from the vacuum belt filter shall be taken by Conveyor 7A/B to the storage shed. The storage shed shall be sufficient to store gypsum equivalent to gypsum generation of minimum 7 days (Generation of all three units to be considered). (II)One number of motorized travelling tripper on each of conveyor 7A/B shall drop the gypsum to the storage shed.
85.	VI/A	IIIA-2	2.01.06	4 of 7	Reclaim Conveyors 4A/B complete with tunnel, pent house, 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 and zero speed switches,	Reclaim Conveyors 4A/B complete with tunnel, conveyor ,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 and zero speed switches, electro-hydraulic thruster brakes, all electrical etc. including all civil, structural and architectural

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SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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					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.	works for tunnel, conveyor gallery, gallery supporting trestles and their associated foundations.
86.	VI/A	IIIA-2			----------	Add New Clause Conveyors 6A/B complete with conveyor supporting structures, short supports, stringers, deck plates, conveyor foundations, drive motors, drive units, pulleys, idlers, take-ups, take-up structure, internal and external belt cleaners, pull chord switches, belt sway and zero speed switches, electro-hydraulic thruster brakes, all electrical, etc. including all civil, structural architectural works and their associated foundations.
87.	VI/A	IIIA-2	2.01.08	4 of 7	Junction House JH-1 complete with all civil, structural, architectural and electrical works including chutes, monorails, hoists/chain pulley blocks, hoist maintenance platforms, external staircases, dust debris chutes etc. JH-1 shall be provided with removable chequered plate covers over openings in	Junction House JH-1,JH-2,JH-3 complete with all civil, structural, architectural and electrical works including chutes, monorails, hoists/chain pulley blocks, hoist maintenance platforms, external staircases, dust debris chutes etc. JH-1,JH-2,JH-3 shall be provided with removable chequered plate covers over openings in machinery hatches for handling under ground equipment as applicable.

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SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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					machinery hatches for handling under ground equipment.	
88.	VI/A	IIIA-2	2.01.12	4 of 7	Two (2) sets of gates each comprising of one number of rod gate and one number of actuator operated rack and pinion gate at inlet of each of the vibrating screen feeder feeding limestone to crushers complete with drive, all mechanical, electrical, structural works, etc.	Clause deleted
89.	VI/A	IIIA-2	3.01.00	7 of 7	a.Gypsum shall be conveyed from the vacuum belt filter discharge to the storage shed through conveyors 6A/B of 150 TPH rated capacity. c.Conveyors 6A/B complete with conveyor supporting structures, short supports, stringers, deck plates, conveyor foundations, drive motors, drive units, pulleys, idlers, take-ups, take-up structure, internal and external belt cleaners, pull chord switches, belt sway and zero speed switches, electro-hydraulic thruster brakes, all electrical, etc. including all civil, structural architectural works and their associated foundations.	a.Gypsum shall be conveyed from the vacuum belt filter discharge to the storage shed through conveyors 7A/B of 150 TPH rated capacity. c.Conveyors 7A/B complete with conveyor supporting structures, short supports, stringers, deck plates, conveyor foundations, drive motors, drive units, pulleys, idlers, take-ups, take-up structure, internal and external belt cleaners, pull chord switches, belt sway and zero speed switches, electro-hydraulic thruster brakes, all electrical, etc. including all civil, structural architectural works and their associated foundations. d.Two numbers (02) motorized travelling tripper on conveyors 7A/B for feeding the gypsum to the

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SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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					d.Two numbers (02) motorized travelling tripper on conveyors 6A/B for feeding the gypsum to the storage shed. Trippers shall be complete with all mechanical, electrical equipment, rails, chute work, rail supporting structures (along with structural stools, as required), cables with cable festooning arrangement, thruster brakes, rail clamps, electric hoist, actuator flap gates etc.	storage shed. Trippers shall be complete with all mechanical, electrical equipment, rails, chute work, rail supporting structures (along with structural stools, as required), cables with cable festooning arrangement, thruster brakes, rail clamps, electric hoist, actuator flap gates etc.
90.	VI/E				**Layout of FGD area** **4410-999—POM-A-001 Rev. B**	**Layout of FGD area** **4410-999—POM-A-001 Rev. C enclosed at Mechanical Annexure-II**
91.	**Sl. No.-40** AMENDMENT NO. CS-4410-109-2-AMDT-08		18 of 83		The duct to Absorber inlet …… thickness. The duct from Absorber outlet to wet stack inlet shall be made of Carbon steel of minimum 7 mm thickness cladded with minimum 2 mm thickness of Alloy C-276 / Alloy 59 or better material.	The duct to Absorber inlet ……thickness. The duct from Absorber outlet to wet stack inlet shall be made of Carbon steel of minimum 7mm thickness cladded with 2 mm (minimum) thickness Alloy C276 / Alloy 59 / **Titanium Gr-II**.
92.	VI/B	I-M1	29 of 49	10.01.00	**Slurry & Process Water Tanks:** All the slurry tanks……..valves etc. Coarse- screen(s) at suction-side of these pumps shall be provided.	**Slurry & Process Water Tanks:** All the slurry tanks……..valves etc. Coarse- screen(s) at suction-side of **slurry recirculation** pumps shall be provided.

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93.	VI/B	I-M1	32 of 49	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.
94.	VI/A	III-A1	7 of 8	10.01.00	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	Contractor shall provide buildings for Limestone Grinding System, Compressors, 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

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					equipments of above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc.	above systems by providing adequate maintenance space, handling facilities, walkways, staircase etc.
95.	VI/A	III-A1	4 of 8	4.01.11	All Slurry re-circulating slurry pumps & Oxidation blowers / Compressors shall be installed inside a building to be provided by the Contractor as per specifications specified elsewhere. All pumps & Oxidation blowers / Compressors 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 / Compressors 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 / Compressors 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.
96.	VI/B	9 of 49	4.01.02 (iv)		Margin over pressure requirement: 44% over the calculated value	Margin over pressure requirement: 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.

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97.	VI/B	I-M1	28 of 49	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.**
98.	VI/B	I-M1	24 of 49	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.**
99.	VI/B	I-M1	13 of 49	5.01.00(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 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	**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 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

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					Silicon Carbide or ceramic or equivalent having a minimum guaranteed life of 20,000 hrs. The Cooling Pumps shall be installed inside a building. The sparger ……. minimum life of 5 years. Minimum 10% ……Sparger Tubes.	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 specified for slurry recirculation pumps. The Cooling Pumps shall be installed** in a **shed with roof sheeting.** The sparger ……. minimum life of 5 years. Minimum 10% ……Sparger Tubes.
100.	VI/A	IV	1 of 3	1.02.00	**Flue Gas Duct** (i) Un cleaned Flue Gas : For each unit: Outlet flange (matching flanges/ expansion joint included in the Contractor's scope) in the tapping from the common Flue Gas Duct going towards the existing Chimney. No load of duct shall be transmitted on the Employers facilities. In case no opening or flange connection is available in the ducts from where tapping will	**Flue Gas Duct** (i) Un cleaned Flue Gas For each unit: 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.

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					be taken, the cutting in the duct as well as flange connection shall be in the scope of the contractor.	
101.	**Sl. No.-171** AMENDMENT NO. CS-4410-109-2-AMDT-08		64 of 83		The FGD system shall ……. Steam Generator is in operation. However, provision shall be made by the contractor for facilitating operation of unit with emergency FGD bypass. This ……..unit in operation. For this purpose. Motorized Guillotine type gates shall be provided at **(i) hot gas inlet to Absorber, (ii) hot gas inlet to booster fan and (iii) outlet of booster fan.** Further, Quick opening Bi-plane motorized / pneumatic damper along with 2x100% seal air fans shall be provided in the by-pass duct. The same shall also be taken into account while designing the control & logics for the FGD System.	The FGD system shall ……. Steam Generator is in operation. However, provision shall be made by the contractor for facilitating operation of unit with emergency FGD bypass. This ……..unit in operation. For this purpose. Motorized Guillotine type gates shall be provided at **(i) hot gas inlet to booster fan and (ii) outlet of booster fan.** Further, Quick opening Bi-plane motorized / pneumatic damper along with 2x100% seal air fans shall be provided in the by-pass duct. The same shall also be taken into account while designing the control & logics for the FGD System.
102.	VI / A	VI	8 of 14	4.02.00 (vi)	**Waste Water** The Contractor guarantees that the maximum purge flow rate to waste water treatment system **for the complete plant** shall be	**Waste Water** The Contractor guarantees that the maximum purge flow rate to waste water treatment system shall be

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					10m3/hr averaged over a 24 hour period from each unit.	10m^3/hr averaged over a 24 hour period from each unit.
103.	VI / A	III-A1	2 OF 8	2.04.00	Clean gas from the absorber ……in the specification. Provision shall be made for facilitating operation of unit with FGD bypass **like bypass damper etc.,** This shall also facilitate the online maintenance of absorber system and associated equipments. Provision shall be made for isolation of the flue gas flow through the absorber and also for bypass of the absorber, to allow maintenance of the absorber with the unit in operation.	Clean gas from the absorber ……in the specification. 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.** This shall also facilitate the online maintenance of absorber system and associated equipments. Provision shall be made for isolation of the flue gas flow through the absorber and also for bypass of the absorber, to allow maintenance of the absorber with the unit in operation.
104 (a)	VI/B	I-M1	13 of 49	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).**
104 (b)	**Sl. No.-59** AMENDMENT NO. CS-4410-109-2-AMDT-08		23 of 83	5.01.00 A (iii)	The slurry recirculation pumps shall have a minimum margin of 10% of flow and **frictional** head …… conditions. All slurry recirculation pumps including motors shall be of the same size and type.	The slurry recirculation pumps shall have a minimum margin of 10% of flow and **frictional** head…… conditions. All slurry recirculation pumps including motors shall be of the same size and type **except for VFD driven slurry recirculation pump-motor set.**

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105.	VI/B	I-M1	29 of 49	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** **- Slurry tanks : Replaceable chlorobutyl /bromobutyl Rubber lining of minimum 4 mm thickness** The outside surface **of the tanks** shall be coated with paint as approved by the Employer…….
106.	VI/B	I-M1	31 of 49	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.
107.	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.**
108.	VI/B	-I-M7	15 of 24	MDL 387 388	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
109.	VI	I-M1	18 of 49	5.06.18	In case the absorber is equipped with several spray levels they shall be designed as follows: (i) The last spray level upstream the mist eliminator shall be operated	In case the absorber is equipped with several spray levels they shall be designed as follows:

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					only in counter flow. (ii) …….. (iii) …….. (iv) ……..	(i) **For spray type Absorber,** the last spray level upstream the mist eliminator shall be operated only in counter flow. (ii) ……. (iii) ……. (iv) …….
110.	VI	I-M1	8 of 49	4.01.01 3(iii)	Pressure at Booster Fan suction | 0 mmWc	Pressure at terminal point before Booster Fan suction | 0 mmWc
111.	VI/B	I-M1	26 of 49	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. **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.**
112.	VI/A	IV	2 of 3	1.07.00	**Waste Water** 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	**Waste Water** FGD waste water pipes, **including LHP/GHP 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

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					(approx.) and temperature shall **be <50°C**. Bidder shall indicate the anticipated range of chloride content in the waste water at terminal point.	terminal point shall be 3.0 kg/cm2(g) , pH shall be 7.0 (approx.) and temperature shall be **50-60°C**. Bidder shall indicate the anticipated range of chloride content in the waste water at terminal point.
113.	VI/A	VII	14 of 38		Note	Add below Note:- 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.** 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** 8. **Any special tool required for maintenance of any of the equipment being supplied is to be included in mandatory T&P along with the equipment.**
114.	**Sl. No.-93** AMENDMENT NO. CS-4410-109-2-AMDT-08		38 of 83		AUXILIARY POWER CONSUMPTION(PA)	**Revised AUXILIARY POWER CONSUMPTION (PA) is enclosed at Mechanical Annexure- III**

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115.					--	In case distance from Limestome Grinding system/ Gypsum Dewatering and Absorber is more than 500M, Bidder shall provide the following :- 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.
116.	VI/B	I:M7	1 to 24 of 24	MDL List	MDL List no. 213.Motor for Booster Fan - Sub QR documents of M/s Crompton Greaves Ltd., Bhopal 214. Motor for Booster Fan - Sub QR documents of M/s Weg, Hosur 215. Motor for Booster Fan - Sub QR documents of M/s Crompton Greaves Ltd., Mandideep 433. Oxidation Blower - Sub QR documents of M/s ITO, Japan 434.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Thysencrupp, Germany 435.Recirculation Slurry Pump - Sub QR documents of M/s DUCHTING PUMPEN, GERMANY 436.Booster Fan - Sub QR documents of M/s Solyvent Flakt AB, Sweden 437.Slurry Pump - Sub QR documents of M/s Duchting Pumpen, Germany	MDL List no. 213.Motor for Booster Fan - Sub QR documents 214. Motor for Booster Fan - Sub QR documents 215. Motor for Booster Fan - Sub QR documents 433. Oxidation Blower - Sub QR documents 434.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents 435.Recirculation Slurry Pump - Sub QR documents 436.Booster Fan - Sub QR documents 437.Slurry Pump - Sub QR documents 438.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents 439.Agitators - Sub QR documents 440.Vaccume Belt Filters - Sub QR documents 441.Vaccume Belt Filters - Sub QR documents 442.Agitators - Sub QR documents 443.Not used 444.Slurry Pump - Sub QR documents 445.Slurry Pump - Sub QR documents 446.Booster Fan - Sub QR documents 447.Wet Limestone Grinding Mills

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					438.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Metso, USA 439.Agitators - Sub QR documents of M/s EKATO RMT GMBH. Germany 440.Vaccume Belt Filters - Sub QR documents of M/s Shanghai Xuhe Environmental Technology Co. Ltd., Shanghai, China 441.Vaccume Belt Filters - Sub QR documents of M/s FLSmidth, USA 442.Agitators - Sub QR documents of M/s Zhejiang Greatwall Reducer Mfg Co. Ltd. 443.Gas to Gas Heat Exchanger (GGH) - Sub QR documents 444.Slurry Pump - Sub QR documents of M/s Weir Minerals, USA 445.Slurry Pump - Sub QR documents of M/s Sam Turbo Industries Pvt. Ltd., Koimbatoor 446.Booster Fan - Sub QR documents of M/s Suewon Poongryuk Machinery Co. Ltd, Korea 447.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Cemtec, Austria 448.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Christian Pfeiffer Maschinenfabrik Austria 449. Oxidation Air Blower - Sub QR documents of m/s Siemens Turbo Machinery / HV Turbo 602. MQP for PDB of M/s pyrotech Electronics Udaipur	(Ball Mills) - Sub QR documents of M/s Cemtec, Austria 448.Wet Limestone Grinding Mills (Ball Mills) - Sub QR documents of M/s Christian Pfeiffer Maschinenfabrik¿ Austria 449. Oxidation Air Blower - Sub QR documents of m/s Siemens Turbo Machinery / HV Turbo 602. MQP for PDB of M/s pyrotech Electronics Udaipur 628. MQP for foundation bolts M/s Quality Engineering Works, Kolkata 629. MQP for foundation bolts M/s Indiana Conveyors, Jejuri 671. MQP for Ball Valve (M/s Leader) -All drgs pertaining to GGH stands deleted

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					628. MQP for foundation bolts M/s Quality Engineering Works, Kolkata 629. MQP for foundation bolts M/s Indiana Conveyors, Jejuri 671. MQP for Ball Valve (M/s Leader) -All drgs pertaining to GGH	
117.	VI/A	V	6 of 10	Notes for clause no. 6.000	Notes:-	Following note is added. Note:- **3. Available reactive value indicated at note 1 above is considering MgCO3 as unreactive dolomitic form.**
118.	VI/B	I-M1	8 of 49	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 De-Nox system.	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.
119.	VI/B	I-M1	18.01.00	40 of 49	Thermal Insulation along with aluminum cladding shall be provided for all the equipments/surfaces having skin temperature more than 60 degree Celsius. The specification …….. …….. …….. ……..	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.** The specification ……..

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
						…… …… …… …… ……
120.	VI/A	I	10 OF 18	4.01.04	A JV / Subsidiary Company formed for …… for the respective equipment(s). **However, in this case, the proposed JV / Subsidiary Company before resorting to design, engineering, manufacturing of such proven equipment(s) listed at clause no. 4.01.02 above by himself should have sourced / shall source such proven equipment(s) for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units** 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 …… the end of defect liability period of the contract, whichever is later. In addition, the Bidder along with the Indian Joint Venture Company/	A JV / Subsidiary Company formed for …… 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 …… the end of defect liability period of the contract, whichever is later. In addition, the Bidder along with the Indian Joint Venture Company/ Subsidiary Company, qualified equipment manufacturers and its holding/ subsidiary Company, as applicable, 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 subvendor for a particular equipment. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
					Subsidiary Company, qualified equipment manufacturers and its holding/ subsidiary Company, as applicable, 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 subvendor for a particular equipment. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 1.5 Million (Indian Rupees One and Half Million only) for each equipment.	**INR 10 Million (Indian Rupees ten Million only)** for each equipment.
121.	VI/A	I	11 OF 18	4.01.05	In case the Bidder or the proposed sub-vendor …….. at clause 4.01.02(c) above for the Oxidation Blowers. **However, in this case, Bidder or the proposed sub-vendor before resorting to design, engineering, manufacturing of such proven equipment by himself should have sourced / shall source such proven equipment for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units** 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	In case the Bidder or the proposed sub-vendor …….. at clause 4.01.02(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.

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
					/licenser's design, manufacturing and quality control system for such equipments. **In addition, the Bidder along with the qualified …… INR 1.5 Million (Indian Rupees One and Half Million only).**	
122.	**Sl. No.-89** AMENDMENT NO. CS-4410-109-2-AMDT-08		35 of 83	4.01.06	(i) In case the Bidder or the …… clause 4.01.02(d) above for the Wet limestone Grinding mills. **However, in this case, Bidder or the proposed subvendor before resorting to design, engineering, manufacturing of such proven equipment by himself should have sourced / shall source such proven equipment for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units** 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 case the Bidder or the …… clause 4.01.02(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 …… **INR 10 Million (Indian Rupees ten Million only).** OR (ii)In case, the bidder or proposed sub vendor …… an additional on demand bank guarantee for **INR 10 Million (Indian Rupees ten Million only).**

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
					In addition, the Bidder along with the qualified …….. INR 1.5 Million (Indian Rupees One and Half Million only). OR (ii)In case, the bidder or proposed sub vendor ……. an additional on demand bank guarantee for INR 1.5 Million (Indian Rupees One and Half Million only).	
123.	VI/A	I	12 OF 18	4.01.07	In case the Bidder or the …….. clause 4.01.02(f) above for the Agitators. **However, in this case, Bidder or the proposed sub-vendor before resorting to design, engineering, manufacturing of such proven equipment by himself should have sourced / shall source such proven equipment for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units** 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 case the Bidder or the …….. clause 4.01.02(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.

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
					In addition, the Bidder ……. 1.5 Million (Indian Rupees One and Half Million only).	
124.	**Sl. No.-86** AMENDMENT NO. CS-4410-109-2-AMDT-08		33 of 83		In case the Bidder or the proposed sub-vendor is a manufacturer **of Slurry Pumps** who meets the requirements stipulated at clause 4.01.02(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 4.01.02(b) above for the Slurry Recirculation Pumps. **However, in this case, Bidder or the proposed sub-vendor before resorting to design, engineering, manufacturing of such proven equipment by himself should have sourced / shall source such proven equipment for at least the first 660 MW unit completely from such qualified manufacturer. For subsequent units** 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	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 **4.01.02 (b) & 4.01.02 (e)** above for the Slurry Recirculation Pumps **and slurry pump respectively**. 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.

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
					/licenser's design, manufacturing and quality control system for such equipment. **In addition, the Bidder …….. INR 1.5 Million (Indian Rupees One and Half Million only).**	
125.	SECTION-VI, PART-B	I-M1	31 OF 49	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.**
126.	VI/B	III-A1	8 of 8	18.00.05	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.	**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.** **A common storage tank for all the units of storage capacity of minimum 5 m3/hr of stack**

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
					All the material in contact with the condensate shall be of suitable material for the operating duty.	**condensate of all 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 contact with the condensate shall be of suitable material for the operating duty.
127.	**Sl. No.-39** AMENDMENT NO. CS-4410-109-2-AMDT-08		16 of 83		**Wet stack** a) Wet stack sizing criteria A wet stack shall …….. 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 wet stack flue liner considering Steam Generator in operation both **with & without FGD system in operation**. The wet stack fuel liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8mm 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 wet stack flue liner	**Wet stack** a) Wet stack sizing criteria A wet stack shall …….. 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 wet stack flue liner considering Steam Generator in operation **with FGD system in operation**. The wet stack fuel liner cladding shall be made of 2 mm thick Titanium (Grade 2 as per ASME SB265) or C-276 alloy over 8mm 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 (as per ASME SA265) / Titanium (Grade 2 as per ASME SB265) of**

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

<table>
<tr><th rowspan="2">SL. NO.</th><th colspan="3">SPECIFICATION REFERENCE</th><th rowspan="2">EXISTING</th><th rowspan="2">READ AS</th></tr>
<tr><th>SEC/ PART</th><th>SUB SEC.</th><th>PAGE NO.</th><th>CLAUSE NO.</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

EXISTING

SN	Item	Design Condition
1.	Boiler load in MW (e)	VWO
2.	Gas flow at FGD inlet (m3/sec)	Design point (as given in cl. No. 3.00.00)
3.	Gas temperature at chimney inlet (deg. C)	To be worked out by bidder considering design point condition.
4	Flue gas velocity (m/sec) (Maximum)	18

projecting over the wet stack roof shall be wrapped with 2mm thick Titanium/ C-276 sheet over insulation. The wet stack ……. ……. …….. ……. Titanium / C-276 sheet.

(b)……
(c) ……

READ AS

minimum 10 mm thickness. The minimum length of flue liner projecting over the chimney roof shall be at least equal to diameter of flue liner. External surface of wet stack flue liner projecting over the wet stack roof shall be wrapped with 2mm thick Titanium/ C-276 sheet over insulation. The wet stack …….
……. ……. Titanium / C-276 sheet.

SN	Item	Design Condition
1.	Boiler load in MW (e)	**TMCR**
2.	Gas flow at Chimney inlet (m3/sec)	To be worked out by bidder considering value indicated under guarantee point condition(as given in cl. No. 3.00.00)
3.	Gas temperature at chimney inlet (deg. C)	
4	**Flue gas velocity inside Chimney inlet (m/sec)**	**< 16.8 for Titanium / C-276 Lining** **< 18.3 for Borosilicate Lining**

(b)……
(c) ……

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
128.	**VI/C**	**GTR**	38 of 82	26.01.00	Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least **eighteen months prior to the schedule date of synchronization of 1st unit.** The chart should ……	Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least **twelve months prior to the schedule date of start of commissioning of the 1st FGD system**. The chart should ……
129.	**VI/D**	**ECC**	14 of 53	34.01.03	The following activities shall be carried out by the contractor, **18 month** prior to schedule date of commissioning ……	The following activities shall be carried out by the contractor, **12 month** prior to schedule date of commissioning ……
130.	**VI/D**	**ECC**	16 of 53	34.02.05	The Contractor shall submit the commissioning documentation, for various equipment/covered under the contract, for the approval of employer, at least **18 months** before the scheduled date of commissioning of the equipment/systems.	The Contractor shall submit the commissioning documentation, for various equipment/covered under the contract, for the approval of employer, at least **12 months** before the scheduled date of commissioning of the equipment/systems.
131.	**VI/D**	**ECC**	10 of 53	25.00.00	The Contractor shall have ……. concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions of the as specified at clause no **21.00.00** of this chapter entitled "Co-operation with other Contractors." The Contractor shall not ……	The Contractor shall have ……. concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions of the as specified at clause no **20.00.00** of this chapter entitled "Co-operation with other Contractors." The Contractor shall not ……

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<table>
<tr><th rowspan="2">SL. NO.</th><th colspan="3">SPECIFICATION REFERENCE</th><th rowspan="2">EXISTING</th><th rowspan="2">READ AS</th></tr>
<tr><th>SEC/ PART</th><th>SUB SEC.</th><th>PAGE NO.</th><th>CLAUSE NO.</th></tr>
<tr><td>132.</td><td></td><td></td><td></td><td>New Clause</td><td>New Clause</td><td>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.</td></tr>
<tr><td>133.</td><td>VI/A</td><td>VII / MANDATORY SPARES</td><td>Page 13 of 38</td><td>
<table>
<tr><td>N)</td><td></td><td></td><td>ELEVATOR</td><td></td><td></td></tr>
<tr><td></td><td>…</td><td></td><td>……</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>…..</td><td>..</td><td>..</td></tr>
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<table>
<tr><td>N)</td><td></td><td></td><td>ELEVATOR</td><td></td><td></td></tr>
<tr><td colspan="6">Refer MANDATORY SPARES FOR GOODS CUM PASSENGER ELEVATOR</td></tr>
</table>
</td></tr>
<tr><td>134.</td><td>VI/A</td><td>VII / MANDATORY SPARES</td><td>New Clause</td><td></td><td>
MANDATORY SPARES FOR GOODS CUM PASSENGER ELEVATOR
(One set of following spares required for each Building)
<table>
<tr><td>1</td><td>Friction block</td><td>2 Nos.</td></tr>
<tr><td>2</td><td>Guide roller of each type</td><td>20% of total population
or 3 Nos. of each type whichever is high</td></tr>
<tr><td>3</td><td>Contactors of each type</td><td>2 Nos.</td></tr>
<tr><td>4</td><td>Control transformer</td><td>1 No. of each type</td></tr>
<tr><td>5</td><td>Time device</td><td>2 Nos. of each type</td></tr>
<tr><td>6</td><td>Rectifiers</td><td>2 Nos. of each type</td></tr>
<tr><td>7</td><td>Over current relay</td><td>2 Nos. of each type</td></tr>
<tr><td>8</td><td>Auxiliary relays</td><td>3 Nos. of each type</td></tr>
</table>
</td></tr>
</table>

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SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
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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	
	a) 'O' rings	3 Sets
	b) Sealing ring of each type	3 Sets
21	Spares for brake	
	a) Fan	2 Nos. of each type
	b) Magnetic coil	3 Nos. of each type
	c) Brake disc	2 Sets
	d) Brake pad	2 Sets
22	Bushing (for door front)	2 Sets
23	Pinion	2 Nos. of each type
24	Elevator Motor with VVVF drive	01 no of each type

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
135.	VI/A	III-A1		18.00.07 New clause	New clause added	**Single-flue or twin flue chimney(s) shall be provided. There shall be one flue (liner) for each unit. The flue gas emission point shall be minimum 150 meters above the plant grade level in case of single flue chimney & 220 meters above the plant grade level in case of twin flue chimney.**
136.	VI/A	III-A1		19.00.00 New clause	New clause added	**Process water & cooling water storage & pumping scheme (for 3 x 660 MW) shall be provided as per tender drawing and as detailed in relevant clauses of Section VI, Part- B, Sub-section I-M1 with its amendments, if any and as specified in specification elsewhere.**
137.	VI/B	I-M1		13.01.00	Two (2) Process water Storage tanks …….. …… the makeup water from terminal point. From the terminal point for process water as detailed in sub-section IV, section VI-**Part B**, the Contractor shall provide 2x 100% Booster Pumps of required capacity & head to feed process water to the two (2) no. of	Two (2) Process water Storage tanks …….…… the makeup water from terminal point. From the terminal point for process water as detailed in sub-section IV, section VI-**Part A,** the Contractor shall provide 2x 100% Booster Pumps of required capacity & head to feed process water to the two (2) no. of process water storage tank designed

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
					process water storage tank designed to store 15 minutes of total maximum water……..control valves etc.	to store 15 minutes of total maximum water……..control valves etc.
138.	VI/A	IV	2 OF 3	1.07.01 NEW CLAUSE	New clause added	**Instrument Air** Contractor shall take a tap off suitably from the existing instrument Air header available along C-row at CD bay rack for meeting the instrument air requirement. The pressure available at TP will be around 6 kg/cm2(g).
139.	VI/A	IV	2 OF 3	1.07.01 NEW CLAUSE	New clause added	**Service Air** Contractor shall take a tap off suitably from the existing service Air header available along C-row at CD bay rack for meeting the service air requirement. The pressure available at TP will be around 6 kg/cm2(g).

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
140 (a)	VI/B	I-M2/A10	1.3.2	71 Of 112	Humidity to be maintained at 60(+/-)5%	Humidity to be maintained at 50(+/-)5%
140 (b)	VI/B	I-M2/A-09	1.03.05	61 Of 112	The hammer crusher will be driven through Electric motor, scoop type hydraulic coupling and gear box.	The hammer crusher will be *driven through V-Belts.*
140 (c)	VI/B	I-M2/A10	**Data sheet of limestone crusher**, cl. No 2.6.0	63 Of 112	Drive arrangement: Electric motor, scoop type hydraulic coupling, and gearbox.	Drive arrangement: *V-Belts.*
141.	Sl. No.-82 AMENDMENT NO. CS-4410-109-2-AMDT-08		32 of 83		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.
142.	Amendment No.01 to Technical specification, Sl. No.186, Document No. CS-4410-109-2-AMDT-08				For industrial structures, analysis for verification of mechanism shall be carried out as per IS:1893 (Part 4):2015 for Earthquake loads.	"Deleted"

AMENDMENT NO. 02 TO TECHNICAL SPECIFICATION (SECTION VI)

SL. NO.	SPECIFICATION REFERENCE				EXISTING	READ AS
	SEC/ PART	SUB SEC.	PAGE NO.	CLAUSE NO.		
143.	Amendment No.01 to Technical specification, Sl. No.181, Document No. CS-4410-109-2-AMDT-08				**Annexure-VIII** SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT Notes: 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. The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages	**Annexure-VIII** SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT Notes: 1. g = Acceleration due to gravity **2. Deleted** The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages

3X660 MW NORTH KARANPURA STPP
FGD SYSTEM PACKAGE

VOLUME II-B

CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

SECTION – D

GENERAL TECHNICAL SPECIFICATION
(SINGLE FLUE RCC CHIMNEY)

PE-TS-441-620-C002

Maharatna Company

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

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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ii) ELECTRICAL
iii) Chimney Elevator

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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 unde rground structures water proof ing, 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

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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

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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 r evision and/or replacem ents 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 d esign of structures subje ct 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 form er shall prevail. In case any particular as pect o f 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 c ontractor shall carry out t he w ork 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 fr om vegetations, roots, salts, rubbish, lumps, organic matter and any other harmful chemicals etc and shall be got approved by the engineer. Normally excavated earth sh all be used for back filling. In case such earth contains deleterious salts, the same shall not be used. A ll cl ods of earth shall be br oken or re moved. Where t he exca vated material is mostly rock and if filling with the same is permitted by the engineer engineer in writing, then the filling with ro ck shall be done in t he 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 b) By establishing markers, boards etc
2	Back filling	(a) On quality of fill material (b) On moisture content of back fill (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 there from 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 s hall be so pla nned that the rock pieces after blasting will be suitable for handling. The hole diam eter sh all be of such a size that the cartridges can easily pass dow n through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal su pervision of the sho t firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and w ooden 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 wo rk site. Should a ny surplus re main when all the holes have been cha rged sha ll be carefully rem oved to a point at least 300m away from the firing point.

The authorized shot firer him self shall m ake all the connection s. The shot firing cable shall not be dragged along the gro und 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 unt il he i s ready to fire shots. Th e number of shots fired at a time shall not excee d the p ermissible limits. Before any b lasting is ca rried out it shall be ensured that all w orkmen, v ehicles and equipm ent on the site are cleared from a n area of minimum 300m radi us from the firi ng point or as required by t he st atutory regula tions at le ast 10 m inutes before the t ime 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 elec tric detonator plac ed inside the cartridge. For sim ultaneous fi ring of a num ber of charges, the e lectric 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, ra ils, pipes or any other pat h 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 cordte x may be done. An e lectric detonator attached to its s ide w ith a dhesive 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 m inutes after the blast has been fire d in ca se of ele ctric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect carefully the wor k a nd satis fy him self tha t all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parall el fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorize d shot firer sha ll be prese nt d uring the rem oval 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 com pletely dewatered. The wo rk will be accepted after all undercuts ha ve been set ri ght and all over excavations are filled back to the required li nes, levels and grades by placing ordinary cement concrete of 1:4:8 proportion a nd/or ric her a nd/or by compacted earth as directed by the engineer. The choice of the grade of concrete will be a m atter of unfettered discretion of the engineer. Over excavati on of the sides shall be made good by the contract or while carry ing out the b ackfilling. The excavation work will be accepted after the above requirements are fulfilled and all the tem porary approaches encroaching insi de the excavation have been removed.

4.2.0 Backfilling

The degree of compaction required will be as per the stipulat ion laid down in IS:4701 and the actua l 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 se ction i n the te chnical spe cification incl uding am endments and additions if any. For ea ch ite m in t he 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 operat ions in det ail as described i n the technical specification.

b) No claim s shall be ente rtained if the d etails show n on the released for construction drawings differ in any w ay from those show n on the tender drawings.

c) The unit ra te quoted shall include m inor det ails which are obviously and fairly intended and which may not have been included in these docum ents but are essential for the satisfactory completion of the work.

d) The bidder's quoted rate shall be inclusive of supplying and providing al l labour, m en, m aterials, equi pments, tools and plant s, 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, cond uit 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 c m or t he w idth of concre te bed/ cushioning layer whichever is more.

ii) For depths exceeding one metre, an allowance of 5 cm per m etre 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 b e kept vertic al u pto depth of 2 m etres from the bottom. For depths greater than 2 metres, the excavation profiles shall be w idened by allowing steps of 50 cm on either side after every two metres from bottom. Where the soil is soft, l oose or sl ushy, width of trench shall be suitably increased or side sloped or the soil shored up as direct ed by the Engineer-in-Charge. However, any additional excavation beyond the limit specified for firm soil herein shall not be m easured 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 et c, are laid, the diam eter shall be re ckoned as the horiz ontal dista nce from outside t o 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 t wo ty pes of rock shall be sta cked separate ly and measured in stacks. The net quantity of each ty pe of rock s hall b e 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 exce eds t he total quantity of excava tion, then the quantity o f each ty pe of rock shall be w orked out from the tota l quantity (from excavation) in the ratio of net quantities in stack measurements of the two types o f rock. If stac king is not fe asible, the m ethod as suggest ed by the engineer shall be followed.

g) Where soil, soft rock and hard rock a re m ixed, the m easurement shall be done as fo llows. The soft and hard rock sha ll be re moved from the excava ted material and stacked separately and measured in s tacks. The net quantity of each ty pe of rock s hall be so arrived by apply ing a deduction o f 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 quant ity (cal culated on t he basis of authorized width/ working spac e un der 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.

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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 operati ons required for executing the work, e.g. material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.

g) Design and subm it for approval conc rete mix designs req uired to be adopted on the job.

Furnish samples and subm it for approval results of tests of various p roperties of the following:

i) The various ingredients of concrete

ii) Concrete

iii) Embedments

iv) Joint seals

i) Provide all incidental item s 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 m ay have to produce, if dire cted by the Engineer, a guarantee in appro ved Perform a fo r satisfactory perform ance 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 arrangem ent of processi ng 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.

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 un questionable 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. No twithstanding 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 form work 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 sha ll be spread, if necessary & thoroughly compacted b y approved mechanical vibration to m aximum, sub sidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators m ust be operated by experienced workmen and the work carri ed out as per relevant IS Code of Practice: In thin m embers w ith hea vy congestion of reinforcem ent or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doub tful, in addition to immersion vibrators the contractor may have to em ploy form vibrators conform ing to IS: 4656. For slabs an d other similar st ructures, th e contractor will additionally em ploy screed vibrator as per IS: 2506. Hand tam ping m ay be allowed in rare cases, subject to the approval of the Engineer. Care m ust be taken to ensure that the inserts, fixtures, reinforcem ent, and formwork are not displaced or distorted during placing & consolidation of concrete.

The rate of plac ement of concre te shall be suc h that no cold joint is formed and fr esh concrete is placed always against green Concrete, which is still plastic and workable. No concrete sh all be placed in open, during rains. During rainy season, no placem ent in the open is to be attem pted unless sufficient tarp aulins or other sim ilar protective arrangem ent for com pletely covering the still green concrete from rain is kept at the site of placement. If there has been any sig n of washing of cement and sand, th e en tire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard ag ainst rains before l eaving the fresh concrete unattended. No accumulation of water shall be pe rmitted on or around freshly laid concrete.

Slabs, beam s, and sim ilar m embers shal l be poured in one operation, unless otherwise instructed by the Engineer. M ouldings, throating, drip course, etc., shall be poured as sho wn on the drawing s or as dir ected by the En gineer. Holes shall be provided and bolts, sleeves, anchors, fastenings, or other fixtures shall be em bedded in concrete as sh own on the drawings or as directed by th e 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 g et disp laced during or immediately after the placement and bring the concrete su rface out of alignm ent beyond tolerance limits, the Engineer m ay direct to remove the portion and reconstruct or repair the same -at the Contractor's expense.

The Eng ineer shall decide upon the time interval between two placem ents of concrete of different ages com ing in contact with each other, taking in consideration th e degree of m aturity 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 join t thoroughly and systematically vibrated.

b) In case concrete has hardened a bit m ore than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed co mpletely without disturbing the rest of the concrete in depth. A rich m ortar 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 th oroughly and systematically vibrated p enetrating 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 m ortar or slurry doe s not rai se inspite of ext ensive vibration, the j oint, will be l eft 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 unform ed, can be obtained by employing a concrete mix of proper design, co mpetent formwork, appropriate m ethods o f ha ndling, placing, and cons olidation 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, rem oved and replaced by sound concrete at the Contractor's cost. The Engineer m ay, at his sole discretion, allow to retain concrete with minor defects provided th e 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 w here there is likelihood of spillage of oil or water ca n 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 bo nd 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 p laced concrete shall be protected by approved m eans from rain, sun, and wind. Concrete placed below the ground level shall be protected against contamination from falling earth du ring and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with such ground, o r with water drainin g from such ground, during placing of concrete and for a period of at least th ree days, or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pum ping out or othe r adequate m eans of drainage to prevent floatation or flooding. Steps, as approved by the En gineer, shall be taken to protect im mature concrete from dam age by debris, excessive 'Loadings, vibration, abrasion, m ixing 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 a llowed if the Engineer is satisfied with the a dequacy of the arrangements made by the Con tractor. Qual ity o f water for curing sh all be as per IS: 456.

If p ermitted by the Engineer, liqu id curing com pound may be used for prevention of premature water loss in c oncrete and thereby effecting curing of concrete. This type of curing co mpound shall be sprayed on newly laid concrete surf aces to f orm a thin film barrier against premature water loss without disturbances to nor mal setting action. The curing com pound shall be emulsified paraffin based and shall comply with A STM re quirements f or

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 RC C 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 anchorages 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 pre pare, bef ore commencement of actual w ork, designs and working drawings for form work and cen tring and get them approved by the Engineer. The form work shall conform to th e shap e, grade, lines, levels and dim ensions as sh own on the drawings.

Materials used for the formwork inclus ive of the supports and centring shall be capab le of withstanding the working load and rem ain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or t ubular steel except when specifically permitted otherwise by the Engineer.

The centring shall be true to vert ical, r igid and th oroughly braced both horizontally and diagonally. Rakers are to be used where forms are to support inclined members. The form s shall be sufficien tly 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 co nvince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be stron g enough to withstand the effects of vibration without appreciable d eflection, bulgi ng, distortio n or loosen ing of its com ponents. 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 im pair the strength of concrete or cau se stains or m arks on the finished surf ace. Where there are chance s of these f ixtures being em bedded, only m ild steel and concrete of adequate strength shall be used. Bolts passing completely through liquid retaining w alls/slabs f or th e 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 bubb les, bulges, fins a nd o ther blem ishes. Any blem ish 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 form work. 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 concreti ng shall start a s early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under consta nt vigilance agains t any interference. In case of delay beyond three days, a fr esh 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 m entioned 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 com pletion of work without any ex tra co st. Before rem oving any formwork, the Contractor m ust no tify the E ngineer w ell 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 m anner, the date on w hich concrete is pla ced in each part of the work and the date on which the form work is removed there fr om 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 showi ng signs of dam age through prem ature rem oval of form work or loading shall be rejected and entirely reconstructed by him without any extra cost to th e Owner, The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

If any oth er typ e of cement other than ord inary Portland cement and Rapid hardening cement is used, the time of removal of forms shall be rev ised such that the strength of this ce ment at the time of re moval of forms match w ith strength of Portland cement at the time of removal of form.

3.20.06 Tolerance

The form work shall be so made as to produce a finished concrete, true to shape, lines, levels, plum b and dim ensions as shown on the drawings subject to t he following tol erances unles s otherw ise specified in t his spec ification 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 sp ecified for local aberrations in .th e 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 tem plates, 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, dim ension, and quality as pe r drawings and specifications. Prior approval of the method of form ing the joints shou ld 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 m ust be dur able and waterproof. It shall be compressible and possess a high de gree of rebound. The dim ensions of the board should be equal to that of the joint being formed. It sho uld, preferably be m anufactured in o ne piece, m atching the dimension of the joint and not prepared by c utting to size smaller pieces from larger boards at site. At the exposed end, the join t shall be sealed with approved sealing co mpound to a depth of at least 25 m m after application of an approved prim er. The sealing compound and the prim er 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 join ts. The thickn ess may vary from 12 m m to 50 m m. The material will have to be procured from reliable manufacturers as approved by the Engineer. The m ethod of inst allations wi ll be si milar to that recommended by the m anufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board again st which concrete will be placed.

3.23.03 Joint sealing strips

Joint sealing strips may be provided at the co nstruction, 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 b e either metallic like G.I., Aluminums, or Copper, or non-metallic like rubber or P.V.C.

Sealing strips will not ha ve any longitudin al joint a nd will b e procured and installed in largest pract icable lengths having a m inimum number of transverse joints. The material is to be procured from reputed m anufacturers having proven records of satisfactory s upply of joint strips of similar m ake and shape fo r other jobs. The jointing procedure sh all be as per the manufacturer's recom mendations, revised if necessary, by the E ngineer. 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 a ny other shape and of thickn ess as indicated in the drawing. The transver se 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 le ngths 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 other wise. 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 3 00 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 a nd shall conform to the relevant Indian Standards. It should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A m inimum lap of 50 mm in length is required at the joints.

b) Non-metallic Sealing Strips

These will be norm ally 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 m m. 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 m m. 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 o r directed, the gap in expansion joints shall be thoroughly clean ed and bitumen compound laid as per m anufacturer's specifications. The com pound to be used shall be of approved m anufacture 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 com pound 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 fou ndations as shown on the drawings. The rubber shall have a unit weigh t of 15 00 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 ge neral, the m ix shall be 1 (one) part cement and 1 (one) part sand and ju st enough water to m ake 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 m ay have to be used in the m ix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be pl aced under expert supervision, so that there is no locked up air. Edges shall be finished properly. If specified on drawings, adm ixtures like Aluminium powde r, "Ironite" etc. m ay have to be added with the grout in required pr oportions. Prem ixed non-shrink grout of approved m anufacture having proper strengt h 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 form work against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of form work. The form work 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 waterpro of 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 surf aces to be rendered watertight. Non-sh rink cement grout with waterproofing com pound as per manufacturers specifica tions shall be injected under pressure to seal all voi ds. Special care shall be taken at joints b y 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 thic k eac h with waterproofing compound as per manufacturer's sp ecification shall b e provided on ou ter 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 th e waterproof course on the outside and inside of the walls and bases of structures.

The m aterials sh all conform to IS: 13 22, and the workm anship to IS: 1609. The bitum en felt should be h essian 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, pr oviding, necessary co rner fillets and cement rendering and cutting chases, etc. shall be done as per drawings and/or instructions. If any protective brickw ork on /against conc rete sub-bases or walls are required, the same shall be provided. A twenty (20) years guarantee for satisfactory perform ances shall be gi ven by the Co ntractor as well as his specialist sub-contractor jointly and severally, for this work. Free rectification of any defects noted in th e wo rk with in this guarantee period w ill be ca rried 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 treatm ent 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/undergrou nd water, if shown o n 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 whe never directed by the Engineer, the C ontractor will check up the actual percentag es of ai r entrained and co rresponding 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 sam pling of concrete, m aking the test specim ens, curing and testing procedure etc. shall be in accord ance with IS: 516 and IS: 1199, the size of specimen being 15 cm cubes. Norm ally, onl y compression te sts shall be performed but under special circum stances the En gineer m ay require other tests to be perfo rmed in accordance with IS: 516. Sampling pro cedure, frequency of sampling and test specim en shall conform to IS: 456. To control the consistency of con crete from every m ixing plant, slump tests shall be carried out by the Contractor every tw o hours or as directed by the Engineer. Slumps corresponding to the test specim ens shall be recorded for reference. The acceptance criteria of concrete shall be in accordance w ith IS: 456. Concrete work fo und unsuitable for accep tance shall have to be dism antled and replacement is to be done as per specification by the Contractor at his own cost. In the course of d ismantling, if any damage is done to the em bedded items or adjacent structures, the sam e 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 im mediately 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 m ay be requ ired by the Engineer, when the strength of test sp ecimen 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 in side 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 23^0C.

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, bend ing, bin ding with annealed wire, welding, tack welding, placing the reinf orcement modification of already em bedded 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 w elding of reinforcement stee l i f perm itted shal l be paid under separate item as provided in the BOQ and no ded uction for labour and binding wire saved for not pr oviding lap length sh all be m ade. Similarly, splicing of reinforcem ent bars using m echanical couplers if permitted shall be paid under separate item as pr ovided in th e 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 m embers are straight a nd hav e straight edges. Howev er, for bending, bin ding, 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 r einforcement used like hard drawn steel wire fabric etc. for reinforced concrete sh all be m easured by weight in tonnes. The weight shall be arrived at by m ultiplying the act ual or theore tical length measured alongwith standard hooks, cranks, bends, authorized laps, etc. whichever is less by th e sectiona l weights. Claim s for payment for this ite m shal l be subm itted w ith supporting docum ents giving the schedule of bars with sk etches. The sectional weight to be adopted shall be IS Section weight. Nothing extra will be payable to the Con tractor on account of, difference in weight, if any, due to different m ethods adopted for issue and measurement.

b) Standard hooks, cranks, bends, authorised laps, supports, hangers and chairs which are covered in approved bar bending schedule sh all be measured in tonnes.

6.03.00 Formwork and Staging

6.03.01 Rates

a) The unit rate s shall be inclusive of all staging, scaffolding, m aking 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 form work 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 form work 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 Ow ner's store to the place of work, erection & installation including setting m aterial in concr ete, etc. complete.

b) The unit rate for MS pipe em bedments and PVC pipe em bedments shall include cutting, w elding, f abrication, erection, em bedding, and transportation to site. Unit rate shall also include the cost of the pipes.

c) Rate for expansion fasteners shall in clude cost of fasteners, installation, and fixing including cost of washers and nuts and site testing if required.

6.04.02 Measurements

a) The m easurement of th e em bedded st eel parts fab ricated 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, m easurements shall be in quintals correct to second place of decimal for the net weight.

d) For m ild steel pipes, measurement shall be in qu intals, correct to second place of decim al, for the net weight of the steel p ipe supplied, fabricated, and installed.

e) The lugs shall be measured in Kg. correct to second place decim al 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 em bedded steel part a nd the track shall be measured in ru nning m etres 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 sur face 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 shim s, bolts, shear keys and such other embedments.

f) Pressure injection grouting with cement based grout if required as per drawing shall be applied at appropr iate spacing to c over the desired surface area and measurement shall be m ade for the surf ace area grouted in sqm as per BOQ item. H owever in wa ter ret aining struct ures, the structural grouting if required to ensure water tightens shall not be payable separately as de emed to be covered in water reta ining 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 m easurement for bitu men board shall be based on actual finished surface area in squar e meters nearest to second d ecimal, for the specified thickness.

b) W ater Stops

The measurement for water stops shal l be in running m etres of actual length of the joint covered, for specified thickness, width, and shapes. No separate measurement shall be m ade fo r lap s/splices for cross-join ts 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, form work, 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 Specific ation 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 Sam pling 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 har d drawn steel wire fab ric for concrete reinforcement.

IS: 1609 - Code of Practice for La ying Damp-proof Treatm ent using Bitumen Felts

IS: 1786 - Indian Standard Specification for High Strength Deform ed 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 str uctures (non-extruding and resilient type.

IS: 2185 - Indian Standard Specification fo r Ho llow 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 Vibrato rs, 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 installa tion 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 fo r 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 Re sistant 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 Com paction Factor Apparatus.

IS: 5525 - Recommendation for detailing of reinforcem ent 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 Han d operated Concrete Mixers.

IS: 5892 - Indian Standard Specification for transit mixer and agitators.

IS: 6452 - Indian Standard Specification fo r High Alum ina 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 W ater S oluble 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 Slum p 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 h igh strength Ordinary Portland Cement.

IS: 8142 - Indian Standard Specification for Determining Setting tim e 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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SECTION - D

SUB-SECTION – D3

CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-999-600-C003

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.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	5
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 MS 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 MS 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 sm oothly 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 plac ed on a level surf ace, ta bles 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 b y 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 shal l inc lude of al l ac tivities m entioned in “Schedule of Item” for completion of the work. No sepa rate payment shall be m ade for fixing, caulking, application of prim er coat , polishing, providing of butt hinges,

holdfasts, sliding/tower bolts, do or st oppers, 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.

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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

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 AND GUARANTEE	13
4.00.00	I.S. CODES AND STANDARDS	14
5.00.00	RATES AND MEASUREMENTS	15

ROOF AND UNDERGROUND WATER PROOFING, INSULATION AND ALLIED WORKS

1.00.00 SCOPE

This section covers furnishing, inst allation, repairing, finishing, curing, testing, protection, m aintenance 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 rem oved 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 m ix 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 25m m the underbed shall usually be composed of cement and sand plaster. For higher thickness the underbed shall be m ade with cem ent concrete. The underbed shall be finished to receive the waterpr oofing treatment direct or insulation as the case may be.

2.01.01 Cement Mortar Underbed

The underbed grading plaster shall be average 25 m m thick maximum. It shall consist of cem ent and coarse sand in the ratio 1:4 nom inal by volum e. The sand and cem ent shall be thoroughly m ixed dry and then water added. Each batch of mix shall be consumed before the initial set starts.

The plaster shall be fully com pacted to the desired grade in continuous operation. The surface shall be even and reasonably smooth.

2.01.02 Cement Concrete Underbed

The underbed cem ent concrete shall be us ed where the subgrade is m ore 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 m m, thick 1:4 cement-sand mortar underbed.

b) Heavy Treatment - Seven Courses

With Hessian base felt

1) Primer coat conform ing 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 m m thick pressed precast concrete tiles with 15 m m 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 conform ing 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 m m thick pressed precast concrete tiles with 15 m m thick 1:4 cement: sand mortar underbed.

or

With Hessian base felt

1) Primer coat conform ing 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 70^0C minimum, 300%

elongation and form ing a perfectly sm ooth perm anently flexible seam less membrane which should have good adhesi on to roof substrates (RCC, tiles, brick, and metals), having a minimum life of 10 years. It should also be resistant to acid (m ild 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 m onths after the date of m anufacture 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 m oisture curing urethane pre-polym ers in solvent. A single coat of this prim er 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 prim er shall be allowed to dry for m inimum of 2hrs. tim e 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-polym ers or equivalent m aterial to form an elastomeric membrane. The overall dry film thickness shall be 1.5m m 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 treatm ent which are vulne rable to accidental dam age 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 subj ected to foot traffic or used as a working area, a cement m ortar (1:4) shall be applied over the top m ost layer of roofing treatment. Over this, a layer of chequered cem ent concrete f looring tiles conforming to IS:13801 shall be provide d in place of stone grit and cem ent 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 a pplication shall be thoroughly cleaned and the epoxy resin based m aterial to be applied as directed by the manufacturer. The m aterial shall not have any adverse effect on the surface on which it is applied and m ust 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 re sistant to growth of fungus and proof against saltpetre action. If desired by the Engineer, a sample shall be prepared in advance and tested for waterpr oofness for 48 hours under 300 m m depth of standing water. The Contractor shall arrange the dem onstration by providing free the materials and labour for the appli cation as free of cost to Owner. This item shall carry a guarantee as specified.

2.04.02 Flashing

Unless otherwise stated flashing sha ll be done in the sam e 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 m m deep a nd caulked with waterproof m astic cement. The minimum overlap with horizontal roofing felt shall be 100 mm.

Where specified or directed by the Engi neer, 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 (exc luding tanks) etc below the ground water table and in contact with soil are cove red under this. Bonding m aterial 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 150m m above ground level. The num ber 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 th is specification and shall conform to the latest revision and/or replacem ents of the following or any other Indian Standard (IS) Codes, unless specified othe rwise. 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 dam - Bitumen primer for use in waterproofing and p 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 specif ication unless any portion is specifically excluded in the "Schedule of Items".

No extra shall be paid for finishi ng 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 m easured in Sqm of actual surface area for the purpose of payment.

No deduction shall be m ade and no extra shall be paid for openings upto 0.4 sqm.

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

C 0 N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
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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 partiti ons, etc. The scope of work shall also include the assem bly and erecti on 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 fram es, shutters, louve r blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating door s, windows, partitions etc. shall be extruded sections conform ing to IS: 733 or IS:1285 or as m anufactured by Indian Alum inium Com pany Lim ited or approved equivalent. Alum inium 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. Im proper alignment or faulty operation due to inadequate st rength 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 a nd 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 m ounted or transom m ounted, suitable for installation with m etal doors. It shall conform to the perform ance Requirem ents and endurance test stated in IS: 3564 - Appe ndix-A. The Contractor shall subm it samples of each type of hardware to the Engineer. The approved sam ples shall be retained by the Engineer for com parison of bulk supply. The sam ples shall be returned to the Contractor toward s end for incorporation in the job. The mastic for caulking shall be of best quality from a m anufacturer approved by, the Engineer. In general, m astic 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 m ade from best quality 18 G m ild steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with sem i tubular edge a nd central stiffening rail, which shall convey the lock and other fixture. Th e fram es shall be m ade 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 th e door in his shop and subm it the manufacturer's catalogue of the slidi ng gear he proposes to use. W here called for the Contractor shall m ake provision for openings to the door for monorail beam s. Doors shall close positively to exclude rainwater from seeping in. W hen called for, sliding doors shall withstand specified wind loads without buckling or jam ming. The door shall slide freely under all ambient conditions.

e) Door Threshold

Door threshold shall be provided. D oors 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 a bove codes shall be applicable for coupling m ullions, transom s, weather bars, and pivot arrangem ents for ventilators, etc. or as called f or. All welds shall be dressed f lush on all exposed and contact surfaces. W here com posite unit openings are required the individual window units shall be joined together with requisite transom s and m ullions. All windows shall be outside glazed, fixed with putty or m etal glazing b eads as specified. W here alum inium glazing beads are specified, they sha ll be extruded alum inium channel 9.5 mm x 9.5 mm x 1.6 mm (Jindal Section No. 2209) unless otherwise shown on drawings. Alum inium beads shall be given one coat of zinc chrom ate 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 1 ½ - 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 alum inum surfaces shall be free from scratches, stains, and discoloration. Anodized surfaces sha ll present a uniform and pleasing look.

3.02.00 For installed Items

a) Installations shall be at correct lo cation, 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 m astic caulking of transoms and mullions, gaskets, weather strips etc. complete.

d) All f rames on external walls shall be m astic 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 m asonry sh all be m ade good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.

h) Aluminium doors, windows, etc. sh all 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 m etal doors, windows, etc. the Contractor shall subm it detailed f abrication drawi ngs to the Engineer for approval. The fabrication shall be started only after approval of drawings.

b) He shall subm it a program me of wo rk to be done for the approval of the Engineer.

c) Before bulk supply, he shall subm it for the approval of the Engineer samples of all bought out item s and sa mples of each type of fabricated items. The sam ples shall by retained by the Engineer for com parison of bulk supply and returned to the Cont ractor towards the end for final incorporation in the job.

5.00.00 IS CODES

All work shall be carried out as per th is specification and shall conform to the latest revision and/or replacem ents of the following or any other Indian Standard (IS) Codes, unless specified othe rwise. 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

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.

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

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

C 0 N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
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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, ventilato rs and fixed louvers, m iscellaneous glazing and partitions, from approved manufacturer like Hindustan Pilkinton or equivalent, having uniform refractiv e 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 m m thick. Sheet glass for doors shall be minimum 5.5 mm thick.

c) Wired glass shall be thick- rolled glass with centrally em bedded 42g wire mesh of Georgian type. This m ay 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 confor m to IS: 400 and be of best quality from approved m anufacturer. It shall be br ought to site in the m anufacturer's original packing.

g) Neoprene gaskets with snap-fit glazi ng beads shall be fixed as per manufacturer's instructions and shall s it snugly against glass to give a leak proof installation.

2.03.00 Glazing, Setting, and Finish

All glazing clips, bolts, nuts, putty, m astic cem ent etc. as required shall be supplied by the Contractor.

All glass shall be thoroughly cleaned be fore 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 m ore clips shall be used as per engineer's instructions. All holes that m ay be necessary for holding the clips glazing heads and all other attachments shall be drilled by, the Contractor.

Glass panes shall be set without spri nging, and shall be bedded in putty and back puttied, except where m ouldings or gasket are specif ied, putty, m astic cement etc. shall be sm oothly finished to the even line and figured glass shall be set with smooth side out.

Where owner will supply glass, the Contr actor 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 dam aged 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 dam aged glass. Edges of large panes of thicker gla ss 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.

VOLUME: II B

SECTION - D

SUB-SECTION – D7

ROLLING STEEL SHUTTERS AND GRILLS

SPECIFICATION NO. PE-TS-999-600-C007

Maharatna Company

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.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
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 m ounted unit. The m otor shall be of sufficient capacity, to move the shutter in either direction at a speed of 0.3 metres per second. In addition to th e gear motor each standard power unit shall include a m agnetic 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 ba r of m otor operated doors shall be provided with a sensitive edge, electrica lly 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 m etres per second. In general, m anually operated shutters shall be push pull type for opening up to 9 Sq. m etre in area. Larger shutters shall, be either chai n and gear operated or crank and gear operated. The crank handle shall be rem ovable. 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 em ergency hand chain/cr ank operation shall also be provided for use in case of failure of the electric system . W here called for, externally mounted shutters shall be operated by control m echanism located inside the building.

2.04.00 Shop Coat

Shutters shall be painted with one coat of red lead or zinc chrom ate prim er. 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 m anufacturer or his authorized representative and all work shall be as per m anufacturer'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 t ouched 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 com pleting the m anufacture of th e different com ponents of the rolling shutter, an arrangem ent for shop inspection by the Engineer shall be m ade to check the conformity with approved shop drawings.

3.02.00 Field Inspection

After installing the shutters, the Contract or shall test the perform ance of the shutter in the presence of the Engineer. The doors shall be sm oothly operable under all am bient 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 m ounting 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 fram e) ar ea of each type used as described in “Schedule of Items”.

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

C 0 N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
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2.00.00	INSTALLATION	3
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 assem bling and fitting of parts by moderate use of drift pins or a moderate amount or reaming and slight chipping and cutting shall im mediately be called to the attention of the Engineer-and approval of the m ethod 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 m asonry sha ll be m ade good to the satisfaction of the Engineer.

2.02.09 Grouting

All bearing plates, loose, lintels and beam s, 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 1:1 ½:3 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 t ype 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 subm it the Manuf acture's literature showing the average pull out and average shear value for anchor of various sizes. Anchors shall be fixed in position st rictly as per the m anufacturer'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 m inimum factor of capacity of 2.5 for the characteristic load of the anchor. Minim um size of anchor sha ll be M8 (8m m). All anchors shall be from the approved manufacturers like HILTI or equivalent.

a) Anchor fasteners shall be supplied a nd fixed in position by the contractor. Anchor fasteners can be of mechanical bonding or chemical bonding.
b) Capacity of the anchor shall be estab lished after considering the effect of concrete grade, em bedment depth, conc rete 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 em bedment depth, load to be transferred, space available for installing anchors.

d) The mechanical bonding anchor are tor que controlled anchors m ade 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, e xpansion sleeves and a cone. Nuts version anchor consists of nuts, th readed rod, washer, sleeves, plastic section, expansion sleeves and a cone. All steel component of anchor shall be electro galvanised to m inimum 5 m icron 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 re sin 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 com ponents of the anchors shall be electro-galvanised to minimum 5-micron thickness.

Light Duty Anchors

This anchor shall com prise of stud, nut , washers, expansion sleeve. The one end of the stud shall have thread and the other end shall have cold form ed conical head. All steel com ponents of th e anchors shall be electro-galvanised to m inimum 5-m icron thickness. The expans ion sleeve shall preferably be of stainless steel of SS316. The anchors sh all conform to m inimum 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 m aterial requirem ent shall confor m to IS: 2721 latest edition. The chain link fencing shall be woven from 3.15mm dia. wire with m esh size of 50m m. The mesh wire shall not vary from specified dia. by m ore than $\pm$0.05m m. all steel wire shall be hot dipped galvanis ed wire. The Dia. shall be m easured over the galvanised coating. The line wire shall be 4.0m m dia. m ild steel. The stirrup wires for securing the line wire to the interm ediate post (RCC/structural steel) shall be 2.5 m m 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 f itted with a nut and washer. Two-way eye bolt strainer shall have suitable ring nuts f itted after the wires have been strained on one side. Stretcher bar shall consist of mild steel flats 25 x 4.75 m m. 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 appropria te adjacent row of m esh, care being taken that no m eshes 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 fe ncing shall be attached to the top and bottom line wire by wire ties spaced at 150m m apart and to the other m iddle line wire by wire ties spaced at 450mm apart.

The bottom of fencing shall be treated as follows:
Continuous concrete sill 125m m wide x 225mm high for full length between posts shall be cast with the top 25 mm above GL and 25m m 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 conform ing to IS:278 latest editions. The barbed wire shall be galvanised and galvanising shall conf orm to the requirement laid down for 'light-coated wire' of IS:4826 and it shall be sm ooth and relatively free of lum ps etc. W ire with excessive roughness blisters, salam moniac spots shall be rejected. The barbed wire sha ll 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 13m m and not m ore 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 a ll. 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 tigh tly by m eans 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 com plete 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 m ild steel of not less than 25 x 4.75 m m 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, si ze, 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 a nd installation for m isc. metals works as required for com pletion 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 m ade of either structural steel or reinforced cem ent 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 m isc. m etals shall be done in MT unless otherwise specified in schedule of items.

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

C 0 N T E N T

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	SCOPE	3
2.00.00	MATERIALS	3
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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 so ling or an equivalent platform so that they do not com e in contact w ith 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 di fferent 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 lam inated m aterials in such f orms or quantities as to af fect adversely the hardening, strength, durability or appearance of m ortar, plaster or concrete or to cause corrosi on to any m etal 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) W ater

Water shall be clean, fresh and free from organic matters, acids or soluble salts and other deleterious substances which m ay cause corrosion, discoloration, efflorescence etc.

g) Reinforcem ent

Reinforcement steel shall be clean and f ree from loose m ill scales, dust, loose rust, oil and grease or other co atings, which may impair proper bond. Structural steel shall conform to IS : 2062. Mild steel and m edium tensile steel bars and hard-drawn steel wire for concrete reinforcem ent 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. A ll 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 cem ent 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 ram ming, 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 firm ly in position by ham mering 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 num ber of layers shall be as per Schedule of item. Orientation shall be as desi red 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 th e brick dim ensions and in perfect alignment. Bricks shall be firm ly placed by ham mering with wooden m allets and sides and joints packed firm ly w ith 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 agains t structural m embers and bonded with dowels, inserts etc. as shown on drawings.

3.03.02 Cement Mortar

Cement m ortar shall be prepared with m aterials specified in clause 2.00.00. Sand for m asonry m ortar shall conform to IS: 2116. Cem ent and sand in the specified proportion shall be m ixed dry thoroughly and m inimum 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 m ay direct addition of additional cem ent without a ny extra paym ent. No m ortar, 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 com plete bond or as clos ers. Bricks shall be laid with frogs upwards over full m ortar beds. Bricks sh all be pressed into m ortar and tapped into final position so as to em bed fully in m ortar. Inside faces shall be buttered with m ortar before the next br icks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept unif ormly 10 mm thick. All joints on f ace shall be raked to m inimum 10 m m depth using raking tool while the m ortar is still green to provide bond for plaster or pointing.

Where plaster or pointing is not provided, the joints shall be struck f lush and finished im mediately. Brickworks two bricks thick or m ore shall have both faces in true plane. Brickwork of le sser 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 especi ally skilled mason. Courses shall be truly horizontal and vertical joints trul y vertical. W ooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniform ity of brick course s. Masons m ust check workm anship frequently with plum b, 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 m aintaining th e bond fully. W here face bricks are not specified, bricks for the exposed face sha ll be specially selected from routine bricks. All exposed brickwork on com pletion of work shall be rubbed down, washed clean, and pointed as speci fied. W here 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 1:1 ½:3 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, dam p proof membrane with one-layer bitum en paper or one layer alkathene sheet shall be laid with m inimum 150 m m lap under slabs on grade.

3.06.00 Plinth Protection

Plinth of buildings shall be protected with brick-on-edge paving of m inimum 750mm width unless otherwise shown on the drawings. The treatm ent shall consist of laying bricks in cem ent mortar 1:6 (1 cem ent: 6 sand) over a 75m m thick bed of dry graded brick aggreg ate, 40m m nom inal size, grouted with sand. The top shall be finished with 1:2 cement mortar pointing (1 cem ent: 2 sand). Plinth protection shall be laid with a minimum outward slope of 1 in 50. The brick aggregate shall be well grade d, broken from well burnt or slightly over burnt and dense brickbats. It shall be hom ogeneous 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 f rom the excavated earth and ram med 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, 75m m thick bed of aggregate of 40mm nominal size, shall be laid with a m inimum 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 ev enly with sand at the rate of 0.6 cubic metre per square m etre area, adequately watered to ensure f illing of voids by sand and again ram med with heavy iron rammers. The finished surface shall give uniform appearance. After the subgrade has been com pacted thoroughly, brick flooring with bricks of specifi ed strength in cem ent m ortar 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 hom e 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 m ortar. The surface sh all 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 m easured separately in Sqm stating the wall thickness and m ore than half brick thickness shall be m easured 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 300m m 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 m easured in Sqm. No deduction shall be m ade and no extra shall be paid for opening upto 0.1 Sqm in area.

Plinth protection shall be m easured under respective item of works executed required for completion of the work as specified.

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

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	8
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5.00.0	RATES AND MEASUREMENTS	9

FINISH TO MASONRY AND CONCRETE

1.00.00 SCOPE

This Section covers finishing, installa tion, repairing, finishing, curing, testing, protection, m aintenance till handing over of finishing item s for m asonry and concrete. This shall also include th e work to be done to m ake the surface suitable for receiving the finishing treatment.

Before com mencing finishing item s, the Contractor shall obtain the approval of the Engineer regarding the schedu ling of work to m inimize dam age by other trades. He shall also undertake normal precaution to prevent dam age 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 m ade for the purpose while the m ortar is still green. W alls shall be rushed down with stiff wire brus h to remove all loose dust from joints and thoroughly, washed with water. All laitance shall be rem oved from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cem ent 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 m oist 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 m ethod 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 sha ll be used unless otherwise Shown on drawing or directed by the engineer. Wherever any special treatm ent 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 pl astered surface with the help of a wooden straight edge, the entire area shall be uniform ly treated with a paste of neat cem ent 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 sam e way as specified in Clause 2.02.02 but using Coloured cem ent in place of ordinary cem ent. W hen coloured plastering is specified in m ore than one coat, the topcoat only shall be made with coloured cement.

Coloured cement shall be either rea dy mixed material or may be obtained by mixing pigments and cement at site, as approved by the Engineer. The pigments to be m ixed with cem ent shall conform to Appendix-A of IS: 2114 latest editions.

Samples of colouring m aterial sha ll be subm itted to the engineer f or approval and m aterial procured, sha ll conf orm in all respects to the approved sam ples, which shall rem ain with the Engineer. All coloured cement and/or pigments shall be stored in an approved m anner in order to prevent deteriorations.

d) Pebble-dash Finish

Mortar of required thickness consisting of 1-part cem ent and 4 parts sand by volum e shall be applied in the usual m anner 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 m ortar with a wood float or the flat end of oil a trowel, in order to ensure satisf actory bond between the dashing and the mortar.

e) Rough-cast Finish

A wet plastic m ix of 3 parts colour ed cem ent 6 parts sand and 4 parts aggregate by volum e (gravel or crushed stone of size from 6 m m to 12 as approved by the Engineer) shall be thrown on to the wall by m eans 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, sha ll be scraped with a steel straight edge to rem ove the surface skin. Th e pattern shall be as approved by the Engineer.

g) Textured Finish

Mortar consisting of 1-part cem ent and 3 parts sand by volum e shall be applied in a m anner 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 m eans 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 approxim ately 14m m and sh all be continuously carried out without break to the full length of wa ll 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 af ter the application of scratch coat. Before application of the second coat, the scratch coat shall be evenly dam ped. This coat shall be applied from top to bottom in one operation & without joints; finish sh all be straight, true, & even. The mortar of this coat shall be as sp ecified 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 m inimum period of seven days, by an approved m ethod, and shall be protected from excessive heat and sunlight by suitable approved m eans. Moistening shall commence, as soon as the plaster has hardened suffici ently and not susceptible to dam age. Each individual coat of plaster shall be kept dam p 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 rake d out to a depth of 10 m m with a hooked tool made for the purpose while the m ortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to rem ove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1-part cement and 3 parts clean, sharp, well gr aded sand by volum e shall be pressed carefully into the joints and f inishes with suitably tools to shape as shown on the drawings. Any surplus m ortar 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 et c. shall be as shown on drawings and/or as approved by the Engineer. Th ese shall have a coat of prim e paint before and another coat of approved paint after erection.

The metal lath shall be expanded m etal, with 12 m m x 38 m m mesh, 16 thick and 3 m m wide strands. Side laps sh all be m inimum 12 m m and end laps 25 mm minimum. The plastering shall be m inimum 20 mm thick measured from the back of lath and applied in two-layers. The m ortar for plastering shall consist of 1-part cem ent and 4 parts sand by volum e m ixed as specified in plastering, Clause 2.02.01. The application, fi nish 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 finish ing coat to give perfectly sm ooth and even finish.

2.05.00 Lime Punning

For plastered surfaces, where an even sm ooth surface is specified, lim e punning with 5 parts of shell lim e properly slaked, strained and aged, m ixed with 1 part clean, washed, sieved, fi ne sand by volum e shall be done. The thickness of lim e punning shall be not less than 2 m m and m ore than 3 m m. The plastered surface shall be saturated with water before application of the

lime punning. The punting shall be applied by skilled workm an and given a smooth and ever finish free from undul ations, cracks etc. and to the satisfaction of the Engineer.

2.06.00 Plaster of Paris Punning

Plastered surfaces, where specified sha ll 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 workm en. The f inish shall be sm ooth, even and f ree f rom undulation, cracks etc.

Before bulk work is taken in hand, a sam ple of punning shall be done on roughly 10 Sq.M. areas and approval of th e 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 sha ll be as specified on drawings. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall subm it 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 m m 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. W here mild steel clam ps, stays etc. are used for anchorage, they shall be ga lvanized (weight of zinc coating shall. not be less than 700 gm s per square m eter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 m m gap between the stone and m asonry, which shall be f illed up and packed by a mortar of 1-part cem ent and 3 parts of sand by volum e. After the m ortar 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 drawi ngs it shall be done by m ortar 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.

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

C 0 N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
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PAINTING, WHITE WASHING, POLISHING, ETC.

1.00.00 SCOPE

This section covers painting, white wa shing, varnishing, polishing etc. of both interior and exterior surfaces of w ood work, m asonry, concrete plastering, plaster of Paris, false ceiling, structur al and other m iscellaneous steel item s, rain water down com er, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items.

Copper, bronze, chrom ium plate, Nickel , stainless steel and alum inium shall generally not be painted or finished except if otherwise specified.

Before com mencing painting, the Contractor shall obtain the approval of the Engineer in writing regarding the sc hedule of work to m inimize dam age; disfiguration or staining to work of other trades or other installations.

2.00.00 INSTALLATION

2.00.01 Materials

Materials shall be highest grad e products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand nam e, manufacturer's name and colour shade, with labels intact and seals unbroken. All m aterials 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 pa int of one shade is obtained from the same manufacturing batch. Each and every supply of prim er, finish paint etc. shall be accom panied by m anufacturer’s te st 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 prim e coats shall be com patible to the m aterial 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 conf orm to the latest IS standards. All such materials shall be m ade by reput able recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and m atching shall be done to the satisfaction of the Engin eer. In such cases, where sam ples 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 a nd loose or peeling paints. The surface shall be rubbed down sm ooth. All nails & screws shall be sunk below the surface and filled with putty after appl ying an under coat. Sm all knots that do not justify cutting and sap streaks shall be covered with m inimum 2 coats of pure shellace coating applied thinly & extended 25 m m beyond the area. All large, loose, or resinous knots shall be rem oved 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 m aterials. Ma sonry cracks shall be cleaned out and patch filled with m ortar similar to the original surface and uniform ly textured. Where this type of resurfacing m ay lead to the finishing paint being different in shade from , the original surfaces, th e resurfaces area shall be treated with minimum one coat of cem ent prim er, 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 m ildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7g of copper carbonate dissolved in 80m l liquor ammonia and diluted to water, or 2.5 percent m agnesium 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, greas e, dried soap f ilms, foreign m atters like cem ent m ortar etc. and free from existing loose red oxide zinc chrom ate primer and should be removed by means of wire brushes, hand scrappers, sand paper, em ery cloth, em ery papers, or by mechanical power tools etc. or as directed by Engineer. For exposed chem ical resistant paints, surfaces shall be blast cleaned to near white m etal. All galvanized iron surfaces shall be pre-treated with a com patible prim er accord ing to the m anufacturer's direction. Any abrasion in shop coat shall be touc hed up with the sam e quality of paint as the original coat. The actual paint ing 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 irregul arities 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 firs t 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 m arks shall show on the finished surface.

2.02.03 Dry Distemper

New plastered surface shall be allowed to dry for at least two m onths. 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 cem ent-plastered surface, the surface shall be washed with solution of 100 gm s. 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. Brushi ng shall not be continued too long, otherwise brush marks may result.

2.02.04 Oil bound washable distemper

The distemper shall be applied after surf ace is prim ed with an alkali resistant primer, and followed by m inimum two coats of oil bound washable distem per all as per manufacturer's instruction.

2.02.05 Waterproof Cement Paint

Surface to be coated with cem ent paint shall be washed and brushed down. As soon as the m oisture has disappeared, th e 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 sim ilar manner. The finished surface shall be kept m oist 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 a pplied. All work shall be as per relevant IS Code.

2.02.10 French polish

All unevenness of the surface shall be rubbed down to sm oothness 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, th e French polish shall be applied with a pad of woollen cloth covered by a fine cl oth. 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 uniform ly a pplied over the entire area to give an even surface. A trace of linseed oil m ay be used on the pad for case of application. The surface shall be allowed to dry before further coats are applied in the sam e m anner. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly dam ped with m ethylated 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 chem ical resistant paints, epoxy, chlorinated rubber, or vinyl butryl paint system shall be used. Manufacturer 's recom mendation shall be followed regarding the paint system , exposed to m oderately to severe corrosive condition and subject to acid/alkali spillage & fumes, shall be followed.

2.03.00 Protection

Furniture and other m ovable objects, e quipment, fittings and accessories shall be m oved, protected and replaced upon co mpletion of work. All stationary equipment shall be well covered so that no paint can f all on them . W ork finished by other agencies shall be we ll 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. rem ove all m arks and m ake good surfaces, where paint has been splashed or splattered, in cluding all equipm ent, 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 rem oved from surrounding surfaces.

Testing

a) As, each part of the work is under pr ogress, i.e. preparation of surface, providing primer, providing different coat s 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 f rom time to time. The Contractor shall provide all necessary arrangem ent for inspection of the painting work duri ng its different working phase. The Contractor shall provide necessary scaffolding, approach for inspection of the above as per direction and sa tisfaction of the Engineer. All the necessary cost for scaffolding, appr oach, platform, lighting arrangem ent testing and inspection shall be borne by the Contractor. Such inspection and testing will not, however, exone rate 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. W here no specific testing procedure is mentioned in the relevant codes, the tests shall be carried out as per the prevalent accepted Engineering practi ce 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 rem oved and replaced by the Contractor. The work shall be redone as per Specification of the contract and dir ection of the Engineer without extra cost to owner.

4.00.00 I.S. CODE

All work shall be carried out as per th is specification and shall conform to the latest revision and/or replacem ents of the following or any other Indian Standard (IS) Codes, unless specified othe rwise. 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.

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

C 0 N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
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FLOOR FINISH AND ALLIED WORKS

1.00.0 SCOPE

This section covers furnishing, in stallation, finishing, curing, testing, protection, maintenance till handing over va rious 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

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.

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, 1 ½ 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 1 ½ 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 be fore 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 surf ace 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 hard ened 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 sm ooth. Then the surface shall be thoroughly washed and cleaned. A grout with al ready prepared mixture of cem ent 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, th e slurry applied again to f ill up any pinholes that might have appeared and a llowed to be cured again for 5 days. Finally, the surface is ground a third tim e with very fine grit blocks (no.: 320) to get sm ooth surface without any pinhol e. A suitable m achine shall do the grinding. W here grinding m achine ca nnot be used hand grinding m ay be allowed when the first rubbing shall be with carborundum stone of coarse grade (no.:60), second rubbing with m edium 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 fr ee, 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 hessi an 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 m onolithically over base concrete or separately over hardened base concrete.

a) Thickness

The finish shall be average 20 m m and m inimum 12 m m thick, unless specified otherwise.

b) Mix

The m ix shall consist of 1-part cem ent, 1-part coarse sand, 2 parts coarse aggregate by volume. The coarse aggregate shall be very hard like granite and well graded between 6 m m and 12 m m. Minimum quantity of water to get workability shall be added.

c) Laying of Monolithic Topping

The concrete base shall be laid as per specification "Cem ent Concrete" and levelled upto the required grade. The form shall rem ain 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 perm itted by the E ngineer, m echanical vibrators of suitable design shall be used to press the topping firm ly and work vigorously and quickly secure full bond with concrete base.

The laitance brought to the surface dur ing com pression shall be rem oved carefully without disturbing the stone chip s. The surface shall then the lightly trowelled to rem ove all, m arks. W hen 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 pa nels of m aximum 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 cem ent applied just prior to laying the granolithic concrete m ix (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 suffici ently, it shall be kept continuously moist for at least 10 days by m eans 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 silicofluoride 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 latte r. The finish shall be of uniform thickness and even dense surface without trowel m arks, pin holes etc. This topping layer shall be pressed firm ly and worked vigoursly and quickly to secure full bond with the conc rete 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 Bitu men 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 lim estone or other hard work.

Coarse aggregate shall be crushed siliceous stone or other approved aggregate 6 m m stone chips shall be used for finish upto 20 m m thick & 10 mm chips for thicker finish.

c) Com position

Bitumen mastic shall conform IS: 1195 a nd shall be either brought to site in blocks weighing about 25 Kg or prep ared at site. If brought in blocks, these shall be remelted in mechanically agitated mastic cookers and coarse aggregate, pref erably preheated f ed 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 m astic 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 m m. 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 dam age during transit and storage. The tiles m ust be caref ully stored to prevent staining by dam p, 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 m anufacturer shall supply al ong with the tiles the grout m ix containing cement and pigment in exact proportions as used in topping of the tiles. The containers f or the gr out m ix shall be suitably m arked to relate it to the particular type and batch of tiles.

c) Mix: Underbed

The underbed for floor and sim ilar horizontal surfaces shall be 1-part lim e putty: 1 part surkhi: 2 parts coarse sand by weight m ixed with sufficient water to form a stiff workable mass. For skirting and dado and all vertical surfaces it shall be about 12 m m thick and composed of 1-part cement and 3 parts coarse sand by weight.

d) Laying

The underbed m ortar shall be evenly spread and brought to proper grade and consolidated to a sm ooth surface. The surface shall be roughened for better bond. Before the underbed had tim e 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 im mediately be placed upon and firm ly 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 m ore 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 dim ensions these shall be sawn and edges rubbed sm ooth. The location of cut tiles shall be planned in advance and approval of the Engineer taken.

At the junction of horizontal surface w ith vertical surface the tiles on the former shall enter at least 12 mm under the latter.

After fixing, the floor shall be ke pt m oist and allowed to m ature undisturbed for 7 days. Heavy traffic shall not be allowed.

If desired dividing strips as specified under Clause 2.01.02(c) m ay be used for dividing the work into suitable panels.

e) Grinding and Polishing

Procedure shall be sam e as Cl ause 2.01.02(e). Grinding shall not commence earlier than 14 days after laying of tiles.

2.02.02 Chequered Tile Finish

The f inish shall consist of m anufactured gray or coloured cem ent 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 m ore than 5 cm. c/c. Depth of grooves shall be not less than 5 m m. The grooves shall be uniform and straight.

The tiles shall conform to clause 2.02.01 (b) except that these m ay have the topping in terrazzo or plain gray cement or colour pigm ent 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 sh all project out 6 m m uniformly from the adjacent plaster or other wall fini shes. The necessary cutting into the surface receiving the finish, to accom modate 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 m m 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 m att, unfading stable finish as desired by the Engineer . The tiles shall be f lat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures, dense and hom ogeneous. The tiles shall be strong and free from flaws like cracks, craze, specks, crawling, etc. and other imperfections. The edge and the undersid e of the tiles shall be com pletely free from glaze and the underside shall ha ve 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 cem ent 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 cem ent 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 m anufactured vitreous, glass, ceram ic or sim ilar hard small pieces set in an underbed over a concrete or m asonry 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 m m thick sm all piece of ceram ic vitreous china, tinted glass, or sim ilar hard wear ing, strong, and durable m aterial in desired shapes and sizes and patterns.

The supply shall com e 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 m ust be water soluble and non-staining. The sections shall be properly m arked 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 cem ent 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, in soluble 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 com posed 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 adhe sive squeezed out through the joints shall be removed immediately.

e) Finishing

If any adhesive m ark 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 m inimum 12 m m and average 20 m m thick. The slabs will be 20 mm thick.

b) Stone Slab

The stone slabs shall be m ade 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 m achine cut to the required dim ensions. Tolerance of ± 5 m m in dim ensions and ± 2 m m in thickness will be allowed. Unless specified the slabs shall be minimum 300 mm x 300 mm.

The stone slabs shall com e from specific regions and in specif ied quality with top surface fine chisel dressed. A ll sides shall also be fine chisel dressed to the full depth to allow finest possible joints.

The slabs shall be delivered to the s ite well protected against dam ages 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 slab s shall be m achine 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 sha ll be laid over the underbed, pressed, and tapped down with wooden m allet to the proper level. The slab shall then be lifted and the underbed corrected as necessary and allowed to

stiffen a little. Next, thick cem ent 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 woode n m allet to bed properly to a very fine joint and to the required level. All surplus cem ent 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 rem ove 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 jo ints 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 followe d except that the workm anship and finish shall not be fine as which are explained hereunder.

The slabs shall be rough chiselled or fi ne chiselled as specified. Tolerance may be allowed upto ± 6 m m for rough finish, but no sharp unevenness and shall be allowed. For f ine chiselling the unevenness shall be lim ited 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 m m. Beyond this depth the edge may be slightly splayed.

The joint thickness shall be kept lim ited to 5 mm in case of rough finish and 3 mm in case of fine finish unless wider join ts are specified. The joints shall be grouted with white or coloured cem ent. If f ine joints in the f looring are specified, the edges of slabs shall be cu t in such a way that it shall f orm 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) Perform ance

i) Precautions specified for durability

4.00.00 I.S. CODES

All work shall be carried out as per th is specification and shall conform to the latest revision and/or replacem ents of the following or any other Indian Standard (IS) Codes, unless specified othe rwise. 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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SECTION - D

SUB-SECTION – D13

SHEET WORK IN ROOF AND SIDING

SPECIFICATION NO. PE-TS-999-600-C013

Maharatna Company

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.
1.00.00	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 m m inimum 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 sam e paint of minimum DFT 12 m icrons over prim er. These shall be fixed directly to runners. The sheets shall m eet the general requirem ent 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 m etal cladding system shall be m ade out of plain sheets having sam e m aterial and coating specification as m entioned above for th e outer face of the sandwiched m etal 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 th is specification and shall conform to the latest revision and/or replacem ents of the following or any other Indian Standard (IS) Codes, unless specified othe rwise. 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.

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SECTION - D

SUB-SECTION – D14

SUSPENDED CEILING

SPECIFICATION NO. PE-TS-999-600-C014

Maharatna Company

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.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	SAMPLES	5
4.00.00	SHOP DRAWINGS	5
5.00.00	ACCEPTANCE CRITERIA	6
6.00.00	RATES AND MEASUREMENTS	6

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 m aximum 1.2 m etre centres. Extra hangers shall be provided at light fixtures that are supported from the ceiling system . The spacing of m ain 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 m aterial in thickness and properties called for in the "Schedule of item s". The Contractor shall submit test certificates to the Engineer for approval before bulk supply. The ceiling panels m ay 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 m anufacturer'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. W here flush surface is required, the joints shall be filled with approved filler material and finished to give a neat uniform surface. Special car e 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 m anufacturer'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 m m recessed flange , roll form ed out of 0.5 m m thick aluminium alloy panels stove enam elled on both sides, fixed on roll-form ed carriers m ade of enam elled 0.95 m m th ick alum inium, 32 m m wide and 39 mm deep with prongs to hold panels in the m odule of 100m m, at m aximum 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 adjustm ent clips made out of spring steel at m aximum 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 m etal 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 subm itted for approval as required and approval shall be obtained prior to delivery of susp ended ceiling components. Shop drawings shall be co-coordinated with all related work and shall show the f ollowing information:

a) A reflected ceiling plan of areas i ndicated 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 m ember f urnished 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 dam aged board. Cut-outs for light fixtures, diffusers etc. shall be of exact dim ensions 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 m easured in Sqm correct to second place of decimal. However, no deduction will be m ade for opening upto 0.25 Sqm . each in area.

VOLUME: II B

SECTION - D

SUB-SECTION – D15

WATER SUPPLY, DRAINAGE AND SANITATION

SPECIFICATION NO. PE-TS-999-600-C015

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.
1.00.00	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 sanita tion works following type of pipe are coved in this Section:

a) Cast Iron pipe

b) Steel pipe (lined, coated with bituminous com position, 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 m aterial, fittings, fixtures, applia nces, 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 m ade well in advance and should get inspected & approved im mediately by the Engineer. All f ixtures shall be adequately protected, covered, and plugged till handing over.

All fittings, gratings, fasteners, unless specified otherwise, shall be chrom ium plated. The chrom ium plating shall be of grade-2 (10m icron thickness) confirming to IS: 4827. Powder coating sh all be of approved colour and shall have minimum thickness (DFT) of 20m icron. 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 m ay be available in the drawings provided, the details m ight have to be supplem ented by the Contractor and get the approval of the Engineer before installation. Special a ttention shall be given to econom ise the layout. Sym metry of layout is very im portant. Fittings m eant for operation shall be located and oriented to allo w easy reach and operation. Maintenance, repairs, and replacem ents of pipes, fitti ngs, and fixtures m ust be conveniently possible. All pipe lines, locations of fittings and f ixtures, etc. shall be as per drawings or as directed by the E ngineer. Correctness of lines, plum b, orientation, symmetry, and levels shall be strictly ensured. All item s shall be fully secured against m ovement in any direction and so located as to allow easy maintenance.

All pipelines, f ittings, and f ixtures sha ll be installed leak proof . W hen the works under scope of this specifica tion 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 f ulfilling the f unctional requirem ents all pipelines shall be laid true to line, plum b and level and sha ll 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 unyiel ding 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 pr ovisions for securing the pipes in every direction and easy m aintenance. All pi pes 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 th at there is no possibility of back flow towards the source of supply from a ny cistern or appliances, whether by siphonage or otherwise. All pipe work s shall be so laid or fixed and maintained as to be and to rem ain completely watertight, thereby avoiding waste of water, dam age of property and the risk of contam ination of the water conveyed.

3.02.03 Contamination

There shall be no cross connection wh atsoever between a pipe/f itting f or conveying or containing wholesom e wa ter and a pipe/fitting for containing impure water or water liable to contam ination 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 m anhole 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 f illing shall be done with selected fine earth, unle ss otherwise perm itted, in 150 m m layers and caref ully consolidated. Special car e shall be taken while f illing in the vicinity of the pipe to avoid dam age. Before backfilling, the laid pipe shall be fully tested and approved.

Where the pipe rests on rock it m ay 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 show n on the drawings the pipes shall be concealed in m asonry or concrete of the structure. The Contractor m ay co-ordinate with the building Contractor for leaving the chases, openings, and conduits as necessary. However, the C ontractor will rectify if required the chases, openings, and conduits, supplem ent and m ake good after laying and testing of the concealed pipelines.

3.02.06 Jointing of Pipes

All G.I. pipes shall be properly thr ead/weld jointed and m ade com pletely water tight and durable. Burr from the jo ints shall be rem oved after screwing. Union joints shall be provided f or all required location to f acilitate maintenance.

3.02.07 Painting

Where required, underground G.I. pipes sh all be given 2 coats of bitum inous paint on the outside after laying. W hen painting is to be done above ground G.I. pipes shall be given one coat of re d lead or zinc chrom ate 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 com ers shall be standard Cast Iron or Asbestos Cem ent Pipes. In case where specifically desire d, M.S. pipes m ay also be used. M.S. pipes shall be painted outside with tw o coats of anticorrosive paints under a coat of primer.

Rainwater down comers shall run along and be secured to walls, colum ns etc. Where desired by the Engineer these m ay 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 approve d 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, unle ss otherwise specified and shall be formed of cement concrete of M-20 grade.

3.03.03 Gutters

The gutters shall be m ade of G.I. or A.C and procured from reputed specialised manufacturers. Each secti on 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 m inimum fall of 1 in 120. Adequate num ber of string supports sha ll be provided so that there is no sagging even when the gutter is full. E ach 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 com ers shall be m ade 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 E ngineer, under no circum stances shall drainage and sewer pipes be allowed to come close to water supply pipelines.

3.04.03 Laying

Each separate pipe shall be individua lly set f or line and f or level. W here lengths of sewer or drain pipes are laid in trench, properly painted sight rails shall be fixed across the trench at a he ight, equal to length of the boning rod to be used, above the required invert leve l 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 interm ediate positions if the distance for sighting is m ore than 50 ft. apart. The excavation shall be bone d 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 sh all be separately and accurately boned between sight rails.

3.04.04 Support and Protection of Pipelines

All pipes shall be laid with sockets l eading uphill. Pref erably the pipe shall rest on solid and even foundations for th e full length of the barrel. However, the pipe m anufacturer'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. W here pipes are not bedded on concrete, the floor shall be left slightly high and carefully placed so th at the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low packing shall be

done in concrete. W here 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 st one 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 m inimum support and protection for glazed stoneware pipes shall be as follows:

a) When cover is less than 2 m etre below ground level and where pipes are unavoidably exposed above ground surface, the pipes shall be com pletely encased or surrounded with concrete.

b) Where pipes are laid on soft soil w ith the m aximum 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 m aximum 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 sof t soil the pipe sewers shall be com pletely encased or surrounded with concrete.

Vitrified clay pipes shall be laid on a bed of 150 m m thick cem ent concrete (1:3:6) nominal mix by volume.

Cast iron pipes and concrete pipes m ay 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 d ecided by the Engineer. Pipes shall be secured to the supports by approved means.

Anchoring of pipes where necessary sh all 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 replacem ent of the pipes. W hen openings or chases are required to be m ade in the structure for entry of pipelines, locations and sizes shall be m arked 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. Tr aps shall have m inimum water seal of 50 m m 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 l east 600 m m above the outer covering of the roof of the building or as shown on drawings. All vertical ventilating, anti-syphonage and sim ilar pipe shall be c overed 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 cham ber. The m aximum distance between m anholes shall be 30 meter unless specially perm itted otherwise. However, f or truck route (f or pipes above 900 mm dia.) this distance can be increased to 45 M. The distance between manhole or inspection cham ber and gully cham ber shall not exceed 6 metres unless desired otherwise provision of IS: 4111 (Part-1) shall be followed for construction of a m anhole. 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 lodgem ent for a ny splashing in case of accidental flashing of the cham ber. The channel or drain at the bottom of cham ber shall be plastered with 1:2 cem ent, sand m ortar and finished sm ooth 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 sh all be used f or 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 therm o welded or bolted as per m anufacturer'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 therefrom 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 t op shall he provided with a suitable mosquito proof wire mesh and cowl. Ventilating pipe shall extend to a height of about 2 m eter when the septic tank is at least 15 m eter 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 concer ned 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 com plete. It shall consist of a 900 m m dia. pit 1000 m m in depth below the invert level of the in let pipe. The pit shall be lined with stone; brick or concrete blocks set in cem ent m ortar (1:6) and f illed 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 m m nom inal. The trench for laying the pipes shall be a m inimum 600 x 600 m m. The joints of the pipes shall be left unsealed. The entire length of the pipe within the trench shall be buried in a 250 m m layer gravel or crushed stone of uniform size. On top of gravel/crushed stone layer is a 150 m m 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 wa tertight 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 sm all quantity of decaying organic m atter such as digested cow-dung m ay be introduced.

3.07.00 Related Works

All works, like earthwork, masonry, concrete, steelwork, cutting holes, chases, repairs and rectification associated dir ectly with installation of water supply and sanitation system s shall com e 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 m m 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 m m to 2000 m m 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, cl amps, drain heads, cleanouts etc. with cutting, making chases and jointing of pipes, making good the walls.

6.01.02 Rainw ater Down-comers

Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, cl amps, 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 com plete as per desc ription of "Schedule of Item s". 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, la ying 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, m aking good of opening in floor and walls, grating, pain ting etc. com plete 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 item s of work executed like brick work, plasteri ng, concrete, reinforcem ent steel etc. provided for com pletion of the structur e 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 m easurements shall be in running m etres 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, W C, 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 m easured 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 m easured in respective item s of work like brick work, RCC, plastering etc. CI cover shall be m easured in num bers as specified in “Schedule of Items”.

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

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 em bankment, sub-base course, base course, tack coat, bituminous m acadam, wearing course, liquid seal coat, shoulder and all incidental item s of work specified or not shown but reasonably im plied or necessary for the completion of the work etc.

The scope also include all works requi red for the construction of drainage including construction of road side drains, RCC culverts, pipe culverts, drainage pipes, m anholes and all other incidental item s 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 contr actor 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. m aterial handling, placem ent, services, approaches etc.) to the engineer for approval.

c) Carrying out tests whenever require d by the engineer to assess the quality of work and subm ission of the test resu lts to the engineer af ter 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 wo rk 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 app lied sealing compound for joint in concrete

n) IS: 1838 - Specification for perfor med 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 ± 25m m 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 th ickness 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 com pleted sub-base, base course and wearing surfaces in the longitudinal and transverse di rections shall be within the tolerances indicated in Table - I. The longitudinal profile shall be checked with a 3m long straight edge at the m iddle 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. Bitum	inous 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 em bankment 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 m atters. At the tim e the sod is cut, the grass shall have a length of approxim ately 50m m 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 sha ll be loosened, freed from all stones larger than 50m m size, sticks, stum ps 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 roughene d 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 soili ng (if required), fertilizer and ground limestone when specified shall be sp read uniform ly. After spreading, the materials shall be incorporated in th e soil by discing or other m eans. The prepared sod bed shall be m oistened if not already sufficiently m oist 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 m etal tampers so as to elim inate air pockets and to press it into the underlying soil. At points where water m ay 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 sh all 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 1000m m along the longitudinal axis of the sod strips. Stakes shall be driven approxim ately plumb through the sods and to be alm ost flushed with them.

3.04.05 Top Dressing

After the sods have been laid in pos ition, the surface shall be cleaned of any loose sod, excess soil and other foreign m aterials. 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 wa tered and protected until final acceptance. Watering shall be done in such a way th at no erosion or dam age to the sodded areas/embankment occur. The Contractor shall erect necessary warning signs and barriers, repair or replace the s ods which are failing to show uniform growth of grass or dam aged by his opera tion and shall m aintain 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 requirem ents of this specification and in conform ity with the lines, grades and cross secti ons shown on the approved drawings and as directed by the Engineer.

3.05.02 Materials

Shoulder shall be m ade of selected ear th or granular m aterial as specified conforming to relevant IRC standards.

3.05.03 Construction Operations

Except in the case of bitum inous pavem ents, the shoulders shall be constructed in advance to the laying of pavem ent courses. The com pacted thickness of each layer of shoulder sha ll correspond to the com pacted layer of pavement course to be laid adjacent to it. After com paction, the inside edges of shoulders shall be trim med verti cal and the area enclosed between the shoulders shall be cleaned of all spilled m aterials before proceeding with the construction of the pavement layer.

In the case of bitum inous pavements, shoulder shall be constructed only after the pavement courses have been laid and compacted.

Regardless of the m ethod of laying, all shoulder construction material shall be placed directly on the shoulder. A ny spilled m aterial 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 requi red cross fall shall be m aintained 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 100m m thick and of suitable length. The depth of blocks unless otherwise m entioned elsewhere shall be 375m m considering 225mm height of footpath above the road level.

3.06.02 Laying

The kerb shall be laid by cutting trenches of 150m m deep. The width of the trench shall be m inimum and just suffici ent 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 w ith a mixture of stone chips (50%) and moorum (50%) at the outside face. Th e 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 m aterial on the prepared sub-grade in accordance with the specification. The material shall be laid in one or m ore 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, m oorum, gravel, crushed stone, crushed slag, crushed conc rete, brick m etal, laterite, kankar etc or com binations thereof depending upon the grading required. The m ixed materials shall be f ree f rom 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 63 mm 4.75 mm 75 micron	100 90 - 100 35 - 70 0 - 20	100 90 - 100 40 - 90 0 - 25	100 90 - 100 50 - 100 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 20 mm 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 80 mm 63 mm 40 mm 20 mm	100 65 - 85 25 - 60 0 - 15 0 - 5
2.	63 mm to 40 mm	80 mm 63 mm 50 mm 40 mm 20 mm	100 90 - 100 35 - 70 0 - 15 0 - 5
3.	50 mm to 20 mm	63 mm 50 mm 40 mm 20 mm 10 mm	100 95 - 100 35 - 70 0 - 10 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 10.0 mm 4.75 mm 150 micron	100 90 - 100 10 - 30 0 - 8
B	10 mm	10 mm 4.75 mm 150 micron	100 85 - 100 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 25 mm 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 unt reated 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 constr uction 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 bitum en of a suitable grade as directed by the Engineer complying with IS: 73.

b) Aggregates

The aggregates shall consist of crushe d stone, crushed gravel (shingle) or other stones. They shall be clean, str ong, durable, fairly cubical in shape and free from any disintegrated pieces, orga nic and other deleterious m atter and adherent coats. The aggregates sh all 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 bitum inous 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 m ix 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 respons ibility for ensuring proper proportion of materials and producing a uniform mix. A variation in binder content upto ± 0.3 percent by weight of total m ix shall however be perm issible 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 bitum inous m acadam 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 m ix plant of adequate capacity sh all be used for preparing the m ix. The temperature of binder at the tim e 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 tim e exceeds 25 Deg. C. Mixing shall be thorough to ensure that a homogenous m ixture is obtained in which all particles of the aggregates are coated uniform ly. The m ixture shall be transported from the m ixing 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 m ixing, the m ix shall be spr ead im mediately by m eans of a self-propelled m echanical paver with suitable screeds capable of spreading, tamping and finishing the m ix to the speci fied 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 m ix. The temperature of m ix 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 th in 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 th e 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 com pacting open graded carpet of specified thickness in a single course of suitable sm all sized aggregates premixed with bitum inous binder on a pr eviously 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 requirem ents of IS: 73, 217, 454 or any other approved cutback as applicable.

b) Aggregates

The aggregates shall consist of angul ar fragm ents of clean, hard, tough and durable rock of uniform quality throughout. They shall be obtained by crushing rock, gravel or river shingl e and be free of elongated and flaky pieces, soft and disintegrated m aterials, vegetable and any other deleterious matter etc. They shall preferably be hydrophobic type. The aggregates shall satisfy the quality requirem ents set f orth 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 dam p or wet or when the atm ospheric temperature in shade is 16 Deg. C or below.

b) Preparation of Base

The underlying base on which the bitum inous 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 rem oving caked earth and other foreign m atters with wire brus hes, sweeping with broom s and finally dusting with sacks as necessary.

c) Tack Coat

A tack coat com plying with clause 3.09.00 shall be applied over the base preparatory to laying of the carpet. Ho wever, 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 h eated to the tem perature appropriate to the grade of bitum en 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 tem perature as directed by the Engineer before these are placed in the m ixer. After about 15 seconds of dry m ixing, the heated binder shall be distributed ove r the aggregates at the rate specified. The mixing of binder with chipping sha ll be continued until the chippings are thoroughly coated with the binder. The mix shall be im mediately 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 surf ace with rakes to the required thickness and cam ber or distributed evenly with the help of a drag spreader without any undue loss of tim e. The cam ber shall be checked by means of cam ber boards and inequalities evened out. As soon as sufficient length of bitum inous material is laid, rolling shall be com menced with 6 to 8 tons' power rollers pref erably 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 becom e apparent sh all be corrected by rem oving or adding premixed m aterials. Rolling shall th en be continued until the entire surface has been rolled to com paction and all the roller m arks have been elim inated. In each pass of the roller, preceding track shall be overlapped uniform ly by at least 1/3 width. The roller wheels shall be kept dam p to prevent the prem ix from adhering to the wheels and be ing 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 com pacted 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 brommed 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 m m 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 150m m 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 f illed 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 200m m below the bottom of the pipe with prior perm ission of the Engi neer and all rock/boulders in the area shall be rem oved and space filled with approved earth free from stone or fragmented m aterials, shaped to the requirem ents and thoroughly com pacted to provide adequate support for the pipe.

Filling of trench shall be carried out simultaneously on both sides of the pipe in such a m anner 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 diam eter of the pipe subject to a m inimum of 450 mm. Laying of pipes shall start from the outlet and proceed towards inlet. All pipes and f ittings shall be gradually lowered into the trench or placed on the supports by approved m eans taking due care to avoid any dam age. Under no circum stances the pipes shall be dr opped into the trench or on supports from heights.
b) Pipe bedding shall be f irst class projection bedding f or positive projecting pipes as per IS: 783 having a projection ratio not greater than 0.70. The pipe shall be carefully laid on bedding m ade up of fine granular m aterials in an earth foundation; the bedding shall be carefu lly shaped to fit the lower part of the pipe exterior for at least ten percen t of its overall height and in which the fill material is thoroughly com pacted in layers not exceeding 150m m in depth around the pipe for the remainder of the pipe laid in trench.

When indicated on the drawings or dir ected 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 dim ension of the cradle sh all 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 m ade with first class brickwork in 1:4 cem ent mortar.

d) The pipe culverts shall be m ade with proper care with respect to the invert of the pipe, gradient if any etc. as sp ecified on the drawings and as instructed by the Engineer.

e) W here R.C.C pipes are encased in concrete at road crossings or at other places the pipes need be suitably s upported avoiding reinforcem ents of concrete blocks, joints properly done before concreting is taken up. Concreting of total height of block m ay be done in a single operation or m ay be done upto som e 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 w ith 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 circum stances 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 ever y change of alignm ent, gradient or diameter there shall be a m anhole or inspection cham ber. The distance between the m anhole or inspection cham ber and gully cham ber shall not exceed 6 meters unless permitted otherwise. Manhole shall be constructed so as to be water tight under test. The ch annel or drain at the bottom of chamber shall be plastered with 1:2 cem ent sand m ortar and finished sm ooth to the grade. The channels and drains shall be shaped and laid to provide a sm ooth flow. Connection to the existing pi pelines shall be through a m anhole. Manholes shall be provided with standard c overs usually of C.I. or as directed by the Engineer. The cover shall be clos ely fitted so as to prevent gases f rom coming out.

4.00.00 Testing and Acceptance Criteria

All testing as m entioned in the specif ication and as m entioned in Clause No. 900 of the “Specification for Roads and Bridge W orks, 1983” published by IRC on behalf of Ministry of Shipping and Transport (Roads W ing) shall be carried out by the Contractor as per the direction of the Engineer.

5.00.00 MEASUREMENT

Method of m easurement shall be as per the latest version of IS:1200, Part-17 and as directed by the Engineer.

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

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	W ORKMANSHIP	19
4.00.00	INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY	29
5.00.00	INFORMATION TO BE SUBMITTED	33
6.00.00	RATES AND MEASUREMENTS	34

SUB-SECTION – D XVII

FABRICATION OF STRUCTURAL STEEL WORK

1.00.00 SCOPE

This specification covers supply, fabri cation, testing, painting and delivery to site of structural steelwork including supply of all consum able stores and rivets, bolts, nuts, washers, electr odes and other m aterials required for fabrication and field connections of a ll 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 C ontractor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following

a) Preparation of com plete detaile d fabrication drawings and erection marking drawings required for all th e 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 subm itted for approval.

b) To subm it 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 consum ables 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 fabricat ed steelwork as per requirem ents of this Specification.

f) Suitably mark, bundle, and pack for transport all fabricated materials.

g) Prepare and f urnish detailed Bill of Materials, Drawing Of fice Dispatch lists, Rivet and Bolt List and any other list of bought out item s 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, m odification and repairs of steelwork at site as may be required to com plete 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 requirem ents 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 Indi an 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 st eel 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 m etal 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 requirem ents 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 m m) 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 m etal 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 fa bricated 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, polygona l, square, or rectangular in plan. Bottom hopper portion m ay have been c onical-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 m ade of m ild steel plates joined together with f ull strength butt weld and provided with stiffe ners 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 m achine or co ld bending process W ithout resorting to heating, hammering, angle smithy and black smithy process.

2.06.05 Poking hole (m anual or pneum atic) and striking plate shall be provided to facilitate coal f low. 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 er ection m arks m ay be required to be added at any stage of work.

2.07.02 All such new erection m arks shall be detailed and included in m arking schemes and fabrication carded out thereafter.

2.07.03 All such new erection m arks shall be considered under item of original fabrication work. As a result of add itional structures becom ing necessary if the work is delayed beyond the tim e sche dule stipulated, the Engineer shall give suitable extension of tim e provided he is satisfied about the reasonableness of the delay involved. However, no claim for extra paym ents 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 a ll necessary clips, bolts, nuts and lock washers required for proper assem bly and rigid installation and fastening to abutting units supporting structural steel framing members.

2.08.11 The gratings shall be of reputed make and m anufacturer, 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 Engi neer or his representative to carry out inspection during all stages of manufacturing of gratings.

2.08.12 Maximum deviation in linear dim ension from the approved dim ension shall not exceed 12mm.

2.08.13 All fabricated grating section and accesso ries 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, m ill scale, grease, oil, or any other foreign m atter 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 com plete, the structural material shall be punched with erection mark and be hot double dip galvan ized. 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 coa ting shall be at least 610 gm /m² - unless noted otherwise.

2.09.04 The galvanized surface shall consist of a continuous and uniform ly thick coating of zinc, firm ly adhering to th e surface of steel. The finished surface shall be cleaned and sm ooth and shall be free from defects like discoloured patches, bare spots, unevenness of coati ng, spelter that is loosely attached to

the steel, blistered surface, flaking or p eeling off etc. The presence of any of these defects noticed on visual or m icroscopic 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 ham mer. The galvanized steel member shall withstand m inimum four one minute dips in copper sulphate solution as per IS: 2633.

2.09.06 When the steel section is rem oved from the galvanizing kettle, excess spelter shall be rem oved by ' bumping'. The processes known as ' wiping' or 'scrapping' shall not be used for this purpose.

2.09.07 Defects in certain m embers indicating presence of im purities in the galvanizing bath in quantities larger th an that perm itted by the specif ications or lack of quality control in any m anner 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 dichrom ate or an approved equivalent solution after galvanizing; so as to prevent white storage stains.

2.09.09 If the galvanizing of any m ember is damaged, the Engineer shall be shown of the extent of dam age, if so directed th e galvanizing m ay 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 fabricat ed & erected as per BOQ item with SS415M, following specification shall be followed.
Stainless steel hopper of grade SS 415M as m anufactured 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 c ontained herein. Fabrication drawings shall be prepared by the contractor on th e 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 th e 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 elem ents of hopper plate in opposite fashion to redu ce the end wastage. Sim ilarly, the hopper plate elem ent having different radii shall be placed one inside the other, to optimize the stainless steel plate use. Such optimization may also require adjustm ent in the size of each elem ent of hopper plate and also additional weld joints.

b) The bill of m aterial 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 fabrica tion, weight of cut and scrap pieces generated. Contractor shall return to the Owner's store all unutilized (surplus) stainless steel plates and a ll 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 edges 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 elect rodes 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 specim ens, general workm anship being good m eeting 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 m irror finish stainless steel facing bonded to the bottom surface of the sole pl ate. The lower unit shall consist of a relevant laminated elastomers pad surfaced with PTFE. A rigid confining m edium substructure bonds the PTFE to the pad. W hen the upper and lower units are mated the stainless steel slides on the PTFE surface with an extrem ely low coefficient of friction. These bear ings shall be designed as per the performance requirem ents. The beari ng shall be of reputed m ake and manufacturer as approved by Engineer, fo r required vertical loads, as per the construction drawings and for a maximum displacement of ± 50 mm.

b) Material

PTFE bearing shall be sliding agains t 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 tem perature resistant adhesive to the stainless steel sub-strata. The stainle ss 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 consis t of m ultiple layers of lightweight fabric im pregnated with a high quality elastom er com pound vulcanized into slabs of uniform standard thickness as per the requirem ent. This shall withstand vertical (com pressive) load not less than 500 kg/cm ² 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 m ortar. The bearing will be placed on this layer while it is still wo rkable and the bearing is levelled. The bearing should not be displaced as the beam is lowered into position. When the m ortar and adhesive are fully set and the beam slightly above the top of the bearing. The upper surf ace of the bearing shall then be coated with sufficient thickness of e poxy resin m ortar so that when the

beam is lowered on to the tem porary supports it com es into full contact with the m ortar and som e 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 m aterials 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 dam aged, shall be removed from the contractor's yard immediately, failing which, the Engineer sha ll be at liberty to get the m aterial removed and the cost incurred thereof sha ll be realised from the Contractor. The Contractor shall m aintain upto date accounts in respect of receipt, use, and balance of all sizes and sections of steel and other m aterials. 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 m aterials 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 a nd the resulting cut-pieces shall be stored in separate stacks off the ground section wise and lengthwise so that they can be easily inspected, m easured, and account ed for at any tim e. If required by the Engineer, the m aterials m ay 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 m arked 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 fasteni ng 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 com partments according to diam eter, 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 m aintain quality control procedures f or different item s of work and m aterials to the extent he deem s necessary to ensure that all work is perform ed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all tim es 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 m ade 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 workm anship not in reas onable conformance with the provisions of this Specification m ay be rejected at any tim e during the progress of the work.

The quality control procedure shall cover but not be lim ited to the f ollowing 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 uniform ity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Stru ctural Steel and other allied products.

2.14.00 Standard dimensions, forms and weights

The dim ensions, form s, weights and tole rances of all rolled shapes rivets, bolts, nuts, studs, washers etc. and othe r m embers used in the fabrication of any structure shall, wherever applicable, conform to the requirem ents 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 awar d of the Contract submit to the Engineer the Schedule of Fabrication and erection of structural Steelworks, for approval. W ithin 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 so me or all of the detailed fabrication drawings will have to be submitted for approval.

The sequence of preparation of fabri cation drawings shall m atch with the approved fabrication and erection sc hedule. The above-m entioned approval for fabrication drawings will be accorded only towards the general conform ity with the design requirem ents as well as specifications. The approval of drawing however shall not relieve the c ontractor of his sole responsibility in carrying out the work correctly and f ulfilling the com plete requirem ents 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 calculati ons that m ay be required for the clarification of the works or substituted parts thereof.

These drawings shall give all the necessary inform ation 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 rega rd to sequence, speed and econom y 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 of for 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 determ ine the effective size of members cut by gas, 3 m m shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld m etal deposited on them, shall be reasonably free from gouges, occasional notches or gouges not m ore than 4 mm deep will be perm itted. Gouges great er than 4 m m that rem ain from cutting shall be rem oved by grinding. All re-entrant corners shall be shaped notch free to a radius of at leas t 12 m m. 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 sh eared or cropped edges of plates or shapes or of edges gas-cut with a m echanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation fo r welding or as m ay be required after the inspection of the cut surface. Surf ace cut with hand-flam e 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 m ore 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 m ore than one thickness of m aterial for m embers, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching m ay be permitted before assem bly, if the thickness of the m aterial is not greater than the nominal diameter of rivet or bolt plus 3 m m subject to a m aximum thickness of 16 mm provided that the holes are punc hed 3 mm less in diam eter than the required size and reamed after assembly to the full diameter.

Holes for rivets or black bolts sh all be not m ore than 1.5 m m or 2.0 m m (depending on whether the diam eter of the rivet or bolt is less or m ore than or equal to 25 m m) larger in diam eter than the nom inal diameter of the rivet or black bolt passing through them.

Holes f or turned and f itted bolts shall be drilled to a diam eter 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 connect ed shall be firm ly held together by tacking welds or clam ps and the holes drilled through all the thicknesses in one operation and subsequently ream ed to size. Holes not drilled through all thickness in one operation shall be drilled to a sm aller size and ream ed out after assembly.

Holes for rivets or bolts shall not be formed by gas cutting process.

3.02.02 Assembly

All parts of riveted m embers shall be well pinned or bolted and rigidly held together while riveting. Drifting to enlarge unm atching holes shall not generally be perm itted. In case drif ting is perm itted to a slight extent during assembly, it shall not distort the m etal or enlarge the holes. Holes that m ust be enlarged to adm it the rivets or bolts shall be ream ed. Poor m atching of holes shall be cause for rejection. The com ponent parts shall be so assem bled that they are neither twisted not otherwise da maged, 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 approxim ately hem ispherical in shape and shall be of uniform size throughout the work for rivets of the sam e 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 af ter their tem perature has f allen below 540°C.

Rivets shall be driven by power rivete rs, of either com pression or m anually operated type, em ploying pneum atic, hydraulic or electric power. Hand driven rivets shall not be allowed unless in exceptional cases specifically approved by the Engineer. After driving, ri vets shall be tight, shall com pletely fill the holes and their heads shall be in full contact with the surface. In case of countersunk rivets, the countersinking sh all be fully filled by the rivet, any proudness of the countersunk head being dressed off flush, if required.

Riveted m embers shall have all parts fi rmly drawn and held together before and during riveting and special care shall be taken in this respect f or all single riveted connections. For m ultiple 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 a nd driving long rivets. The Contractor shall prove the quality of riveting by cu tting some rivets chosen at random by the Engineer. No extra paym ent will be m ade to the Contractor f or 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, rem oved 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 replaci ng any num ber of further rivets at the Contractor's cost as he deems necessary.

Bolted construction shall be perm itted onl y in case of field connections if called for on the Drawings and is subjected to the lim itation of particular connections as m ay 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 otherwis e suitably shaped, where necessary, to give the heads and nuts of bolts a satis factory bearing. The threaded portion of each bolt shall project trough the nut at l east one thread. In all cases the bolt shall be provided with a washer of su fficient thickness under the nut to avoid any threaded portion of the bolt being w ithin the thickness of the parts bolted together. In addition to the norm al 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. W elding 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 f oreign m aterial except that m ill scale, which withstands vigorous wire brushing, may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutti ng 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 m ore than 4 mm. If the separation is 1.5 m m or greater, the size of the fillet welds shall be increased by the am ount of the separation. The fit of joints at cont act surfaces, which are not com pletely sealed by, welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded sha ll be carefully aligned. Misalignm ents greater than 3 m m shall be corrected and in m aking 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 mm 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 beam s except where encased in concrete, in which case, pipe separators shall be used.

3.14.00 Bearing Plates

Provision shall be m ade for all necessa ry 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. Altern atively, diam ond pattern grating if approved may be used.

The grating shall be m ade 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 fr ee 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, trim med, and neatly finished around com ponents of the steel structures encountered. Binding strip shall be provided on the gra ting to suit the prof ile. Openings in gratings shall be provided with steel bar toe plates of not less than 5 m m thickness and 100 mm width.

Unless otherwise indicated on drawings, a ll penetrations of grating units shall be made up in split section, accurately fitted, and neatly finished. Grating units shall be provided with all necessary clip s, 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 fl oorings, covers etc. shall be 6 m m O/P. Chequered plate shall be accurately cut to the required sizes and shapes and the cut edges properly ground. Stiffe ners 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 Galvaniz ing

3.16.01 General

Structural steelwork for switchyard or ot her structures as m ay be specified in the contract shall be hot dip galvan ized in accordance with the Am erican Society for Testing and Materials Specification ASTM-A 123 or IS: 2629 - Recommended practice for Hot-Dip Galvan izing of Iron and steel. W here the steel structures are required to be ga lvanized the field connection m aterials like bolts, nuts and washers shall also be galvanized.

3.16.02 Surface Preparation

All m embers 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 im mersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and tem perature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling tim e is adjusted accordingly.

The pickling process shall be com pleted 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 uniform ly heated bath. It shall m eet all the requirements when tested in accordance with IS: 2633 - Method for testing uniform ity of coating on Zinc Coated Articles and IS: 4759 - Specification for Hot-dip zi nc coatings on Structural Steel & other allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniform ly. The threads of bo lts shall not be m achined after galvanizing and shall not be clogged with zinc. The threads of nuts m ay be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing a nd the process of galvanizing itself, shall not adversely affect the m echanical properties of the m aterials to be galvanized. W here m embers are of such lengths as to prevent com plete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been dam aged shall be acid stripped and re-galvanized unless otherwise directe d, but if any m ember 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 w ith steel wire brush to rem ove spatter metal, slag etc. and 100% of welds sh all be inspected visually for size, length of weldm ent and external defects. W eld 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 exam ination shall be carried out to determ ine soundness of weldments as follows:

i) 10% at random on fillet-joints.

ii) 100% on all butt-joints.

c) Should the ND tests indicate def ects like im proper root penetration, extensive blowholes, slag intrusion et c., such welds shall be back gauged, joints prepared again and rewelded. All def ects shall be rectif ied by the Contractor at no extra costs.

d) All electrodes shall be procured fr om approved reputed m anufacturers 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 perform ed in accord ance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tones of welded fabrication, the Engineer m ay ask for 1(one) test-destructive or non-destructive including X -ray, ultrasoni c test or sim ilar, the cost of which shall be borne by the Contractor.

4.02.04 Rivets, bolts, nuts and washers

All rivets, bolts, nuts, and washers sha ll be procured from M/s. Guest Keen William Ltd. or equivalent and shall conf irm to the relevant Indian Standards. If desired by the Engineer, representativ e 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 ham mer, 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 prim ers shall be of standard quality and procured f rom approved m anufacturers and shall conform to the provisions of the relevant Indian Standards.

4.02. 12 Galvanizing

All galvanizing shall be unif orm and of standard quality when tested in accordance with IS: 2633 - Method for tes ting uniformity of coating on Zinc Coated Articles and 15: 4759 - specifica tion for Hot-Dip Zinc Coatings on Structural Steel & other allied products.

4.03.00 Tolerance

The tolerances on the dim ensions of individual rolled steel com ponents shall be as specified in IS: 1852 - specifica tion for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated com ponents (such as beam s and girders, colum ns, crane gantry girder etc.) of the steel struct ures shall be as specified in IS: 721 - Tolerances for Fabrication of Steel Structures.

4.04.00 Acceptance

Should any structure or part of a struct ure be found not to co mply with any of the provisions of this specification, the same shall be liable to rejection. No Structure or part of the structure once re jected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer m ay, at his discretion, check so me 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 successf ully carried out, the steelwork will be accepted forthwith and the Engineer will issu e acceptance certificate, upon receipt of which, the item s will be shop painted, p acked and dispatched. No item to be delivered unless an acceptance certificate for the sam e has been issued. The satisfactory com pletion 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 f ield connection m aterials in such sequence as will perm it the most efficient and econom ical performance of the erection work. The Owner may prescribe or control the sequence of delivery of m aterials, 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 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 st eelwork for bunkers, tanks and/or silos as applicable.

vi) Fabrication and shipping of all other rem aining steelwork including miscellaneous steelwork.

vii) Final date of completion of all shipments.

b) Shop

Location of the Tenderer' s fabri cation workshop giving details of equipment, m anpower, 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, m aterial 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 m onth, giving the up-to-date status of preparation of deta iled shop drawings, bill of m aterials, procurement of m aterials, actual fa brication done, shipping and all other relevant information.

c) Detailed monthly material reconciliation statem ents relevant to the W ork done and reported in the Progress Repor t, 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 m ill test report in respect of steel m aterials, 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 item s shall be read in conjunction with these specifications including am endments a nd additions, general conditions of contract, special conditions of contract s, and other tender docum ents, if any. For each item of Schedule of Item s, 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 m inor details which are obviously and fairly intended and which m ay not ha ve been included in the description in these docum ents but are essential for the satisf actory com pletion of the work. Rates shall also include for taking all safety measures.

6.01.03 The bidder's -rates f or all item s of schedule of item s shall include com plete cost towards plant, equipm ent, erec tion and dism antling of scaffolding, m en, materials and consum ables, skilled and unskilled labour, levies, taxes, royalties, duties, transport, storage, repair/rectif ication/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 claim s 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 St eel shall include for fabrication and erection, transportation to site, pr eparation checking collecting and distributing of the fabrication drawings a nd design calculations, erection scheme, alignment, welding, including pr eheating 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, erec tion scheme, protection against dam age in transit, stability of structures, etc. The rates shall also be inclusive of providing and installing tem porary stru ctures, transport of Owner issue material from store, return of surplus/waste steel m aterials including cut pieces'/waste steel, provision of add itional butt/weld joint to reduce the wastage and all other general, special, such requirements as m ay 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 intensities, 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 dism antling, a dditions to, alterations in and/or modifications shall be inclusive of all operations such as lowering of material, carriage etc., as m entioned 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 tem porarily dismantled/supported members, connected member.

The bidder should prepare an optimise d cutting plan as per fabrication drawing to utilise the steel material upto maximum extent and minimise the w astage/scrap. Quantity of w astage/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 m arks after additions to, alterations in and/or m odifications shall be inclusive of all operations mentioned in technical specification for the calculated weight of the rectified/modified erection m ark rejected at site. This shall not include the weight of temporarily dismantled/supported members, connected member. All the operations m entioned above for restoring such m embers shall be carried out at no extra cost. The work of erec tion of any erection mark which has not been dismantled but have been m odified/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 incl ude design, supply, transportation of the complete assem bly with guides and dust protection cover and installation of bearings in position drilling, bolting, er ecting aligning etc. along with any taxes, duties thereon etc.

6.01.17 The bidder' s rates for Stainless St eel hopper (if specified) shall include fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication draw ings and design calculations, all other operations m entioned in the technical specification. The rates shall also include for erection scheme, alignment, making cutting plan, cutting, jointing, bending, rolling, grinding, drilling, bolti ng, assem bly, edge preparation, welding including pre-heating, post-heating, testing of welders, inspection of welds, inspection and testing, protection ag ainst damage in transit, stability of structures, installation of tem porary structures etc. The rates shall also be inclusive of providing and installing tem porary structures, transport of Owner issue material from store, return of surplus / waste steel m aterials including cut pieces'/waste steel, provision of add itional 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.

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

C 0 N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
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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, et c. 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 dam aged beyond repair during transport and handling or refabrication of parts, which are incorrectly fabricated.

v) Fabrication of parts om itted during f abrication 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 replacem ents 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 f abricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification a nd the sequence and the design criteria laid down by the Engineer. All work sha ll 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 colum n shall be plum bed and m aintained in a true vertical position subject to the limits of tolerance under this Specification.
No perm anent field connections by rive ting, 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 pneum atic tools. Hand passing or "throwing" of rivets are desirable. Any other m ethod of conveying hot rivets from the furnace to the driving point m ust be approved by the engineer. No-cold rivets shall be driven. All other requirem ents of riveting including quality and acceptance criteria shall be in accordance with the relevant portions of the Specification for Fabrica tion of Structural Steelwork of the Project.

3.01.07 Field Bolting

All relevant Portions in respect of bo lted construction of the Specification for Fabrication of Structural Steelwork app licable 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. Bolte d parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible m aterials. W hen assem bled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight m ill 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 m inimum bolt tension by any of the following methods.

a) Turn-of-nut Method

When the turn-of-nut m ethod 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 im pacts 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 rem aining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additi onally by the applicable am ount of nut rotation specified in Table-I with tightening progressing system atically 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 m ethod m ay have the outer face of the match-marked with the protruding bolt point before final tightening, thus affording the inspector visual m eans of noting the actual nut rotation. Such marks can be m ade by the wrench operator by suitable m eans after the bolts have been brought up snug tight.

b) Torque Wrench Tightening

When torque wrenches are used to provi de 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 m otion when torque is m easured. W hen using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previous ly tightened, which m ay 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 times 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 crane	a) Difference in levels of 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 Plum b 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 part s 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 subm it a tentative program me based on the inform ation available in the Tender Docum ent and visit to site indicating the structure-wise erection schedule proposed to be m aintained 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.

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

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 de tails, 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. Manuf acture of roof decking sheets shall not com mence 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 a nd stacking arrangem ents in store shall ensure that sheets are erected in a sequence which f ollows that f or the manufacture. The decking sheets shall be erected using an arrangem ent of sheets and joints to conform with th e requirem ents 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 m anner as to provide the m aximum weather protection taking into account the direction of the prevailing wind.

The lines form ed 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 plum b and level with all fixings evenly spaced and accurately lined. All dirt and grease shall be rem oved from the surfaces of the sheets as the work proceeds.

3.02.04 Site Cutting

Approval m ust 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 sh eets 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 com plies w ith 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 com pliance 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 sm all thickness of the sheeting. All drilling swarf sha ll be rem oved 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 subm it with his tender details of the proposed m ethod 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 m inimum thread diameter of 5.6m m. These self-drilli ng 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 m ore than span/250 for the loads likely to be im posed during concreting and in future. The self-d rilling screws are to be spaced at a maximum distance of 390m m 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 approve d by the m anufacturer which do not damage the coating of the decking sheets.

3.03.00 Protection during Construction

Precautions shall be taken during the er ection of the roof decking to ensure that partially erected decking are pr otected during inclem ent weather and damage at all times.

3.04.00 Damage

Any damage to coating & prim er during transportation is to redone with the similar type of coating as per the m anufacturer'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 th is specification and shall conform to the latest revision and/or replacem ents of the following or any other Indian Standard (IS) Codes, unless specified othe rwise. 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 treatm ent 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 f or 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 m easured 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.

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

C 0 N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	GENERAL	3
2.00.00	MATERIALS	3
3.00.00	INSTALLATION	4
4.00.00	ACCEPTANCE CRITERIA	5
5.00.00	IS CODES	6
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 610m m x 610 m m floor panel m ust be capable of withstanding the designed service load. The ultim ate 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 m aximum deflection of 1/350. If required by the Engineer, the sam ples shall be accepted only after carrying out load tests. The Engineer m ay relax the test requirements with concentrated load in case cabinets are not handled with castor fitting arrangement.

One additional pedestal shall be pr ovided under floor stringer along front panel area of each control board for taking possible additional load that m ay occur from time to time.

2.02.02 Surface finish

All rem ovable panels shall have the top surface finished with 2 m m thick flexible PVC flooring conform ing to IS:3462 and shall be fixed to the surface with compatible high-creep resistant adhesive. The PVC f loor tile shall be in single piece for each floor panel. Under si de 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 m m high and 2 m m thick, com pletely m atching with false flooring surface finish m aterials 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 beam s. 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 m oisture from com ing in cont act with cables and to m inimize dust problem.

The floor panels and channels shall be com pletely interchangeable and rem ain in position without screwing or bolting under working/imposed loadings.

Any dam age to the sub floor during inst allation of the false flooring system

shall be made good by the contractor wit hout any extra cost to the Owner. All steel surfaces are to be protected by two coats of polyurethane paint over a compatible prim er and any dam age to the paint during installation shall be made good. In case the loads exerted by th e weight of machines are above the stated characteristics of floor finish m aterial, the floor shall be protected by overlaying hard board during installation of machine or equipment.

All installation work of the f alse f looring 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 dam aged 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 sim ilar type of coating as per the m anufacturer'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 th is specification and shall conform to the latest revision and/or replacem ents of the following or any other Indian Standard (IS) Codes, unless specified othe rwise. 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 f or complete item described in the Schedule of Items and shall include, but not lim ited to, s upply & installation of floor panels, supporting systems, paintings etc.

6.02.00 Method of Measurement

False flooring shall be m easured in Sq.M for net area of the work done. No deduction shall be m ade for openings m easuring up to 0.4 sq.m . in area. No extra shall be paid for extra labour in cutting and for wastage etc. in m aking 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 de rate or m odify 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 m odify the design instead of derating the pile, the contractor shall carry out the sam e and install separate test piles and test the same to guarantee the safe load at no ex tra 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 m eet the guaranteed capacity or rejected due to any other reason, the Cont ractor shall install extra piles at no extra cost to the Owner. Further, the extra cost, due to the increase in the pile c ap size if any, on account of extra piles, shall be borne by the Contractor.

2.12.00 It is essential that all equipm ent and instruments are properly calibrated both at commencement and im mediately 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 E ngineer 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 subm itted to the Engineer. I f the Engineer d esires t o w itness s uch t ests C ontractor s hall a rrange t o 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 supp lied to him and for determ ining the Reduced Levels (RL) of these locati ons with respect to the benchm ark indicated by the Engineer. Two estab lished ref erence lines in m utually perpendicular direction shall be indicated to the Contractor. The Contractor s hall provide at site all the required survey instrum ents to the satisf action of t he 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 p ile bore, quality of concrete, integrity of piles, etc.

2.15.00 **AVAILABLE SUB-SOIL DATA**

An abstract of the sub soil data is f urnished in the tender docum ent. However, t he detailed soil investigation report shall be m ade available for reference of the bidder, if so required, at the office of the Owner. The soil data f urnished is i n 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/M³ 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 adequa te so as to reach the specified founding level.

4.01.04 Provision shall be kept for chiselli ng within the pilebore, as specified elsewhere in this specification. Chiselli ng shall be carried out only with the approval of Engineer.

4.02.00 Installation Criteria

4.02.01 For determ ining the founding level of pile s in soil as specified elsewhere, the Contractor shall have to perform Standa rd 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 m etres each above and below the specified founding level. The bore shall be 100 m m diameter and method of boring shall conform to IS: 1892.

4.02.02 For determ ining founding level of pile s in rock, as specified elsewhere socketing horizon shall be established by the Contractor by collecting rock cores of N X size in a separate borehole, and testing the sam e 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 com pressive 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 com pressive 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. H owever, 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 m aintained regarding the strata at founding level. SPT value and UCS from the nearest borehole s hall be indicated therein.

4.02.06 The founding level of the pile shall be d ecided based on the criteria elaborated i n 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 Engi neer 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 to When working near existing structures care shall be taken to avoid any damage 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 I S: 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, arrangem ent of testing apparatus/equipm ent, deployment of qualified/experienced m anpower, preparation of field quality plan, etc. On f inalized field quality pl an, the Owner shall identif y, customer hold points, beyond which work shall not p roceed without written approval from the Engineer. The testing apparatus/equipm ent installed in the field laboratory shall be calibrated/ c orrected 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 i n Table - 1. The testing shall be done at field laboratory or any other laboratory approved by the Engineer. Ho wever, the testing frequencies set forth are the desirable m inimum and the Engineer shall have the f ull authority to call f or tests as f requently as he m ay deem necessary to satisfy himself that the m aterials and works com ply with the appropriate specifications. The m aterials shall be tested to m eet all the specified requirements before acceptance at m anufacturers premises or at independent government approved laboratory. Tests i ndicated in the table are f or 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 m aterials shall be tested for quality, strength and other properties. Details of testing shall be as specified under technical s pecification for Cement concrete (Plain and Reinforced).

5.05.02 One sample consisting of six test cubes sh all be m ade 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, m inimum one sam ple 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, m inimum one sam ple consisting of three t est 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 slum p 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 positi on 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 item s of work in the schedule of items, describe the work in brief. The various item s in schedule of item s sh all be read in conjunction with the corresponding sections in the Technical Specifications, including am endments, and additions, if any. For each item in schedule of item s, the unit rate shall include for the activities covered in the de scription of the item as well as for a ll necessary operations described in the specification and specific requirements.

8.01.02 The unit rates shall include for m inor details which are obviously and fairly intended, and which m ay not have been included in the description in these documents, but are essential for the sa tisfactory com pletion of the work. Unit rates shall also include f or all saf ety 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 s hall be inclusive of m obilization of all plant, equipment, scaffolding, labour, m aterials, skilled and unskilled labour, and demobilization after com pletion of work, supervision, establishing the level a nd coordinates at each work.

8.01.04 The quoted rate for piling for a particul ar diam eter and capacity of pile shall remain valid for the actual lengths provided /to be provided irrespective o f the minimum length specified elsewhere in this specification.

8.01.05 The quoted rate for piling as per descrip tion of item works shall b e inclusive of providing all plant equipm ent, 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 b ench mark and distances from one set of grid lines furnished by the owner.

8.01.06 The quoted rate for piling shall be inclus ive of bailing out all the pile bore spoil from the pilebore, keeping the borehole free from bored m aterial/debris etc. and disposing the bored/chiselled m aterial along with the drilling m ud upto 2 Km. beyond plant boundary or as directed by Engineer, flushing the pile bore by fresh bentonite before concreting, co llection of sam ples from bottom of pilebore, transporting to laboratory, testing and reporting of results.

8.01.07 The quoted rate for piling s hall include shifting of plant and equipment from one pile location to another pile locati on, providing tem porary 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 have 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

A1.0 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 term inated after penetrating through the strata having SPT penetration less than __* cm for ____* blows, for a m inimum length of _____* times the diameter of the pile.

A2.2 In Rock

a) Piles shall be installed and socketed into the rocks f or a length (socketing length) equal to _____* tim es the pile diameter subject to a m inimum of _____* meter below the socketing horizon.

b) Socketing horizon shall consist of rock strata having m inimum uniaxial compressive strength of _____* kg/sq.cm.

A3. Average cut-off level f or tender design and initial load test can be assum ed 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 6 T max
3.	High pressure Mud Pumps		10 HP min 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 equipm ents shall be m obilized 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 a) diameter 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 a) SPT in soils/ weathered rock b) Core & UCS value of rock	1 borehole for 100-150 piles or group of 150 Sqm	Annexure - B
3.	Bentonite (Mud) properties. a) Basic properties of bentonite before use. b) Contaminated mud from pile bore bottom before concreting	Liquid Limit, Marsh Viscosity, Specific gravity, sand content, swelling index, pH value. Density, sand content	in lab in lab	As per Cl. 5.7 Each Pile	As per Annexure C 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 a) Workability b) Cubes	Slump cone test Compressive Strength test	Each pile As per spec.	As per Cl. 5.5 As per Cl. 5.5	As per specification. 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

Maharatna Company

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.
1.00.00	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 form ation 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 dim ensions 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, com paction, turfing on slopes (if required), lighting, disposal of residual/surplus earth etc. It also includes supply ing and providing all labour, materials, supervision, services, equipm ents, tools and plants, testing and all incidental item s 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 b) By establishing markers, boards etc
2	Filling	(a) On quality of fill material (b) On moisture content of fill material (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.

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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

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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 ag ency 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 form ed, the treated soil barrier shall not be disturbed.

2.02.00 Chemicals and Rate of Application

Any of the following chem icals (conforming to relevant Indian Standards) in water em ulsion shall be applied by pressure pum ps, uniform ly 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, basem ents etc. m ay either be fully enveloped by the chem ical barrier or the treatm ent m ay start 500 m m 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-term ite treatm ent shall be m easured f or plinth area treated.

This includes treatm ent, to foundations, walls, trenches, basem ents, 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-Term ite Measures in Buildings
Pre-constructional chemical treatment measures.

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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

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. # Frequency of test for Sr. No. 3, 4 & 5 shall be one in every 5000 M^3 for each type & source of fill material. @ 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. Note: **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)	11	Y	Y
	10	Y	Y
	9	Y	Y
	8	Y	Y
	7	Y	-
	6	Y	-
	5	Y	-
	4	Y	-
	3	Y	-
	2	Y	-
	1	Y	-
b) Earth Fill Material (After Compaction)			

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 *	-	-	-	-	-	
	2	Y *	Y #	-	-	-	-	-	
	3	Y	Y	-	-	-	-	-	
	4	Y	-	-	-	-	-	-	
	5	Y	Y	-	-	-	-	-	
	6	Y	Y	-	-	-	-	-	
	7	Y	-	-	-	-	-	-	
	8	Y	Y	-	-	-	-	-	
	9	-	Y	-	-	-	-	-	
	10	-	Y #	-	-	-	-	-	
	11	-	Y	-	-	-	-	-	
	12	Y	Y	-	-	-	-	-	
	13	-	-	Y	-	-	-	-	
	14	-	-	Y	-	-	-	Y	
	15	-	-	-	Y	-	-	-	
	16	-	-	-	Y	-	-	-	
	17	-	-	-	-	-	-	Y	
	18	-	-	-	-	-	-	Y	
	19	-	-	-	-	-	-	Y	
	20	-	-	-	-	-	-	Y	
	21	Y	Y	Y	Y	Y	Y	Y	All tests as per IS-Codes

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	Remarks/Frequency of Test
Load test on structures as per IS: 456 & core test	-	-	-	-	-	-	-	-		-	Y*	-	-	* These tests shall be carried out, incase of doubt regarding grade of concrete to due poor workmans-hip based on results of cube strength.
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	-	-	
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	-	-	-	-	-	-	-		-	-	-	-	

CIVIL & STRUCTURAL WORKS

Test Requirements / Item/Components	15. Structural Steel Like Columns, Girders, Beams & Truss Etc.	16. C.W. Pipes/Ducts
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.	
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

CIVIL & STRUCTURAL WORKS

Item/Components		Test Requirements
17. Roof Decking sheets (Supply and fixing)		
18. Wall Cladding work		
a) Outer sheet	1	T.Cs for Physical & Chemical properties
b) Inner sheet	2	Dimensional, thickness, depth of valley etc.
c) Insulation	3	Fixing of decking sheets
d) Fixing of wall cladding	4	Sides end laps
	5	Appearance
	6	T.Cs for fasteners &'Z' spacers
	7	Dimensional conformity
	8	Check for coating of silicon modified polyester paint thickness
	9	Galvanizing test as per IS code
	10	Check type of permanent colour coating
	11	Tests as per BHEL tech spec. and IS: 8183
	12	Storage
	13	Positioning and location of laps and plumb level
	14	Compressive strength, Water absorption resistant to Acid, resistant to flexural strength, INEAD
	15	Comp. Strength, bond strength working, time, chemical resistant
	16	Warpage
19. Acid Resistant Lining		
a) Acid resistant Bricks/Tiles		
b) Acid resistant Mortar		

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	
							1
							2
							3
							4
							5
							6
							7
							8
							9
							10
							11
							12
							13
							14
							15
							16

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SECTION – D

SUB SECTION – D25

RCC STACK

SPECIFICATION NO. PE-TS-441-620-C025

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 REINFORCED CONCRETE CHIMNEY

1.0.0 SCOPE

This specification covers reinforced cement concrete works, including steel 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 1.1.2 1.1.3	65	100	Very narrow and deep RCC structures 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.

VOLUME: II B

SECTION – D

SUB SECTION – D26

BOROSILICATE GLASS BLOCK LINING SYSTEM

SPECIFICATION NO. PE-TS-441-620-C026

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

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1 PROJECT DESCRIPTION

1.1. Description

The subject plant includes úKℕŜŜ tall R.C.C chʎYyŜè with ǎʎyƎfŜ mild steel flues. The indicative sketch for the same is provided elsewhere in the document.
From the FGD the flue gas will be carried to úKℕŜŜ new 150 m concrŜűŜ chiYyŜèǎ ŜIjdzʎLJLJŜŘ with ǎʎyƎtŜ mild steel flue can ŜI·ŎK, to be lined with borosilicate glass block lining system.

1.2. Flue gas characteristics

The chimney shall be working with FGD in line mode, with the operating temperature for the flue gases shall be 55-65 deg centigrade.

1.3. General configuration (Refer Annexure 1)

The Chimney shell and liner configuration shall be as given in Annexure-I. However, during detailed engineering, minor modification can be done with owner's consent.

2 SCOPE OF WORK

2.1 Scope of supply
The scope of work includes Engineering, materials, equipment's and Services for the:

2.1.1 Design, material supply, fabrication, application, Handling, transportation, storage, preserve, pack and furnish with adequate packing, test and on site application of borosilicate glass block system, over mild steel liner in the chimney, including

- Required surface preparation of mild steel flue liners, including material, labor, primer etc. all complete, for application of borosilicate glass block lining system over mild steel flue liners.
- Complete liquid (condensate) collection system up to collection sump.Borosilicate lining system at gas sampling connections ports, manholes and other appurtenances inside chimney flue liners.

2.1.2 All necessary parts, and works necessary for transport, storage and application purposes. Coordination with chimney designer & chimney contractor- providing required inputs.

2.1.3 Submission of the drawings and getting the same approved from BHEL and the project owner for borosilicate glass block lining system, erection, transportation and storage, installation of condensate extraction system.

2.1.4 The Bidder 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, 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 each 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 Bidder 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 Bidder.

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 Bidder shall obtain the owners approval prior to introducing any such change.

2.2 Bidder Services

Field personnel provided by the Bidder shall be capable and qualified to perform the required duties to the satisfaction of BHEL and the owner.

Erection services:

The Bidder shall furnish competent supervision for erecting the equipment provided under this Specification. The erection services shall be coordinated with other agencies in the scope of the subject chimney contract.

3 SPECIAL EQUIPMENT, TOOLS AND INSTRUMENTS

Bidder shall provide all special equipment, tools and instruments required for handling and storage, and for test and maintenance of borosilicate lining system provided under this Contract.

4 STANDARDS AND CODES

4.1 The borosilicate lining system to be provided under this Specification, including all appurtenances and accessories, shall be designed, fabricated, 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, fabricated, inspected, tested and preserved, as applicable, to comply with currently recognized International and/or manufacturer's specification, whichever are tighter and more restrictive.

4.2 In all cases Bidder 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 Bidder shall submit upon request a copy of Its Quality Assurance Manual including Quality Procedures.

5.2 The Bidder 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 Bidder shall conduct test to verify the mechanical properties of borosilicate bricks and adhesive/mortar and the tests shall be documented during the course of design and fabrication, and shall be made available to owner.

5.4 Unless otherwise specified the bidder's standard tests shall be performed on all batches of materials furnished. The owner may or may not elect to witness tests, but the bidder shall notify the Owner's Quality Assurance Department no later than 10 days in advance of all scheduled tests.

6 SAFETY, NOISE AND ENVIRONMENT REQUIREMENTS

6.1 SAFETY

The 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 the all materials that are potentially flammable materials and must be handled in keeping with good industry practice and in compliance with the manufacturer's recommendations.
- Owner shall supply the Bidder with the applicable rules and regulations for disposal of scrap and waste materials, which are to be followed by the bidder.

6.1.2 Safety and protection of work and property:

6.1.3

- The Bidder shall provide for the safety and protection of the work and of 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 and equipment and materials free from injury of 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 Should the lining system to be furnished by the Bidder have discharge points to the environment and/or generate waste

materials that must be discharged to the environment, the Bidder shall provide, upon Purchaser's request, a plan for the treatment of the discharge/waste to meet current regulations of the Indian government/ regulatory authorities.

6.2.2 The Bidder shall submit, within thirty (30) days of demand, additional information on noise and/or other environmental data. All information shall be prepared in a manner acceptable Indian government/ regulatory authorities.

7 TECHNICAL REQUIREMENTS

7.1 Design parameters

7.1.1 Liner considerations

The borosilicate glass block liner will be designed with a minimum thickness of 38 mm, for all its entire length. Proper provisioning should be made for borosilicate lining system for lining around gas sampling ports, expansion joints, man holes and other appurtenances.

7.1.2 Condensate handling

Stack gases in FGD inline mode are saturated vapors. The complete installation of condensate extraction system shall be in the bidder’s scope.

7.2 Design operating conditions

- Operating conditions shall be as per annexure-I
- A margin of 15 deg centigrade above the operating conditions mentioned in Annexure II shall be taken while selecting the appropriate material for design of the lining system.

7.3 Performance Requirements

7.3.1 Borosilicate brick lining system will be designed in such a way that it will not require unscheduled outages for repair except for planned and scheduled routine maintenance and inspections.

7.3.2 Borosilicate brick lining system and all of the required components will be designed for a safe, useful life of thirty (30) years (minimum).

7.3.3 The lining system (borosilicate glass block and adhesive) agency shall produce documents for operation of 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. Supporting documents for the experience to be furnished during bid/after award.

7.3.4 The lining system shall be tested for its wet stack surface properties by an independent institute of sufficient knowledge and experience, subject to acceptance by the project owner, and furthermore the lining system supplier has a demonstrable track record of providing technical advice and support to customers for the design of environmentally effective liquid control systems in flue gas ducts and chimneys.

7.3.5 The lining system (borosilicate glass block and adhesive) shall be offered by a supplier with demonstrated capabilities in the area of onsite technical support and QA/QC supervision, who employs QA/QC supervisors with a demonstrated experience of at least 5 years in technical support and QA/QC supervision of the subject lining system.

7.3.6 The lining system (borosilicate glass block and adhesive) has been tested for fire risk by an independent institute of sufficient knowledge and experience, subject to acceptance by the project owner, and it has through this testing demonstrated the ability to protect the steel chimney flues from structural damage for a minimum period of 2 hours, as per ASTM E-119.

7.3.7 The lining system (borosilicate glass block and adhesive) has been tested for worker health and safety on an actual large scale installation project by an independent institute of sufficient knowledge and experience, subject to acceptance by the project owner, and it has demonstrated through such testing that it can be used by teams of workers safely, without adverse health effects, and such without requiring excessive protective measures.

7.4 Design Requirements

7.4.1 General

- Design of the borosilicate lining system must be performed by a professional engineer with a minimum of 5 years' experience in the design of such system for chimney flues.
- Design requirements of this specification are to be regarded as minimum requirements. If the Fabricator's design and/or experience dictate these minimum requirements should be exceeded, the design should be performed accordingly.

7.5 Materials Requirements

The steel chimney flues, made of minimum 8 mm thick MS steel, shall be internally protected with a lining system consisting of minimum 38 mm thk borosilicate glass blocks, applied with a flexible, chemically resistant adhesive, using a lining system that meets all of the following requirements:

7.5.1 The lining system shall use closed cell borosilicate glass blocks with the following physical properties:

a. Density 0.144 x 10^3 kg/m3
b. coefficient of linear thermal expansion not greater than 5.5 x 10^ (-6) /°C,
c. compressive strength greater than 1.00 Mpa as per ASTM C 165,
d. flexural strength greater than 0.62 Mpa as per ASTM C.203/C.240,

7.5.2 The borosilicate glass block system shall use a flexible, chemically resistant adhesive, with all required surface preparation, primer, labor, equipment etc., all complete, with the following physical properties:

a. tensile strength at 23 °C greater than or equal to 1.0 N/mm2 as per ASTM D.412

The lining system manufacturer 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 Bidder shall construct adequate facilities for the storage of material. Upon completion of fabrication, the Bidder 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/tackels, machinery required to maintain the controlled environment during installation of borosilicate glass block shall be in the scope of bidder.

8.2 Storage

8.2.1 Materials shall be stored in a dry area and within the temperature and humidity limits recommended by the material Bidders. Do not allow shelf-life limits, as determined by the Bidder, to be exceeded.

8.2.2 Materials surfaces shall be protected from dust, fog, rain and other contaminants.

8.2.3 Affected plies shall be removed if any of the above requirements are not met during final surface preparation. The surface exposed due to the removal of the plies shall be abraded and prepared, per this Specification, before applying new plies.

9 JOB SITE INSPECTION AND PREPARATION

9.1 In coordination with the chimney supplier, the borosilicate 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

05-R-516	EDC-FGD BHEL-RANIPET	CONTRACT PHASE TRANSMITTAL: FOR CHIMNEY DESIGN	Sheet 01 of 01
		Project:	NTPC-NORTH KARANPURA (3x660 MW)
		Ranipet Cust No	G601 , G602 & G603
		FGD type	Coal fired -Wet limestone FGD system

DATA FOR CHIMNEY DESIGN

OPERATING CONDITIONS (Per Boiler)

Boiler Load			Design Point (VWO)	Guarantee Point (660MW)
		Type of Coal	Worst Coal	Worst Coal
Flue Gas Flow	:	TPH	3765	3532
Flue Gas Volume	:	m^3/s (wet)	1055	967
Flue Gas Temperature	:	°C	62.9	59.8
Flue Gas Density	:	kg/m^3	0.99194	1.01381

FGD OUTLET-FLUE GAS COMPOSITION % BY Volume – (WET BASIS)

CO_2	:	%	8.19	8.55
N_2	:	%	63.83	66.25
O_2	:	%	5.77	5.88
SO_2	:	%	0.0024	0.0024
H_2O	:	%	22.21	19.32

DUST SIZE DISTRIBUTION AT CHIMNEY INLET - % MICRONS

Below 3	94.3	Between 10 - 15	22.19
Between 3 - 5	45.79	Between 15 - 20	15.0
Between 5 - 10	28.8	> 20	10.69

OTHER DATA

Elevation of Breeching Line of the Duct in metres	38 (Approx.)	
Duct Size - Inside Dimensions in metres	5.9 (W)x12(H)	
Chimney Shell Opening Dimensions in metres	6.9 (W)x13(H)	
Flue Gas Pressure at Chimney Entry Level (mm WC)	By PEM	PEM Chimney designer to decide
No. of Chimneys	By PEM	
Type of Chimney	By PEM	
Chimney Arrangement	By PEM	
Height of Chimney	By PEM	

NOTE:

REV	DATE	REASON FOR REVISION	PREPARED	CHECKED	APPROVED
00	22-10-2018	Fresh issue	RL	KM	VK

VOLUME: II B

SECTION – D

SUB SECTION – D27

TITANIUM / C276 CLADDED CHIMNEY FLUE LINER

SPECIFICATION NO. PE-TS-441-620-C002

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

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1.1 **General**

Chimney flue liners of single flue RCC chimneys shall be provided for the subject project, including supply & installation of condensate extraction system for acid drainage.

The Chimney flue liner shall be made of composite metal of Cladded steel consisting of Mild steel base of 8 mm/12mm/ 16mm thickness (as per different flue cans shown in detailed engineering drawing) cladded with 2 mm thick titanium sheet. Cladding shall be done with explosion bonding or hot rolling or combination of both to achieve the required quality as per ASTM B 898-11. Entire length of Chimney flue shall be manufactured as per this specification. The grade of titanium sheet shall be Grade 2 as per ASME SB265.

Or

The Chimney flue liner shall be made of composite metal of Cladded steel consisting of Mild steel base of 10 mm /12mm/ 16mm thickness (as per different flue cans shown in detailed engineering drawing) cladded with 2 mm thick Alloy C-276 sheet. Cladding shall be done with explosion bonding or hot rolling or combination of both to achieve the required quality as per ASTM B 898-11. Entire length of Chimney flue shall be manufactured as per this specification.

Thermal insulation, as specified elsewhere, shall be provided on the external side of the flue liners. Two manholes placed diametrically opposite shall be provided in each flue at all internal platform levels. Also provision shall be made for gas sampling ports, condensate extraction system, expansion compensator or any other appurtenance or its component required for satisfactory function of intended purpose of chimney flue liner.

Chimney liner material should be sourced from a supplier, who has supplied composite metal of Cladded steel consisting of Mild steel base cladded with titanium/C276 sheet for chimney liners or other industrial applications storing corrosive chemicals or working under pressure. The supplier shall be approved by QA department.

The Contractor shall engage an experienced fabricator for Titanium / C-276 cladded plate welding. The fabricating agency should have fabricated Titanium /C276 cladded or Titanium/C276 sheets in application like chimney flues or vessels storing corrosive liquid of minimum size 5m (diameter) or industrial equipment working under pressure in industrial plants. The fabricated chimney flue/vessels should be in operation. The welders should be certified & tested welders for Titanium /C276 or Titanium/C276 clad structures. The fabricator shall be approved by QA department.

1.2 **Flue gas parameters (Refer Annexure I)**

Operating conditions is de fined in Annexure-I. However, during detailed engineering, variation may occur as per approved document.

2 SCOPE OF WORK

Supply of all materials, fabrication, erection at site, including preparation of fabrication drawings, connection design, transport, storage, handling, testing, etc. all complete work, for

1. Chimney flue liners (cans), made of Titanium/C276 alloy clad sheet (internal side cladded with 2mm thick titanium/C276 alloy over a base of 10mm/16mm mild steel), including, stiffeners, connection of one liner can with another, supporting arrangement of liners with structural steel platforms (chimney platform is in scope of main chimney contractor).
2. All openings for manholes, gas sampling ports, condensate extraction system, provisions for expansion compensator etc., and other provisions necessary for satisfactory function of intended purpose of chimney flue liner.
3. Thermal Insulation from outside of Flue cans as per detailed drawing and BOQ.
4. Painting entire external surface of chimney flue liner with acid and heat resisting black bituminous paint (conforming to type I(i) of IS:158) in four coats.
5. External surface of mini-shell over roof, (refer Annexure IV), shall be wrapped with 2mm thick titanium/C276 sheet, over insulation.
6. Submitting all designs and drawings of fabrication, Condensate drainage system, expansion joints etc. and getting it approved from BHEL.
7. Supply, fabrication and erection of condensate extraction & drainage system. Condensate will be collected in a collection tank. For drainage of condensate from condensate extraction system, outside chimney liner, to terminal point (collection tank), FRP pipe shall be provided. Suitable attachments and its sealing should be provided at transition from Titanium pipes protruding outside chimney shell to FRP pipe for drainage.

3 STANDARDS AND CODES

3.1 Standards and Codes referred in this Speci fication and in the Supplements to this specification, for m an Integral part of this Spe cification. All such Standards and Codes are to the issue, including all amendments, supplements, etc., current as of the date of the Contract, unless indicated otherwise. In th e event of a varian ce between the requirem ents of the Standards and Code s and the particular requirem ents set forth in the specification, the stringent amongst the two shall be adopted.

3.2 Subject to the provisions stated above , the Chi mney flue liner and com plete system defined as per scope shall be desi gned, manufactured, erected, and tested in accordance with the standards, regulations , d irectives an d publications of the following agencies and organizations and listed standards below:

EPRI: Revised Wet Stack Design guide

ASME BPVC Section II Part C: Specifica tions for W elding Rods, Electrodes, and Filler Metals.
ASME BPVC Section V Non-destructive Examination
AWS welding guidelines
ASTM D4618 Standard Specification for Design and Fabrication of Flue Gas Desulfurization System Components for Protective Lining Application
NACE Standard RP0178-89, Standard Recomm ended Practice Fabrication Details, Surface finish requirements, and Proper Design Considerations for Tanks and vessels to be lined for Immersion service
ASME SB265 Standard specif ication f or Titanium and titanium alloy strip, she et, and plate
ASTM A264 Standard specification for stainless chromium-nickel steel-clad plate
ASTM B862 Titanium and titanium alloy welded pipes
ASTM A36 Structural steel
ASTM A28 3 Carbon steel plates, sec tion steel and steel bars for interm ediate and low strength
ASTM B898-11 Standard Specification for Reactive and Refractory Metal Clad Plate
ASME SB367 Casting
ASME SB381 Forgings
ASTM B363 Fittings
ASTM A578 / A578M – 07 Standard Specif ication for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications
ASTM A263 Standard Specification for Stainless Chromium Steel-Clad Plate
ASME Code: Boiler and Pressure Vessel Code, Section IX, Welding Qualifications
ASME Code: Boiler and Pressure Vessel Code, Section VIII, Division1
ASME Code: Boiler and Pressure Vessel Code, Section II, SA and SB equivalents to ASTM specifications as applicable
ASME SB575 Plate, Sheet & Strip
ANSI/AWS Z49.1, Safety in Welding and Cutting
ASME SFA 5.14 Weld filler material (Bare) ERNiCrMo-4
ASME SFA 5.11 Weld filler material (Covered) ENiCrMo-4
ASME SB366, ASME SB 462 Fittings
ASME SB564, ASME SB 462 Forgings ASTM A578 / A578M – 07 Standard Specification for Straig ht-Beam Ultrasonic Exam ination of Rolled Steel Plates for Special Applications
ASTM A265 - 12 Standard Specification for Nickel and Nickel-Bas e Alloy-Clad Steel Plate

4 TECHNICAL REQUIREMENTS OF TITANIUM CLADDED CHIMNEY FLUE LINER SYSTEM

4.1 Material

The composite flue Chimney flue liner shall be of Mild steel base of 10 mm or 16mm thickness cladded with 2 mm thick titanium, using explosion bonding or hot rolled or combination of explosion bonding & hot rolled, for its entire Chimney flue length as per scope. The grade of titanium shall be Grade 2 as per ASME SB265 Base metal, structural steel: As per BHEL Corporate Standard AA 10119 (Refer Annexure III) or confirming to A36 as per ASTM or Grade S 235 as per BSEN 10025-2. Minimum yield strength shall be 235N/mm2.

The approximate quantity breakup of the material shall be as below:

S.No.	Clad material		Base material		Surface area, m^2. (Approx.)
		Minimum thickness, mm	material	Minimum thickness, mm	
1	Titanium, Grade 2	2 mm	Mild steel	8 mm	4200
2	Titanium, Grade 2	2 mm	Mild steel	12 mm	950
3	Titanium, Grade 2	2 mm	Mild Steel	16 mm	250
4	Titanium, Grade 2	2 mm	Mild Steel	10 mm	250

- The cladding metal shall be bonded to the base metal by explosion bonding, or hot rolled or combination of explosion bonding & hot rolled, for its entire Chimney flue length as per scope which will conform to the requirements of this specification.
- The rolling of the titanium clad plate for making cylindrical chimney flues shall be done using rolling machine with rollers having relatively soft material layer like PVC or rubber or any suitable material approved by customer over steel rollers for protection of titanium clad surface against dent and surface damage.

4.2 Dimensions, tolerances, testing, properties:

4.2.1 General

(A) Base Metal Mild Steel as per this specification

a) Sizes:

(i) The Mild steel plates to be used as base metal for cladding shall be supplied in the following dimensions:
Length (minimum) and width (minimum) of the plate = 7m (length) X 2m (width)
b) Tolerances:
i) Tolerances for dimensions, flatness shall be as per IS 2062.
ii) Tolerance on thickness of base metal shall comply with IS:1852 "Rolling and Cutting tolerances for Hot Rolled Steel products" and ASTM B898
iii) Thickness specified is minimum 10mm or 16mm.
iv) Minimum yield strength shall be 235N/mm2.
c) The chamfered MS plate at transition from 16mm to 10mm shall be manufactured from 16mm thick MS plate.

(B) Titanium Sheet Grade 2 as per this specification
(a) Sizes:
i) Titanium Grade 2 sheet to be used as clad material before cladding shall be supplied in the following dimensions:
Length (minimum) and width (minimum) = 7m (length) X 1.0m (width)

(b) Tolerances:
Tolerances for thickness, dimensions, flatness shall be as per ASME SB265 -2013 Section II Part-B.
(c) Thickness specified for Titanium Grade 2 Sheet shall be minimum 2mm.
(d) Mechanical and Chemical properties shall be according to ASME SB265 -2013 Section II Part-B.

(C) Cladded Titanium Sheet with MS base plate as per this specification
a) Sizes:
i) The Titanium cladded sheet after cladding shall be supplied in the following dimensions:
Length(minimum) and width(minimum) = 7m (length) X 2m (width)
Width of plate shall be in general 2m (minimum). However, to adjust the height of flue can as per drawing and spacing of chimney platform, lesser width of titanium cladded plate shall be manufactured and supplied for fabrication with edge details suitable for welding of titanium cladded plates.
b) Tolerances:
Tolerances for thickness, dimensions, flatness shall be as per ASTM B898-11. The minimum specified material specification of its component base metal and Titanium sheet individually shall be as mentioned above.
c) Clad metal thickness shall not be less than specified thickness of minimum 12mm (2mm Titanium + 10mm MS Plate) or minimum 18mm (2mm Titanium + 16mm MS Plate).
d) For complying with requirement of minimum plate size of cladded plate, one longitudinal joint is permitted in clad material of Titanium sheet with specified weld quality and post weld finishes before cladding. In case cladded plate has length longer than specified Titanium sheet length, one staggered transverse welding is permitted. However, bidder has to submit the detailed cladding procedure along with

Technical offer as m entioned in this specification. Al l welding shall be done in accordance with ASME Section IX and AWS.

e) Measurem ent of flue can inn er surface area for pay ment shall be based o n thickness of cladded plate 12/18mm. In ch amfer area at tran sition from 16mm to 10mm MS plate, the measurement of inner surface of flue shall be considered under 18mm thick cladded plate.

4.2.2Freedom from Defects:

The material shall be clean, smooth, sound and free from injurious defects.

4.2.3Test Samples:

Test samples shall be selected and prepared as per ASTM B 898. Number of tests and re tests shall be carried out as per ASTM B 898.

4.2.4Mechanical Properties of cladded Steel:

(i) Tensile: The tensile lest conducted on the test specimen including cladding metal shall follow the following properties:
Tensile strength – 410N/mm2 minimum
Yield strength - 230N/mm2 minimum
(0.2% offset)

(ii) Ductility Bend Test of Cladded material: The ductility bend test shall be done as per ASTM B898-11. Two types of bend tests of the composite plate shall be made, one with the cladding metal in compression and the other with the cladding metal in tension.

(iii) Shear Strength of Cladded material: The Shear strength test shall be carried out as per ASTM B898-11. When tested, the shear strength of the cladded plate shall not be less than 137.9 N/mm2.

(iv) Ultrasonic testing: The cladded plate shall be examined ultrasonically as per ASTM A578/ A578M with acceptance Quality level “Class-C”.

4.2.5Repair of cladding:

Any repair work on the cladded plate shall be agreed upon between Customer and the contractor.

4.3 **Welding of Titanium Cladded MS plate for fabrication of Chimney Flue**

1. Welding of titanium clad sheet with titanium sheet shall be done using TIG (Tungsten arc welding), following relevant Indian codes, AWS and other international codes.
2. Welding preparation: Raw materials before processing shall be inspected for surface defects, and treated prior to adjustment. Before welding, titanium must be cleaned thoroughly of any dirt, impurities etc. Use acetone to remove oil and other organic impurities on both sides of the weld. The filler wire is scrubbed with acetone before use.

3. Groove preparation: Flame cutting methods should be used for straight slope mouth. Groove processed surface should be flat, smooth, and shall not have cracks, delamination, inclusions, burrs, flash and other defects, groove surface shall have silver-white gloss.
4. The edge preparation and extent of Titanium plate cladding for making provision of welding of cladded plate shall be done at manufacturer's shop as per welding details of cladded plate.
5. For welding details for titanium cladded sheets refer Annexure VI.

4.4 **Quality assurance:**

I) The contractor shall submit details of all the tests required to ensure that the cladded plates offered conform to the requirement of the applicable codes and standards conducted by manufacturer.

II) Bidder shall be solely responsible for the quality assurance responsibilities, and should be responsible for quality assurance activities of his full-time staff, all the engineering and all experiments. Supervisors should also have large experience in metal siding engineering.

III) Composite plate production and fabrication should meet the relevant standards and regulatory requirements of the country, and should give full consideration to the use of environmental conditions and conditions of use affect the material.

IV) Bidder shall submit, and get approved from BHEL, construction site welding, installation considerations and installation quality assurance methods. Other matters should also be complied with latest national/international and industry norms and standards.

V) Composite plate manufacturer shall have a sound quality assurance system, and shall submit a comprehensive quality assurance program, the plan should include qualified quality assurance procedures, organization and personnel involved Proof and influence the quality of the project activities such as design, procurement, manufacturing, transportation, installation and maintenance control.

5 TECHNICAL REQUIREMENTS OF C276 CLADDED CHIMNEY FLUE LINER SYSTEM

5.1 **Material**

The com posite ch imney f lue liner shall be of Mild steel base of 10 mm /16mm thickness cladded with m inimum 2 mm th ick C276 alloy, using explosion bonding or hot rolled or com bination of explosi on bonding & hot rolled, fo r its entire length of scope. The C276 cladding sheet shall be as per ASME SB575.

Base m etal, structural steel: As pe r BHEL Cor porate S tandard AA 10119 (Refer Annexure III) or confirm ing to A36 as per ASTM or Grade S 235 as per BSEN 10025-2. Minimum yield strength shall be 235N/mm2.

The approximate quantity breakup of the material shall be as below:

S.No.	Clad		Base material		Surface area, m^2. (Approx.)
	material	Minimum thickness, mm	material	Minimum thickness, mm	
1	C276	2 mm	Mild steel	8 mm	4200

2	C276	2 mm	Mild steel	12 mm	950
3	C276	2 mm	Mild steel	16 mm	250
4	C276	2 mm	Mild steel	10 mm	250

- The cladding metal shall be bonded to the base metal by explosion bonding, or hot rolled or combination of explosion bonding & hot rolled which will conform to the requirements of this specification.
- The rolling of the C276 clad plate for making cylindrical chimney flues shall be done using rolling machine with rollers having relatively soft material layer like PVC or rubber or any suitable material approved by customer over steel rollers for protection of C276 clad surface against dent and surface damage.

5.2 **Dimensions, tolerances, testing, properties:**

5.2.1General

(A) Base Metal Mild Steel as per this specification
(a) Sizes:
(i) The Mild steel plates to be used as base metal for cladding shall be supplied in the following dimensions:
Length (minimum) and width (minimum) of the plate = 7m (length) X 2m (width)
(b) Tolerances:
(i) Tolerances for dimensions, flatness shall be as per IS 2062.
(ii) Tolerance on thickness of base metal shall comply with IS:1852 “Rolling and Cutting tolerances for Hot Rolled Steel products” and ASTM B898
(iii) Minimum yield strength shall be 235 N/mm2
c) The chamfered MS plate at transition from 16mm to 10mm shall be manufactured from minimum16mm thick MS plate.

(B) C276 Sheet as per this specification
(a) Sizes:
(i) The C276 sheet to be used as clad material before cladding shall be supplied in the following dimensions:
Length (minimum) and width (minimum) = 7m (length) X 1.0m (width)
(b) Tolerances:
Tolerances for thickness, dimensions, flatness shall be as per ASME SB575.
(c) Thickness specified for C276 Sheet shall be minimum 2mm.
(d) Mechanical and Chemical properties shall be according to ASME SB575.

(C) Cladded C276 Sheet with MS base plate as per this specification
(a) Sizes:
The C276 cladded sheet after cladding shall be supplied in the following dimensions:
Length (minimum) and width (minimum) = 7m (length) X 2m (width)

Width of plate shall be in general 2 m (minimum). However, to adjust the height of flue can as per drawing and spacing of chimney platform, lesser width of C276 cladded plate shall be manufactured and supplied for fabrication with edge details suitable for welding of C276 cladded plates.
(b)Tolerances:
Tolerances for thickness, dimensions, flatness shall be as per ASTM B898-11.
(i) The minimum specified material specification of its component base metal and C276 sheet individually shall be as mentioned above.
(c) Clad metal thickness shall not be less than specified thickness of minimum 12mm (2mm C276 + 10mm MS Plate) or minimum 18mm (2mm C276+ 16mm MS Plate).
d) For complying with requirement of minimum plate size of cladded plate, one longitudinal joint is permitted in clad material of C276 sheet with specified weld quality and post weld finishes before cladding. In case clad plate has length longer than specified C276 sheet length, one staggered transverse welding is permitted. However, bidder has to submit the detailed cladding procedure along with Technical offer as mentioned in this specification. All welding shall be done in accordance with ASME Section IX and AWS.
(e) Measurement of flue can inner surface area for payment shall be based on thickness of cladded plate 12/18mm. In chamfer area at transition from 16mm to 10mm MS plate, the measurement of inner surface of flue shall be considered under 18mm thick cladded plate.

5.2.2Freedom from Defects:

The material shall be clean, smooth, sound and free from injurious defects.

5.2.3Test Samples:

Test samples shall be selected and prepared as per ASTM A265. Number of tests and re tests shall be carried out as per ASTM A265.

5.2.4Mechanical Properties of cladded Steel:

(i) Tensile: The tensile lest conducted on the test specimen including cladding metal shall follow the following properties:
Tensile strength – 410N/mm2 minimum
Yield strength - 230N/mm2 minimum
(0.2% offset)

(ii) Ductility Bend Test of Cladded material: The ductility bend test shall be done as per ASTM B898-11. Two types of bend tests of the composite plate shall be made, one with the cladding metal in compression and the other with the cladding metal in tension.
(iii) Shear Strength of Cladded material: The Shear strength test shall be carried out as per ASTM B898-11. When tested, the shear strength of the cladded plate shall not be less than 137.9 N/mm2.

(iv) Ultrasonic testing: The cladded plate shall be examined ultrasonically as per ASTM A578/ A578M with acceptance Quality level "Class-C".

5.2.5Repair of cladding:

Any repair work on the cladded plate shall be agreed upon between BHEL and the contractor before carrying out such repair.

5.3 Welding of C276 Cladded MS plate for fabrication of Chimney Flue

1. Welding of C276 clad sheet with C276 sheet shall be done using TIG (Tungsten arc welding), following relevant Indian codes, AWS and other international codes.
2. Welding preparation: Raw materials before processing shall be inspected for surface defects, and treated prior to adjustment. Before welding, C276 must be cleaned thoroughly of any dirt, impurities etc.
3. Groove preparation: Flame cutting methods should be used for straight slope mouth. Groove processed surface should be flat, smooth, and shall not have cracks, delamination, inclusions, burrs, flash and other defects, groove surface shall have silver-white gloss.
4. The edge preparation and extent of C276 plate cladding for making provision of welding of cladded plate shall be done at manufacturer's shop as per welding details of cladded plate.

5.4 Quality assurance:

i) The contractor shall submit details of all the tests required to ensure that the cladded plates offered conform to the requirement of the applicable codes and standards conducted by manufacturer.
ii) Bidder shall be solely responsible for the quality assurance responsibilities, and should be responsible for quality assurance activities of his full-time staff, all the engineering and all experiments. Supervisors should also have a wealth of experience in metal siding engineering.
iii) Composite plate production and fabrication should meet the relevant standards and regulatory requirements of the country, and should give full consideration to the use of environmental conditions and conditions of use affect the material.
iv) Bidder shall submit, and get approved from BHEL, construction site welding, installation considerations and installation quality assurance methods. Other matters should also be complied with latest national/international and industry norms and standards.
v) Composite plate manufacturer shall have a sound quality assurance system, and shall submit a comprehensive quality assurance program for manufacturing, transportation, installation and maintenance control.

6 FABRICATION OF CLAD STEEL FLUE

6.1 SCOPE

This specification covers supply, fabricati on, testing, painting and delivery to site of Titanium/C276 clad steel work including supply of all consum ables, bolts, titanium/C276 bolts & f ixtures, nuts, washers, electrodes, filler materials, titanium cover plates, tools and plants and other m aterials required for fabrication and field connections of all structural clad steelwork, titanium/C276 sections/shapes covered under the scope of the contract. Fabrication of structural steel works shall be as per Sub-section D14: Fabrication of structural steelwork of Chimney Specification Section D (PE-TS-441-620-C002)

6.2 GENERAL

6.2.1 Work to be provided for by the Contractor

The work to be provided fo r by the Contractor, unless ot herwise specified elsewhere in the contract, shall include, but not be limited to the following

a) Preparation of com plete detailed fa brication drawings and erection m arking drawings required for all the structures covered under the scope of the contract based on the approved design drawings. As deci ded by the Engineer, som e or all of these detailed drawings will have to be submitted for approval.

b) To subm it revised design with calcula tions and detailed fa brication dra wings in case any substitution of the designed sections are to be made.

c) To subm it design calculations for jo ints and. connections developed by the contractor along with detailed fabrication drawings.

d) Furnish all m aterials, labour, tools a nd plant and all consumables required for fabrication and supply, all nece ssary bolts, nuts, washers, tie rods and welding fille r materials and electrodes for field connections,

e) Furnish shop painting of all fabricated clad steelwork as per requirem ents of this Specification.

f) Suitably mark, bundle, and pack for transport all fabricated materials.

g) Prepare and furnish detailed Bill of Ma terials, Drawing Off ice Dispatch lists, Bolt List and any other list of bought out items required in connection with the fabrication and erection of the structural **clad** steelwork.

h) Insure, load and transp ort all fabricated **clad** steelwork field connection materials to site.

i) Maintain a fully equipped workshop at site for fabrication, m odification and repairs of **clad** steelwo rk at site as m ay be r equired to com plete the works in accordance with the Contract.

j) Fabrication work including surface finish, cutting, bending, welding etc as per ASME B 265/ ASME SB 575/ASTM D 4618, NACE Standard RP0178-89 and ASME Sec-IX.

6.2.2Conformity with Designs

The contractor shall design all connec tions, supply and fabricate all cladded steelwork and furnish all connection m aterials in accord ance with the approved drawings and/or as in structed by the Eng ineer k eeping in v iew the m aximum Utilization of the ava ilable s izes a nd sect ions of cladded stee l m aterials. The methods of painting, m arking, packing and de livery of all fabricated m aterials shall

be in accordance with the provisions of the contract specification and/or as approved by the Engineer. Provision of all relevant Indian/International Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract.

6.2.3 Electrodes & Filler materials

All tungsten electrodes EW Th-2 & filler materials etc to be used for TIG welding under the Contract shall be of approved reputed manufacture and shall comply with Section SFA-5.12/ SFA5.12M of ASME Section II Part C: Specifications for Welding Rods, Electrodes, and Filler Metals.
Applicable Filler wire for welding must meet high-quality standards. Filler wire to be used shall be in straight cut length and not in coil form.

6.2.4Storage of material

6.2.4.1 General

All materials shall be so stored as to prevent deterioration/contamination 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 realized from the Contractor. The Contractor shall maintain up to 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.

6.2.4.2 Cladded 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. Materials have to be stored under cover and suitably painted on base metal side and suitable cover on clad plate side for protection against weather.

6.2.4.3 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.

6.2.4.4 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 bags or compartments according to diameter, length, and quality.

6.2.4.5 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.

6.2.5Quality Control

The Contractor shall establish and maintain quality control procedures for different items of work and materials 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, labor 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

Cladded Steel: Quality manufacturer's test certificates complying the requirement mentioned ASTM B898/ ASTM A264 for each lot of supply.

b) Rivets, Bolts, washers : Manufacturer's certificate, dimension checks, Nuts & material testing.

c) Electrodes & filler wire : Manufacturer's certificate complying ASME Section II Part C: Specifications for Welding Rods, Electrodes, and Filler Metals. Electrodes and Filler wire shall also conform to schedule 5/J for level of testing of AWS A5.01M/A5.01

d) Welders : Qualifying tests in accordance with the requirements of ASME Section IX/ ASTM A488/A488 M-16.

e) Welding sets : Performance Test certificate.

f) Welds : Visual Inspection, Dye penetrant inspected in accordance with ASME Section VIII, Division 1, Appendix 8, Radiographic tests in accordance with the requirements of ASME Section V.

g) Paints : Manufacturer's certificate, physical inspection reports

6.2.6Standard dimensions, forms and weights

The dimensions, forms, weights and tolerances of all cladded plates, Titanium /C276 shapes/sheets, Titanium/C276 bolts, bolts, nuts, studs, washers etc. and other

members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of specification specified elsewhere and latest relevant Indian/International Standards.

6.2.7Fabrication 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 chimney flue with titanium/C276 cladded steel plate for approval. Within one week after receipt of approved design/drawing of chimney flue from BHEL, contractor shall submit detailed fabrication drawing indicating detail of all joints, cut pieces, edge/groove detail, stiffener, bolting arrangement, sealing arrangement, expansion joint detail, gutter and drainage pipe connections and other detail as necessary for completeness of work for approval. 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) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.
c) 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 clad 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 clad 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 BS499-1:2009/other national or international standard 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.

7 WORKMANSHIP

7.1 Fabrication

7.1.1General

All workmanship shall be equal to the best practice in m odern structural shops, and shall conform to the provisions of th e ASTM D4618 and NACE Standard RP0178-89.

Plates out of which flues will be fabricated, should be bent to the required shape on an appropriate machine. Rolling m achine shall be with rollers ha ving soft m aterial like PVC or rubber or any suitable m aterial approved by custom er over steel rollers for protection of clad plat e surface agains t dent and surface dam age. No s mithy process shall be adopted for the purpose. Pl ates are to be prevented from distorting by m ore than the tolerances specified during transportation, storage, handling, erection and jointing. All com ponents should be correctly locate d and brought into correct alig nment and level with in specifi ed erection tolerances, before adjacen t pieces are jointed or secured.

7.1.2Straightening Material

The product surfaces sh all be free o f excess imperfections and extran eous materials as determ ined by visual exam ination. Ex cessive im perfections are those which exceed the s tandards of the cladding and ba se m etal specifications resp ectively, or approved standards. Exam ples of i mperfections are scratches, dents, burrs, seams, blisters, and heavy oxidation. Im perfections, which reduce the cladding, or base metal thick ness, or bo th, below the m inimums specified are not perm issible. Examples of extraneous materials are dirt, lubricants, metal chips, abrasive grit, and excess weld metal or spatter.
The claddin g surface shall be b lasted, pick led, ground, or polish ed to rem ove extraneous material.
Surface defects m ay be blended by grind ing, p roviding the m etal thick ness is not reduced below the specified minimum.
If straightening is necessary, it may be done by Rolling m achine with rollers having soft material like PVC or rubber or any suitable material approved by customer over steel rollers for protection of clad plate surface against dent and surface damage.

7.1.3Cutting

Clad steel plate can be cut thermally by using flame or plasma cutting method. In the case of plasma cutting, the plate is usually positioned such that the cladding material

side is sho wing. W here fla me cut edges are necessary, they should be ground to remove hardened material before blasting.

7.1.4Planning of edges

The edge preparation and extent of Titanium/C276 plate cladding for m aking provision of welding of cladded plate shall be done at shop as pe r welding details of cladded plate.
All edges and similar abrupt contours shall be rounded off by grinding or m achining to a 1⁄8 in. (3 mm) minimum radius.
Fillets and changes in cont our shall be ground to a 1 ⁄8 in. (3 mm) m inimum radius where required for the selected lining m aterial. Any grinding done on welds, edges, and fillets shall be done carefully to eliminate potential problems caused by gouging of the parent metal.
Groove preparation: Flame/Plasma cutting methods should be used for straight slope mouth. Groove processed surface should be flat, smooth, and shall not have cracks, delamination, inclusions, burrs, flash and other defects.

7.1.5Clearances

The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end.

7.1.6Welded Construction

7.1.6.1 General

Welding shall be in accordance with ASME Section IX/ASTM A488/A488M/ ASTM D 4618-92. Welding shall be done by e xperienced and good welders who have been qualified by tests in acco rdance with ASME Section IX. Any portion of the weld remaining on the internal surface of the stack subjected to flue gas shall be made flush and ground smooth.
Horizontal weld seam s fabricated flue can using C276 clad plat e shall be lim ited to 1/8-in (0.003-m) reinforcem ent or projecti on on the inside of the liner. Horizontal welds on the inside of a choke are us ually ground flush to prevent liquid re-entrainment.
Vertical weld-seam reinforcem ent in a wet stack, including the c hoke, is also shall be limited to 1/8 in (0.003 m). Limiting the size of the horizontal weld seams is more critical than the vertical weld seams with regard to minimizing liquid re-entrainment.
For all welding processes, the Contractor prepares and subm its for approval the welding-procedure specification (WPS) and the procedure- qualification test resu lts (PQR). For carbon-steel welding, the weldin g-procedure specification includes the non-mandatory inform ation included in Appendix E of AWS D1.1/Subsection D Fabrication of Structural steel works, in addition to the mandatory information listed in Appendix IV, Table IV-1 of AW S D1.1. For alloy welding, the welding

procedures typically address all essential and nonessential variables of Section IX of the ASME Code. Only approved welding proce dures shall be used for fabrication of Titanium/C276 clad members.

7.1.6.2 Preparation of material

Surface to be welded shall be free from loose scale, slag, rust, grease, paint, and any other foreign material. Joint surfaces shall be free from fins and tears.
Raw materials before processing shall be inspected for surface defects, and treated prior to adjustment.

Before welding, titanium must be cleaned thoroughly of any dirt, impurities etc. Use acetone to remove oil and other organic impurities on both sides of the weld. The filler wire if used, shall be scrubbed with acetone before use.

Before welding, C276 must be cleaned thoroughly of any dirt, impurities etc.

7.1.6.3 Assembling

Parts to be fillet welded sha ll be brought in, as close cont act as practicable and in no event shall be separated by more than 2.5 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be incr eased by the amount of the separation. The fit of joints at contact surfaces, which are not co mpletely sealed by, welds, shall be close enough to exclude water after painti ng. Abutting p arts to be butt-welded sha ll be carefully aligned. Misalignm ents greater than 2 mm shall be corrected and in making the correction the part s shall not be drawn into a sharper s lope than two degrees (2°).
The work shall be positioned for flat welding whenever practicable.

7.1.6.4 Welding Sequence

In assem bling and joining parts of a st ructure, the procedure and sequence of welding sha ll be such as will avoid n eedless distor tion a nd m inimize shrinkage stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

7.1.6.5 Welding technique

7.1.6.5.1 Titanium clad metal welding

Welding of titan ium c lad sheet with ti tanium sheet shall be done using TIG (Tungsten arc welding), following relevant Indian codes, AW S and other international codes.
For welding details for titanium cladded sheets refer Annexure VI.

7.1.6.5.1.1 CLEANING

Careful pre-weld cleaning is essential to the successful joining of titanium cladded sheet. Proper surface preparation is important to
(1) Remove scale, dirt, and foreign material that can contaminate the joint,
(2) Help control weld porosity in arc-welding operations, and
(3) Ensure uniform surface conditions and thereby improve weld consistency
However, if elevated temperature forming has been performed, the light oxide scale should be removed. Otherwise the oxide skin on the adjacent surfaces being joined will be fused into the weld nugget, which can lead to a drastic reduction in the ductility of the welded joint.

7.1.6.5.1.2 Grease and Oil Removal.

Grease and oil accumulated on titanium parts during machining and other operations must be removed prior to joining to avoid contamination. Degreasing may be accomplished in any of the following ways:
(1) Steam clean
(2) Alkaline wash or dip in a dilute solution of sodium hydroxide
(3) Solvent wash methyl ethyl ketone, methyl alcohol, toluene, acetone, or other chlorine-free solvents
(4) Hand wipe with solvent-dampened. clean- lint-free cloths immediately before welding. Plastic gloves are recommended for this type of operation. Reactions between
solvents and some of the compounds in rubber gloves can leave deposits on the joint that cause porosity. Parts showing evidence of surface contamination immediately prior to assembly should be rejected and must be reCleaned. If the surface contamination is light dust settled out of the atmosphere, the parts are wiped with solvent-dampened cloths and dried just prior to the joining operation.
Residue from the degreasing treatment must not be allowed to remain in the joint area. Temperature-sensitive crayon and paint markings and pencil and ink markings also should be removed from areas before joining operations. These materials can contaminate either the underlying metal or the weld metal and result in embrittlement or porosity.

7.1.6.5.1.3 Scale Removal.

Scale if formed shall be removed by any suitable method such as chemical pickling or mechanical technique as per manufacturer recommendations.
The steps followed by one fabricator in removing light scale are as follows:
(1) Degrease to remove oil or grease
(2) Alkaline clean
(3) Rinse
(4) Immerse in scale. conditioner
(5) Rinse
(6) Immerse in HF-HNO_3 pickle.

7.1.6.5.1.4 Evaluating Cleanliness.

A common method for evaluating the cleanliness of a part emerging from descaling and pickling operations is to observe wate r breaks during the water rinse. No water break indicates a clean s urface while the p resence of a water break indicates som e foreign material remaining on the surface.

7.1.6.5.1.5 SHIELDING

Protection of titanium from contamination during joining operations can be accomplished in any of the following ways.
(1) Perform the operation inside an inert-gas-filled chamber.
(2) Perform the operation with flowing inert gases through the welding torch, back-ups, fixtures, and auxiliary tooling.
(3) Perform the operation in a good vacuum " a closed chamber".

7.1.6.5.2 C276 clad metal welding

Welding of C276 clad sheet with C 276 sheet shall be done us ing TIG (Tungsten arc welding). Welding shall be in accordan ce with ASME Section IX/ASTM A488/A488M/ ASTM D 4618-92. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with ASME Section IX. Any portion of the weld remaining on the internal surface of the stack subjected to flue gas shall be made flush and ground smooth.
For welding details for C 276 cladded sheets refer Annexure VII.

7.1.6.6 Equipment

These shall be capable of producing proper current so that the operator m ay produce satisfactory welds. The welding m achine shall be of a type and capacity as recommended by the m anufacturers of electrodes or as m ay be approved by the engineer.

7.1.6.7 Architectural Clearances

Bearing plates and stiffener connections shall not be perm itted to encroach on the designed architectural clearances.

7.1.6.8 Shop connections

a) All sho p connectio ns shall b e otherwis e riveted or welded as s pecified on the Drawings.

a) 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.

7.1.6.9 Castings

Steel castings shall be annealed.

7.2 Shop erection

The cladded 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 cladded steelwork shall be shop erected in such a way as will facilitate the check of interchange ability.

7.2.1Shop painting

7.2.1.1 General

Unless specifically exempted, all other steel work 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 fiber brush.

7.2.1.2 Inaccessible parts

Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, positively of different colors to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

7.2.1.3 Contact surfaces

Contact surface shall be cleaned in accordance with sub-clause 7. 1.6.5.1.1 for cladded titanium plate before assembly.

7.2.1.4 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.

7.2.1.5 Surfaces adjacent to field welds

Unless otherwise provided for, surfaces within 50 mm of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

8 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

8.1 Inspection

Visual inspection shall be made for all welds during the welding operation and gain after the w ork is completed to determ ine that thorough fu sion exists between adjacent layers of weld metal and between the weld metal and base metal. After the welding is completed, slag shall be rem oved from all welds. The weld the adjacen t weld metal shall be cleaned by brushing or other suitable means. The inspector shall pay particular attention to surface cracking, surface porosity, surface slag inclusion, undercut, overlap, gas pockets , and size of welds. De fective welding shall be corrected according to ASME or AWS code requirements.

Unless specified otherwise, inspection to all, work shall be made by the Engineer or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative sh all have free acces s at all reasonab le times to those parts o f the manufacturer's works which are concerne d with the fabrication of the steelwork under this Contract and he shall be afforded all reason able facilities for satisfying himself that the fabrication is being done in accordance with the pro visions of this Specification.

The Contractor shall provide free of charge , such labour, m aterials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as m ay be required by the Engineer to carry out inspection and/or te sts in accordanc e with the Contract. T he Contractor shall guarantee compliance with the provisions of this Specification.

Verification inspection and testing of welds for carbon-steel liners may be performed in acco rdance with A WS D1.1 a nd ASCE' s Design an d Construction of Steel Chimney Liners. Inspection of m aterial and workmanship may verify confor mance with the AISC's Manual of Steel Constr uction Specifications and Codes and the AISC's Quality Criteria and Inspection Standards.

For alloy welding, all welds should be vi sually inspected by an AWS Certified Welding Inspector (CWI), qualified per AWS Standard QC1. All allo y welds that will be expo sed to f lue gas are teste d using liqu id-penetrant exam ination according to Artic le 6 of ASME Section V. All liqu id-penetrant testing is pe rformed by an ASNT Level II inspec tor. Certif ication ve rifying the qua lifications of th e welding inspector should be submitted before welding operations start.

8.2 Testing and Acceptance Criteria

8.2.1 General

The Contractor sh all carry ou t s ampling and testing in accord ance with th e specification specified elsewhere/Approved Field Quality Plan and as supplem ented herein f or the f ollowing item s at his own Cost. The Contractor shall get the specimens tested in a laboratory approve d by the Engin eer and su bmit to the Engineer th e te st resu lts in tr iplicate w ithin 3 (three) day s af ter com pletion of the test.

The Contractor usually prepares and submits workmanship samples for approval prior to the start of work. The workmanship samples are visually inspected and liquid penetrant tested prior to submittal. The approved workmanship samples are visibly displayed at the shop and job site for the benefit of the welders and inspectors, as examples of acceptable weld surfaces.

8.2.2Welding

a) The weld surface shall be cleaned with steel/titanium /C276 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 per requirements of specification specified elsewhere.

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 complying requirements of ASTM or AWS codal requirement at no extra costs.

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 ASTM or AWS standards, the cost of which shall be borne by the Contractor.

8.2.3 Bolts, nuts and washers

All bolts, nuts, and washers shall confirm to the relevant Indian/international 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/ international Standards. Cost of all such testing shall have to be borne by the Contractor.

8.2.4Shop 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 / international Standards.

8.2.5Acceptance

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.

8.2.6Delivery of materials

8.2.6.1 General

The Contractor will deliver the fabricated structural clad 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.

8.2.6.2 Marking

Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the marks shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection.

8.2.6.3 Shipping

Shipping shall be strictly in accordance with the sequence stipulated in the agreed programme. Contractor shall dispatch the materials to the 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

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 refe rence to assem bly drawi ngs and corresponding piece numbers.
Each packin g 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 p ieces, 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 delive ry of the m aterials a t site, a ll pa cking m aterials sh all a utomatically become the property of the Owner.
Notwithstanding anything stated hereinbefo re, any loss or dam age re sulting from inadequate packing shall be made good by the Contractor at no additional cost to the Owner. When facilities exist, a ll shipments shall be covered by approved Insurance Policy for transit at the cost of the Contractor.
The contractor shall ship the com plete materials or part on boar d 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 th e Owner be liab le to pay any warehouse, wharfage, demurrage and other charges.
If, however, the Owner has to make pa yment of any of the above-m entioned charges, the amount paid will be deducted from the bills of the Contractor.
Necessary advice regarding the shipm ent with relevant details sha ll re ach th e Engineer at least a week in advance.

9 INFORMATION TO BE SUBMITTED

9.1 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 tim e of com pletion, item izing 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/connection bolts.

iv) Fabrication and shipping of main steelwork.

v) Fabrication and shipping of cla dded steelwork for flue can , supporting bracket, stiffener, drain , gutter , vanes etc. as applicable.

vi) Fabrication and shipping of all other rem aining steelwork including miscellaneous steelwork.

vii) Final date of completion of all shipments.

b) Shop

Location of the Tenderer' s fabrication workshop giving details of equipm ent, manpower, the total cap acity, and th e capacity that will be availab le exclusively for this contract shall be submitted.

9.2 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.

10 RATES AND MEASUREMENT

10.1 Rates

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.

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.

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.

No claims shall be entertained, if the details shown on the `Released for Construction' drawings differ from those shown on the bid/tender drawings.

Rates shall be inclusive of all leads and lifts/elevation.

The bidder's rates for Cladded 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.

The bidders 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.

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.

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 Cladded Structural Steel works, as per the technical specification.

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 Cladded Structural Steel works, as per the technical specification.

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. Utilised cladded steel pieces cut/removed shall be returned to the project stores free of charge. Non-return of unutlized cladded 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 cladded 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.

The bidder's rates for re-erection of erection marks after additions, 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.

10.2 MODE OF MEASUREMENT

i) The measurement for the item of fabrication, erection, alignment, welding, etc. of structural cladded steel work shall be based on the approved inner surface area in sqm. Payment of Titanium strips for joining titanium cladded plates (if used) and expansion joint overlapping strips, titanium/C276 section used as gutter, drain, vanes etc for condensate collection system shall be made separately in Kg.

ii) 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, stiffener over base metal of clad plate.

iii) 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.

~~iv)~~ 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.

~~v)~~ 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.

vi) 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.

vii) 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.

viii) The measurement for the item of **Titanium/C276 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.

ix) The measurement for the item of Titanium/C 276 condensate collection gutter/vanes shall be based on the actual finished weight of gutter/vanes in Kgs, corrected to second place of decimal.

x) The measurement for the item of FRP pipe based on the actual finished length in kg. No separate payment shall be made for fittings, bends, fixtures etc. for FRP pipe.

xi) The measurement for the item of Titanium/C 276 condensate strip for expansion joint shall be based on the actual finished weight of strip in Kgs, corrected to second place of decimal.

11 ASSEMBLY AND ERECTION

11.1 Assembly

Each flue would be assem bled from its Component "Cans" near to ground level within the wind-shield. Incom plete flue would be hung only from the flue support platform during assem bly, and progressively hoisted to enable c onnection of further cans at its lower end. Upon com pletion of the initial sectional length, this length will be hoisted and supported in its final position at the flue support floor as indicated in the drawing. It is envis aged that each flue will be assembled and hoisted in required sectional lengths; site joints between sect ional lengthily being located just above a steel floor level.

Joints between individual cans should be flanged and bolted on out side and to have sealed welded joints on inside as sp ecified elsewhere**.** The Contractor shall subm it a drawing showing proposals for erection and in dicating locations of all site joints which should be kept to minimum.

11.2 Erection

Erection of Clad Steel Flue s and shall be done as pe r requirem ent of IS 800 & relevant international code. The Cont ractor shall sub mit to the Engineer a programme of erection for his approval. All plant, equipment, tools, tackle and any other access ories required for the erection shall be provided by the Contractor. Storing and handling of fabr icated m aterials for erecti on, setting out of members, providing tem porary supports, bracing, fasteners, bolts, nuts etc. shall be the responsibility of the Contractor and shall be taken into account in quoting the rate.

11.3 7.3 Tolerances

Permissible tolerances in the fabrication and erection of clad 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 center line by more than : 10 mm in any 15-meter height

c) Centre of any section at height 'h' is in mm. above GL shall : (h/2500 + 10) mm, not be vertical center where line by more than

c) 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).

SUB-SECTION-II-E4

LT POWER CABLES

1.00.00 **CODES & 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 as on date of opening of bid. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

2.00.00 **TECHNICAL REQUIREMENTS**

2.01.00 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

2.02.00 All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.

2.03.00 Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be stranded.

2.04.00 XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

2.05.00 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.

2.06.00 For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanised steel as follows :

Calculated nominal dia. of cable under armour	Size and Type of armour
Upto 13 mm	1.4mm dia GS wire
Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
Above 40 & upto 55mm	1.4 mm thick GS formed wire /2.5mm dia GS wire
Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

2.06.01 The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm mm^2 per meter at 20 deg C. The sizes of aluminium armouring shall be same as indicated above for galvanized steel.

2.06.02 The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire.

2.07.00 Outer sheath shall be of PVC as per IS: 5831 & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.

(a.) Oxygen index of min. 29 (as per IS 10810 Part-58).

(b.) Acid gas emission of max. 20% (as per IEC-754-I).

	(c.) Smoke density rating shall not be more than 60 % (as per ASTMD-2843).
2.08.00	Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted: 1 core - Red, Black, Yellow or Blue 2 core - Red & Black 3 core - Red, Yellow & Blue 4 core - Red, Yellow, Blue and Black
2.09.00	For reduced neutral conductors, the core shall be black.
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath. (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Sequential marking of length of the cable in metres at every one metre -To be embossed / printed The embossing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.
2.12.00	Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum, over the declared value in the technical data sheets.
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
2.14.00	Cable selection & sizing
2.14.01	Cables shall be sized based on the following considerations: (a) Rated current of the equipment (b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage (c) Short circuit withstand capability This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.

2.14.02	Derating Factors Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes: a) Variation in ambient temperature for cables laid in air b) Grouping of cables c) Variation in ground temperature and soil resistivity for buried cables.
2.14.03	Cable lengths shall be considered in such a way that straight through cable joints are avoided.
2.14.04	Cables shall be armoured type if laid in CHP area or directly buried.
2.14.05	All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and ~~preferable~~ sizes shall be 1Cx150, 1Cx300, 1Cx630, 3Cx150 & 3Cx240 sq.mm. However for cable sizes upto 120 sq.mm. both XLPE insulated & PVC insulated LT power cables are acceptable
3.00.00	**CONSTRUCTIONAL FEATURES**
3.01.00	1.1 KV Grade Power Cables (a) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured/ unarmoured, PVC outer-sheathed conforming to IS:7098. (Part-I). (b) 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). (c) 1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propyline Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968.
4.00.00	**CABLE DRUMS** (a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418. (b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

(c.) The standard drum length for power cables shall be 1000 meters; however for cable sizes of 1C X 630mm2, 3C X 150mm2 and 3C X 240mm2 (sizes if applicable) standard drum length shall be 750 meters. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths.

5.00.00 TESTS

1.0 All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

2.0 However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client /Employers representative and submit the reports for approval.

3.0 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.

4.0 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

5.01.00 **Type Tests**

5.01.01 The reports for the following type tests shall be submitted for one size each of LT XLPE and LT PVC Power cables. Size shall be decided by the employer during detailed engineering:

S.No.	Type test	Remarks
	For Conductor	
1.	Resistance test	
2.	Tensile test	For circular non-compacted conductors only
3.	Wrapping test	For circular non-compacted only
	For Armour Wires/ Formed Wires	
4.	Measurement of Dimensions	
5.	Tensile Test	
6.	Elongation test	
7.	Torsion test	For round wires only

8.	Wrapping test	For aluminium wires / formed wires only.
9.	Resistance test	
10(a)	Mass of zinc coating test	For GS Formed wires/wires only
10(b)	Uniformity of zinc coating	For GS Formed wires /wires only
11.	Adhesion test	For GS Formed wires/wires only
	For PVC/XLPE insulation & PVC Sheath	
12.	Test for thickness	
13.	Tensile strength & elongation tests	before ageing and after ageing
14.	Ageing in air oven	
15.	Loss of mass test	For PVC insulation and sheath only
16.	Hot deformation test	For PVC insulation and sheath only
17.	Heat shock test	For PVC insulation and sheath only
18.	Shrinkage test	
19.	Thermal stability test	For PVC insulation and sheath only
20.	Hot set test	For XLPE insulation only
21.	Water absorption test	For XLPE insulation only
22.	Oxygen index test	For outer sheath only
23.	Smoke density test	For outer sheath only
24.	Acid gas generation test	For outer sheath only
	For completed cables	
25.	Insulation resistance test (Volume resistivity method)	
26.	High voltage test	
27.	Flammability test as per IEC-332 Part-3 (Category-B)	

Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of LT power cables enclosed.

SUB-SECTION-II-E5

LT CONTROL CABLES

1.00.00 **CODES & 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 as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D –2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

2.00.00 **TECHNICAL REQUIREMENTS**

2.01.00 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

2.02.00 All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.

2.03.00 Conductor of control cables shall be made of stranded, plain annealed copper.

2.04.00 PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

2.05.00 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.

2.06.00 For multicore armoured cables, the armouring shall be of galvanised steel as follows:

Calculated nominal dia of cable under armour	Size and Type of armour
Upto 13 mm	1.4mm dia GS wire
Above 13 upto 25 mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
Above 25 upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
Above 40 upto 55mm	1.4 mm thick GS formed wire/2.5mm dia GS wire
Above 55 upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.

2.07.00 Outer sheath shall be of PVC as per IS: 5831 and grey in colour. In addition to meeting all the requirements of Indian Standards referred to, outer sheath of all the cables shall have the following FRLS properties.

(a.) Oxygen index of min. 29. (As per IS 10810 Part-58)

(b.) Acid gas emission of max. 20% (As per IEC-754-I)

(c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTMD-2843.

2.08.00 Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted.

1 core - Red, Black, Yellow or Blue

2 core - Red & Black

3 core - Red, Yellow & Blue

4 core - Red, Yellow, Blue and Black

5 core - Red, Yellow, Blue, Black and Grey

2.09.00 For cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall

	be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm.
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath: (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed. The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC-332 Part-3.
2.12.00	Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum over the declared value in the technical data sheets.
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
2.14.00	Cable selection & sizing Control cables shall be sized based on the following considerations: (a) The minimum conductor cross-section shall be 1.5 sq.mm. (b) The minimum number of spare cores in control cables shall be as follows:

No. of cores in cable	Min. No. of spare cores
2C, 3C	NIL
5C	1
7C-12C	2
14C & above	3

2.14.01	Cable lengths shall be considered in such a way that straight through cable joints are avoided.
2.14.02	Cables shall be armoured type if laid in CHP area or directly buried.
3.00.00	**CONSTRUCTIONAL FEATURES**
3.01.00	1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I).
3.02.00	1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propyline Rubber(EPR) suitable for

withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968. Minimum conductor size shall be 2.5 sqmm.

4.00.00 CABLE DRUMS

(a.) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

(b.) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

(c.) The standard drum length for control cables shall not be less than 1000 metres. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drums with shorter lengths.

5.00.00 TESTS

All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client /Employers representative and submit the reports for approval.

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

The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

5.01.00 **TYPE TESTS**

5.01.01 The reports for the following type tests shall be submitted for one size of control cables. Size shall be decided by the employer during detailed engineering

S. No.	Type Test	Remarks
	For Conductor	
1.	Resistance test	
	For Armour Wires / Formed Wires (If applicable)	
2.	Measurement of Dimensions	
3.	Tensile Test	
4.	Elongation test	
5.	Torsion test	For round wire only
6.	Wrapping test	For aluminium wires / formed wires only.
7.	Resistance test	
8(a).	Mass of zinc Coating test	For GS wires/formed wires only
8(b).	Uniformity of zinc coating	For GS wires/formed wires only
9.	Adhesion test	For GS wires/formed wires only
	For PVC insulation & PVC Sheath	
10.	Test for thickness	
11.	Tensile strength and elongation test	before ageing and after ageing
12.	Ageing in air oven	
13.	Loss of mass test	For PVC insulation and sheath only
14.	Hot deformation test	For PVC insulation and sheath only
15.	Heat shock test	For PVC insulation and sheath only
16.	Shrinkage test	
17.	Thermal stability test	For PVC insulation and sheath only

S. No.	Type Test	Remarks
18.	Oxygen index test	For outer sheath only
19.	Smoke density test	For outer sheath only
20.	Acid gas generation test	For outer sheath only
	For completed cables	
21.	Insulation resistance test(Volume resistivity method)	
22.	High voltage test	
23.	Flammability test as per IEC-332 Part-3 (Category-B)	

5.02.00 Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of Control Cables enclosed.

SUB-SECTION-II-E6

CABLING EARTHING & LIGHTNING PROTECTION

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 as on date of opening of bid. 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:513	Cold rolled low carbon steel sheets and strips.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubulars and other wrought steel fIttings
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:2309	Code of Practice for the protection of building and allied structures against lightning.
IS:2629	Recommended practice for hot dip galvanising of iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing
IS:3063	Fasteners single coil rectangular section spring washers.
IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables
IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
IS:9537	Conduits for electrical installation.
IS:9595	Metal - arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables.
BS:476	Fire tests on building materials and structures
IEEE:80	IEEE guide for safety in AC substation grounding
IEEE:142	Grounding of Industrial & commercial power systems

	DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
	DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors
	BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
		Indian Electricity Act.
		Indian Electricity Rules.

1.02.00 Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

2.00.00 DESIGN AND CONSTRUCTIONAL FEATURE

2.01.00 **Inter Plant Cabling**

2.01.01 Interplant cabling for main routes shall be laid along overhead trestles/duct banks. Cables from main plant to switchyard control room shall be laid in overhead trestles or duct bank. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. Directly buried cables, if essential, shall not have concentration of more than 4 cables in one route. All buried cables shall be armoured

2.01.02 **Transformer yard**

In transformer yard cables shall be laid in overhead trestle. The main cable routes coming out from Main plant building and crossing the Transformer yard shall be laid in overhead trestles. In transformer yard, trestle height for rail/road crossing shall be suitable for movement of Generator Transformer with bushing.

2.01.03 **Trenches**

PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

2.01.04 No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant.

2.01.05 **Cable Vault**

The cable vault/ / cable spreader room space below the HT / LT switchgear room, Control Rooms, unit control equipment room, Programmer room, UPS, Charger & Battery Rooms, shall have **800 mm wide** and 2.1 m high movement passage all around the cable trays in the cable vault/ cable spreader room for easy laying/maintenance of cables

Cable vaults shall be provided with adequate drainage facilities for drainage of fire water.

Each cable vault should have at least two doors.

Exit signs shall be provided near doors for personnel escape in case of emergency

2.01.06	**Boiler Area** Cable trays in boiler & ESP area shall be supported from the boiler and ESP structures. The same shall be coordinated with SG/ESP contractor. Cable trays in these areas shall be in vertical formation to avoid dust accumulation. No cable trenches shall be provided in boiler/ESP area.
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.
2.01.08	**OffSite Area** For feeder in bidder's scope for offsite areas, overhead cable tray arrangement shall be followed. However cable trenches/slit may also be acceptable, for some areas, if found to be required during detailed engineering. Cable trenches provided shall be separated from fuel oil area to avoid oil accumulation.
2.01.09	The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling.
2.01.10	Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable.
2.01.11	Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to: • Meet all safety requirements • Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc
3.00.00	**EQUIPMENT DESCRIPTION**
3.01.00	**Cable trays, Fittings & Accessories**
3.01.01	Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.
3.01.02	Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per Clause No. 3.13.00 of this chapter.
3.01.03	Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm.
3.01.04	Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanised as per Clause No. 3.13.00 of this chapter. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.
3.01.05	The tolerance for cable tray and accessories shall be as per IS 2102 (Part-1). Tolerance Class: - Coarse

3.02.00 **Support System for Cable Trays**

3.02.01 Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings.

3.02.02 Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder

a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.

b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fitings and accessories shall be prefabricated factory galvanised.

c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvansied surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied

d. All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drilling and other machining operation.

e. The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below:

The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS 1079.

f. Cantilever arms of 320 mm, 620mm and 750 mm in length are required, and shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.

g. Support system shall be able to withstand

- weight of the cable trays
- weight of the cables (75 Kg/Metre run of each cable tray)
- Concentrated load of 75 Kg between every support span.
- Factor of safety of minimum 1.5 shall be considered.

3.02.03 The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Bidder without any additional cost to

	the Employer. The bidder shall submit the detailed drawings of the system offered by him alongwith the bid.
3.02.04	Four legged structure shall be provided wherever there is change in elevation and change in direction
3.02.05	FOR COAL HANDLING PLANT/**FGD PLANT AREA** THE FOLLOWING SHALL ALSO BE APPLICABLE**:**
a)	All overhead cable routes shall be along the route of the conveyor gallery on separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0M above the grade level except for rail/road crossings where it shall be at 8.0M above grade level. Tap offs from the overhead cable trestle can be through shallow trenches with prior approval of the Employer. Directly buried cable, if essential, shall not have concentration of more than 4 cables on one route.
b)	Cable trenches shall be provided only in Switchgear/MCC rooms.
c)	Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches, receptacles etc.
d)	Cables for PCS and BSS shall be routed along the conveyors through GI conduits.
3.03.00	**Pipes, Fittings & Accessories**
3.03.01	Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria
3.03.02	GI Pipes shall be of medium duty as per IS: 1239
3.03.03	Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.
3.03.04	Hume pipes shall be NP3 type as per IS 458.
3.03.05	TERNE Coated Flexible Steel Conduits shall be water proof and rust proof made of heat resistant lead coated steel. Conduit diameter shall be uniform throughout its length. Internal surface of the conduit shall be free from burrs and sharp edges. Conduits shall be complete with necessary accessories for proper termination of the conduit with junction boxes and lighting fixtures
3.03.06	HDPE pipes and conduits shall be PE-80, PN-10 type as per IS 4984/IS 8008 part-I.
3.04.00	**Junction Boxes**
3.04.01	Junction box shall be made of Fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of

	suitable diameter. The JB shall have suitable for installing glands of suitable size on the bottom of the box. The JB shall be suitable for surface mounting on ceiling/structures. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Junction box surface should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JB's will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets should be of powder coated MS. Type test reports for the following tests shall be furnished:- (a) Impact resistance for impact energy of 2 Joules (IK07)as per BS EN50102 (b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb. (c) Class of protection shall be IP 55. (d) HV test.
3.04.02	Terminal blocks shall be 1100V grade, of suitable current rating, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side the required cables/wire size. All internal wiring shall be of cu. Conductor PVC wire.
3.05.00	**Terminations & Straight Through Joints**
3.05.01	Termination and jointing kits for 33kV, 11 kV, 6.6 KV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be Pre-moulded type or heat shrinkable type. Further Cold shrinkable type termination and jointing kits are also acceptable. The Cold shrinkable type kits shall be type tested as per relevant standards. Calculation to withstand the required fault level shall also be furnished in case of cold shrinkable type kits. 33 kV, 11 kV, 6.6 KV and 3.3kV grade joints and terminations shall be type tested and Type test reports as per IS:13573 Part-II and IEC60502 shall be furnished. Also, heat shrink material shall comply with requirements of ESI 09-13 (external tests). Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Cable joints and terminations should be with FRLS properties as per IEC 60754-1&2. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless crimping type cable lugs & ferrule or mechanical connectors (wherein bolts are tightened that shear off at an appropriate torque) as per DIN standard suitable for aluminium compacted conductor cables. (Tender drg. no 0000-211-POE –A-51-RA of cable lug attached at the end of this chapter).
3.05.02	Straight through joint and termination shall be capable of withstanding the fault level of 21 KA for 0.12 Sec. with dynamic peak of 52 KA for 33 KV system & of 40 kA for 0.12 sec with a dynamic peak of 100 kA for 11 kV, 6.6 KV & 3.3 KV system. Straight through joints shall have provisions for shield connection and earthing wherever required and complete with all accessories and consumables suitable for storage without deterioration at a temperature of 50 deg. C with shelf life of more than five years. 1.1 kV grade straight through joints shall also be of proven design
3.05.03	1.1 KV grade Straight Through Joint shall be of proven design.

3.06.00	**Cable glands**
3.06.01	Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.
3.07.00	**Cable lugs/ferrules**
3.07.01	Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to IS/DIN standards.
3.08.00	**Trefoil clamps**
3.08.01	Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, to withstand the forces generated by the peak value of maximum system short circuit current.
3.09.00	**Cable Clamps & Ties**
3.09.01	The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.
3.10.00	**Receptacles**
3.10.01	Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break,AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polymide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with inbuilt ELCB rated for suitable mA sensitivity ranging from 30-300 mA .
3.11.00	**Cable Drum Lifting Jack**
	The jack for cable drum lifting shall be of screw type with 10 ton capacity. The cable drum jacks shall be manufactured from fabricated steel. The spindles supplied with the cable drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for

	NTPC use. Contractor has to make arrangements for his own jacks for cable reeling/unreeling under his scope of installation.
3.12.00	**Galvanising**
3.12.01	Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.
3.12.02	The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified
3.13.00	**Welding**
3.13.01	The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595
4.00.00	**INSTALLATION**
4.01.00	**Cable tray and Support System Installation**
4.01.01	Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.
4.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with tray loadings/drawings.
4.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.
4.01.04	The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval and the same shall be finalized at pre-award stage.
4.01.05	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.
4.01.06	In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the

prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

4.02.00 **Conduits/Pipes/Ducts Installation**

4.02.01 The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.

4.02.02 GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.

4.02.03 Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material

4.02.04 Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit /pipe size (dia).	**Spacing**
Upto 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm and above	3.0 M

4.02.05 For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.

4.03.00 **Junction Boxes Installation**

4.03.01 Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

4.04.00 **Cable Installation**

4.04.01 Cable installation shall be carried out as per IS:1255 and other applicable standards.

4.04.02 For Cable unloading, pulling etc following guidelines shall be followed in general:

a) Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.

b) While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager.

4.04.03 Cables shall be laid on cable trays strictly in line with cable schedule

4.04.04 Power and control cables shall be laid on separate tiers inline with the approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on top most tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with cable clamps/ties with self locking arrangement. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by cable clamps/ties with self locking arrangement at every five meter interval and at every bend.
Fibre Optical cable shall be laid in trenches/trays or as decided by Employer.

4.04.05 Bending radii for cables shall be as per manufacturer's recommendations and IS:1255.

4.04.06 Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ HDPE pipe.

4.04.07 No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted. Vendor shall identify and accordingly procure the cable drum length.

4.04.08 In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.

4.04.09 Wherever few cables are branching out from main trunk route troughs shall be used.

4.04.10 Wind loading shall be considered for designing support as well Cable trays wherever required.

4.04.11 Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures.

4.04.12 The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.

4.04.13 **Separation**

At least 300mm clearance shall be provided between:

- HT power & LT power cables,
- LT power & LT control/instrumentation cables,

4.04.14 **Segregation**

1) Segregation means physical isolation to prevent fire jumping.

2) All cables associated with the unit shall be segregated from cables of other units.

3) 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. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

4) In switchyard, control cables of each bay shall be laid on separate racks/trays.

4.04.15 Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

No. of cores in cable	No. of spare cores
2C,3C	NIL
5C	1
7C-10C	2
14C and above	3

4.04.16 **Directly Buried Cables**

a) Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS:1255 and the enclosed drawings showing cabling details.

b) RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.

4.04.17 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at

	every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags. The cable tag requirements mentioned above shall prevail over Tag requirements mentioned elsewhere in this document for HT power, LT power & control cables.
4.04.18	While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.
4.05.00	**Cable Terminations & Connections**
4.05.01	The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer'' instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.
4.05.02	Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.
4.05.03	The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.
4.05.04	Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.
4.05.05	All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, ---etc along with cable numbers and coiled up after end sealing.
4.05.06	All cable terminations shall be appropriately tightened to ensure secure and reliable connections.
5.00.00	**EARTHING SYSTEM**
5.01.00	Earthing system shall be in strict accordance with IS:3043 and Indian Electricity Rules/Acts The earthing system shall be designed for a life expectancy of at least forty (40) years, for a system fault current of 50 kA for 1.0 sec. The minimum rate of corrosion of steel for selection of earthing conductor shall be 0.12mm per year.

Earthing system network/earthmat shall be interconnected mesh of mild steel rods buried in ground in the plant. All areas under contractor scope of supply shall be interconnected together by minimum two parallel conductors. The Contractor shall furnish the detailed design and calculations for Employer's approval. Contractor shall obtain all necessary statutory approvals for the system. All the columns shall be earthed by nearby risers and earthmat grid spacing shall be minimum 10 mts. Minimum two nos of risers shall be provided for each equipment in SG area. Separate dedicated riser shall be provided for C&I earthing purpose and also for Lightning down conductor connection purpose. Sufficient nos of risers near the equipment shall be provided as per the system requirement.

5.02.00 The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects

5.03.00 The material of the earthing conductors shall be as follows:

1)	Conductors above ground level and in built up trenches.	-	Galvanized steel
2)	Conductors buried in earth	-	Mild steel
3)	Earth electrodes	-	Mild steel rod

5.04.00 The sizes of earthing conductors for various electrical equipments shall be as below:

	Equipment	Earth conductor buried in earth	Earth conductor above ground level & in built-up trenches
a)	Main earth grid	Min 40 mm dia. MS rod or as per actual calculation whichever is more	65 x 8mm GS flat
b)	33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear	---	65 x 8mm GS flat
c)	415 V MCC/ Distribution boards / Transformers	---	50 x 6mm GS flat
d)	LT Motors above 125 KW	---	50 x 6mm GS flat
	25 KW to 125 KW	---	25 x 6mm GS flat
	1KW to 25 KW	---	25 x 3mm GS flat
	Fractional House power motor	---	8 SWG GS wire
e)	Control panel & control desk	---	25 x 3 mm GS flat
f)	Push button station / Junction Box	---	8 SWG GI wire
g)	Columns, structures, cable trays and bus ducts enclosures	---	50 x 6mm GS flat

	h) Crane, rails, rail tracks & other non-current carrying metal parts — 25 x 6mm GS flat
5.05.00	Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise approved. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable.
5.06.00	Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 meter. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground
5.07.00	Neutral points of HT transformer shall be earthed through NG resistors. The Contractor shall connect the NGR earthing point to earth electrodes by suitable earth conductors.
5.08.00	Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.
5.09.00	Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound.
5.10.00	Suitable earth risers as approved shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.
5.11.00	Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding.
5.12.00	Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.
5.13.00	Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm.
5.14.00	Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.
5.15.00	A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same.

5.16.00	Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.
5.17.00	Earth pit shall be of treated type & shall be constructed as per IS:3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with salt and charcoal as per IS:3043. Test links shall be provided with bolted arrangement alongwith each earth pit, in order to facilitate measurement of earth resistance as & when required.
5.18.00	On completion of installation continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured and recorded. All equipment required for testing shall be furnished by contractor.
5.19.00	Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead.
5.20.00	Other Requirements of Earthing System:

Standard/Code		IEEE 80, IS 3043
Earthing System		
Life expectancy		40 Years
System Fault Level		System Fault Level 50 KA for 1 sec
Soil resistivity		Actual as per site conditions.
Min. Steel corrosion		0.12mm/year
Depth of burial of main earth conductor		600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.
Conductor joints		By electric arc welding, with resistance of joint not more than that of the conductor.

Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection.

Surface resistivity	- Gravel	3000 ohm-meter
	- Concrete	500 ohm-meter

6.00.00	**LIGHTNING PROTECTION SYSTEM**
6.01.01	Lightning protection system shall be in strict accordance with IEC : 62305 and latest IS standards.
6.01.02	Lightning conductor shall be of 25x6mm GS strip when used above ground level and shall be connected through test link with earth electrode/earthing system
6.01.03	Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings.

6.02.00 **Down Conductors**

1. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode.

2. Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point.

3. All joints in the down conductors shall be welded type.

4. Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval.

5. Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm.

6. All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system.

7. Lightning conductors shall not pass through or run inside GI Conduits.

8. Testing link shall be made of galvanized steel of size 25x 6mm.

9. Pulser system for lightning shall not be accepted.

10. Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths.

7.00.00 TESTS

7.01.01 All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

7.01.02 However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.

7.01.03 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.

7.01.04 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.

7.02.00 **Type Test reports shall be furnished for the following**

7.02.01 Type tests on Cable Trays support system

a) **Test 1A:**

On main support channel type-C2 for cantilever arms fixed on one side only. A 3.5 meter length of main support channel shall be fixed vertically at each end to a rigid structure as per the fixing arrangement as shown in the enclosed drawing. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the points shown in the enclosed drawings and at the following load intervals:

i) Working load

ii) Working load + point load

iii) Off load

iv) Proof load + point load

v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.

B) **Test 1B:**

Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2

Test 2: On Main support channel type -C2 for cantilever arms fixed on both sides

a) Test 2A: A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per the fixing arrangement as shown in the enclosed drawing. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals.

i) Working load

ii) Working load + Point load

iii) Off load

iv) Proof load + Point load

v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied

b) Test 2 B: The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side.

Test 3 : **Tests on Channel Fixed on Beam/Floor**

A length of main support channel section shall be fixed to steel structure/floor and have loads applied as shown in the drawing enclosed and as detailed below

a) Test 3A : A length of steel structure shall be rigidly supported. It should be fitted on a meter length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place.

b) Test 3B: With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place.

c) Test 3C: With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line.

The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded.

Test 4 : Channel Insert Test

A 2.5 m length of C1 channel fixed to the concrete wall/ steel structure as per actual site installation conditions. 6 nos. of 750 mm cantilever arms shall be attached to C1 channel as shown in enclosed drawing. Each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals.

i) Working Load

ii) Working Load + Point Load

iii) Off Load

iv) Proof Load + Point Load

v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied

Test 5 : Channel nut slip characteristics (what ever applicable)

Tests 5A1,5A2,5A3 : A length of channel C1 section 200mm long shall have fitted bracket with the two bolt fixing as shown in drawing enclosed.
With loads applied at the position shown in drawing enclosed nut slip shall be determined with bolt torque of 30NM, 50 NM and 65 NM No fewer than three measurements shall be made for each torque setting.

A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM.

Tests 5B1,5B2,5B3: The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing as shown in drawing enclosed. With loads applied at the position shown in drawing, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting.

A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM.

Test 6 Weld Integrity Test

After deflection test as per test 1A, 1B, 2, 3 & 4 weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any.

7.02.02 Cable termination kit and straight through joints should have been tested as per IS:13573 for 3.3kV grade & above.

7.03.00 **Routine/ Acceptance Tests**

7.03.01 Routine Tests

a) Routine tests as per specification and applicable standards shall be carried out on all requirements/items covered in the specification.

b) Physical & dimensional check on all equipments as per approved drawings/standards

.

c) HV/IR as applicable.

d) Check/measurement of thickness of paint/zinc coating/nickel-chrome plating as per specification & applicable standard.

7.03.02 Acceptance Test

a) Galvanising Tests as per applicable standards

b) Welding checks

c) Deflection tests on cable trays:

d) One piece each of 2.5m length of cable tray of 300mm & above shall be taken as sample from each offered lot. It shall be supported at both end & loaded with uniform load of 76 kg/meter along the length of cable tray. The maximum deflection at the mid-span of each size shall not exceed 7mm.

d) Proof load tests on cable tray support system

i) Tests on Main Support Channel shall be done if only C1 Channel are in scope of supply and cantilever arms shall be fitted on one side. This test shall be same as test 4 of type test.

ii) Test on Main Support Channel shall be done with C2 channel and cantilever arms fitted on both sides, if C2 channels are in scope of supply. This test shall be same as test 2A of type test. Then test (i) above shall not be done.

iii) Nut slip characteristic test (it shall support minimum load of 350kg before nut slips with a bolt torque of 65 NM). This test shall be same as test 5B3 of type test.
The procedure for carrying out tests at "d" above shall be as per details given in Type Tests in specification thereafter Die-Penetration test shall be carried out to check weld integrity.

e) The above acceptance tests shall be done only on one sample from each offered lot.

8.00.00 COMMISSIONING

8.01.01 The Contractor shall carry out the following commissioning tests and checks after installation at site. In addition the Contractor shall carry out all other checks and tests as recommended by the Manufacturers or else required for satisfactory performance..

8.01.02 **Cables**

a) Check for physical damage

b) Check for insulation resistance before and after termination/jointing.

c) HT cables shall be pressure tested (test voltage as per IS:7098) before commissioning.

d) Check of continuity of all cores of the cables.

e) Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/inserting, shorting, change in terminal connections, etc., shall be carried out by the Contractor.

f) Check for correct polarity and phasing of cable connections.

g) Check for proper earth connections for cable glands, cable boxes, cable armour, screens, etc.

h) Check for provision of correct cable tags, core ferrules, tightness of connections.

8.02.00 **Cable trays / supports and accessories**

1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories.

2) Check for continuity of cable trays over the entire route.

3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.

4) Check for earth continuity and earth connection of cable trays.

8.03.00 **Earthing and Lightning protection system**

1) Earth continuity checks.

2) Earth resistance of the complete system as well as sub-system.

9.00.00 **ELECTRICAL LAYOUT PHILOSOPHY**:

While developing the layout the bidder must give due consideration to the following requirements:

a) Adequate distance shall be maintained between the transformers. As basic guidelines following norms will be adhered to:

1) Transformers shall be separated from the adjacent building/structures and from each other by a minimum distance as defined below or by a fire wall of two hours of fire resisting of height at least 600 mm above bushing / pressure relief vent whichever is higher.

Oil capacity of individual transformer (in liters)	Clear separating distance (in meters)
5,000 to 10,000	8.0
10,001 to 20,000	10.0
20,001 to 30,000	12.5
Over 30,001	15.0

2) In case of auxiliary transformers having an aggregate oil capacity in excess of 2300 liters but individual oil capacity of less than 5000 liters, the maximum separating distance between transformers and surrounding building shall be at least 6M unless they are separated by fire separating walls or are protected by high velocity spray system.

3.) Rail track shall be provided in Transformer yard for movement of each transformer. The rail track in Transformer yard shall be connected with TG area rail track The Foundation top of transformer & rail top shall be at EL +/- 0.0M. Bus duct support or Transformer body shall be at least 8.0M from A-Row of TG building to clear the movement of GT/ Stator/UT/ST/UAT on rail line. Jacking pads shall be provided where the rail track changes the direction. Mooring post shall be provided on rail track for handling the transformers.

4) For each transformer a pit shall be provided all around at a distance of 1.5 m (minimum) from transformer outer edge. A sump pit shall be provided for each pit. A common oil retention pit per unit shall be provided to hold oil quantity of the largest transformer (by volume) & 10 minutes of water quantity of HVW spray system for the largest transformer. Sump pit of individual transformer shall be connected to common oil retention pit of that unit.

5) Rail track shall be provided for all outdoor transformers up to road for movement of each transformer of size more than or equal to 7.5MVA Transformer. Jacking pads shall be provided where the rail track changes the direction. Jacking pad

shall also be provided at the location of installation of transformer and mooring post shall be provided on rail track for handling the transformers.

6.) The Transformer fencing shall be at 1.0 M (minimum) distance from the pit wall. The Height of fencing shall be 2.5 M (minimum) and fencing shall have personal entry gate and removable type fencing/gate for transformer withdrawal.

7) The transformer firewall, pit sizing and clearances from adjacent building/structures etc. shall be as per IS 1646/CBIP manual on Transformer

8) However, for all outdoor transformers of oil capacity less than 2000 litre, a trench of suitable size shall be provided all around at a distance of 1.0 m (minimum) from transformer outer edge. A sump pit shall be provided for each trench.

b) Layout requirements for Electrical MCC/switchgear rooms

1. 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 LT boards shall be provided in LT switchgear room at only one floor

2. The following clearances shall be maintained for HT Switchboard.

a.) Front Clearance

i) For one Row of Swgr. - 2.0 M (Min)

ii) For two Rows of Swgr. - 2.5 M (Min)

b.) Back Clearance - 1.5 M (Min.)

c.) Side Clearance

Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore end clearance shall be 800+width of panel (including spare panels/dummy panels etc.)

3. The following clearances shall be maintained for LT Switchboard.

a.) Front Clearance

i) For one Row of Swgr - 1.5M (Min)
ii) For two Rows of Swgr - 1.5/1.75M depending upon the depth of panels etc

b.) Back Clearance
i) For single front - 1.0M (Min)
ii) For double front - 1.5M (Min)

c.) Side Clearance

Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore end clearance shall be 800 mm + width of panel.

For offsite areas, HT Switchboard clearances shall be followed wherever both LT & HT switch boards are in the same MCC room.

4. Height of HT/LT Switchgear Room and Boiler MCC room

i) With Bus Duct – 4.5 m (min)

ii) Without Bus Duct – 4.0 m (min)

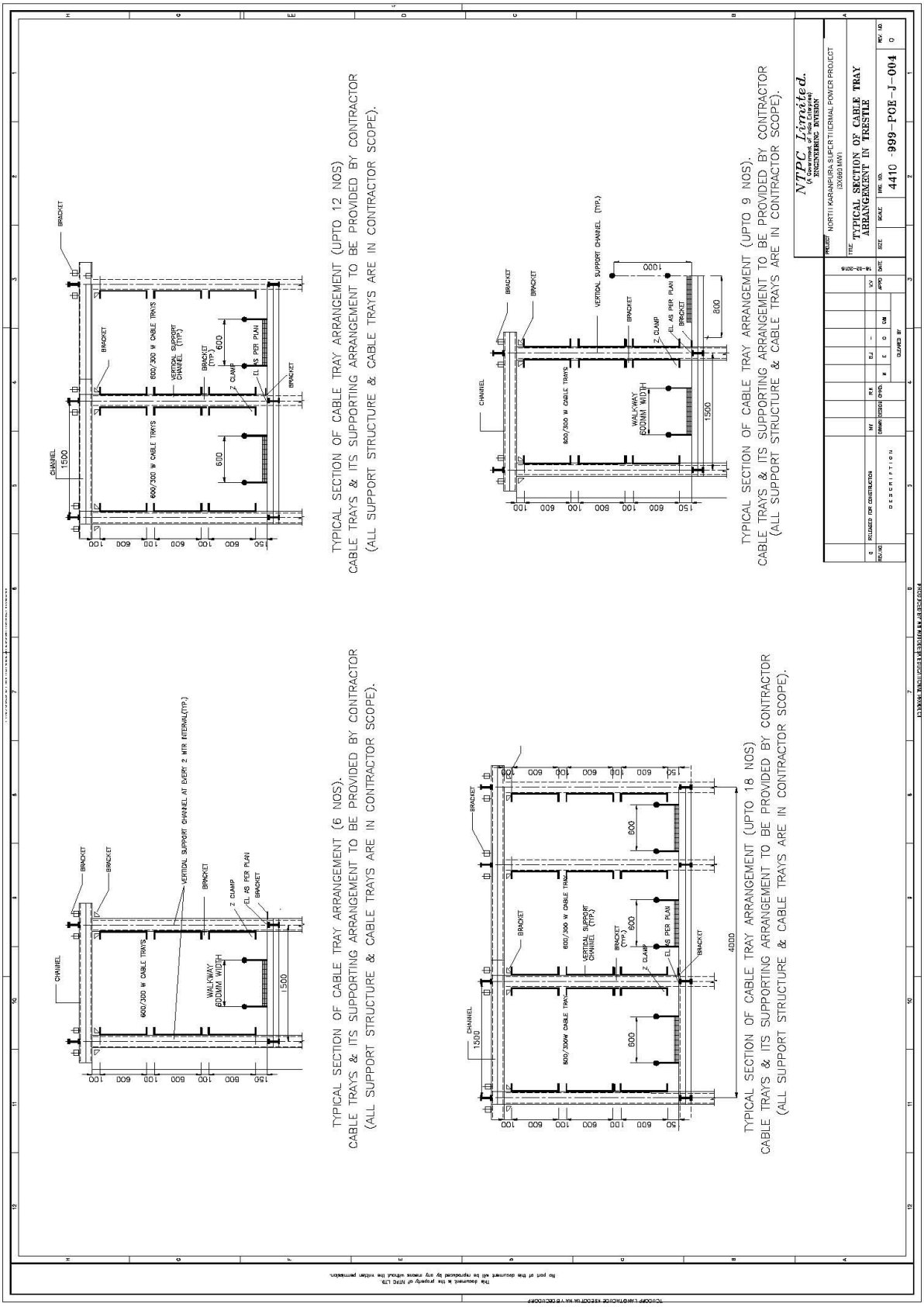
Further no vertical bracings shall be envisaged in HT/LT switchgear room and associated cable vault area.

5. Cable trench/Cable vault

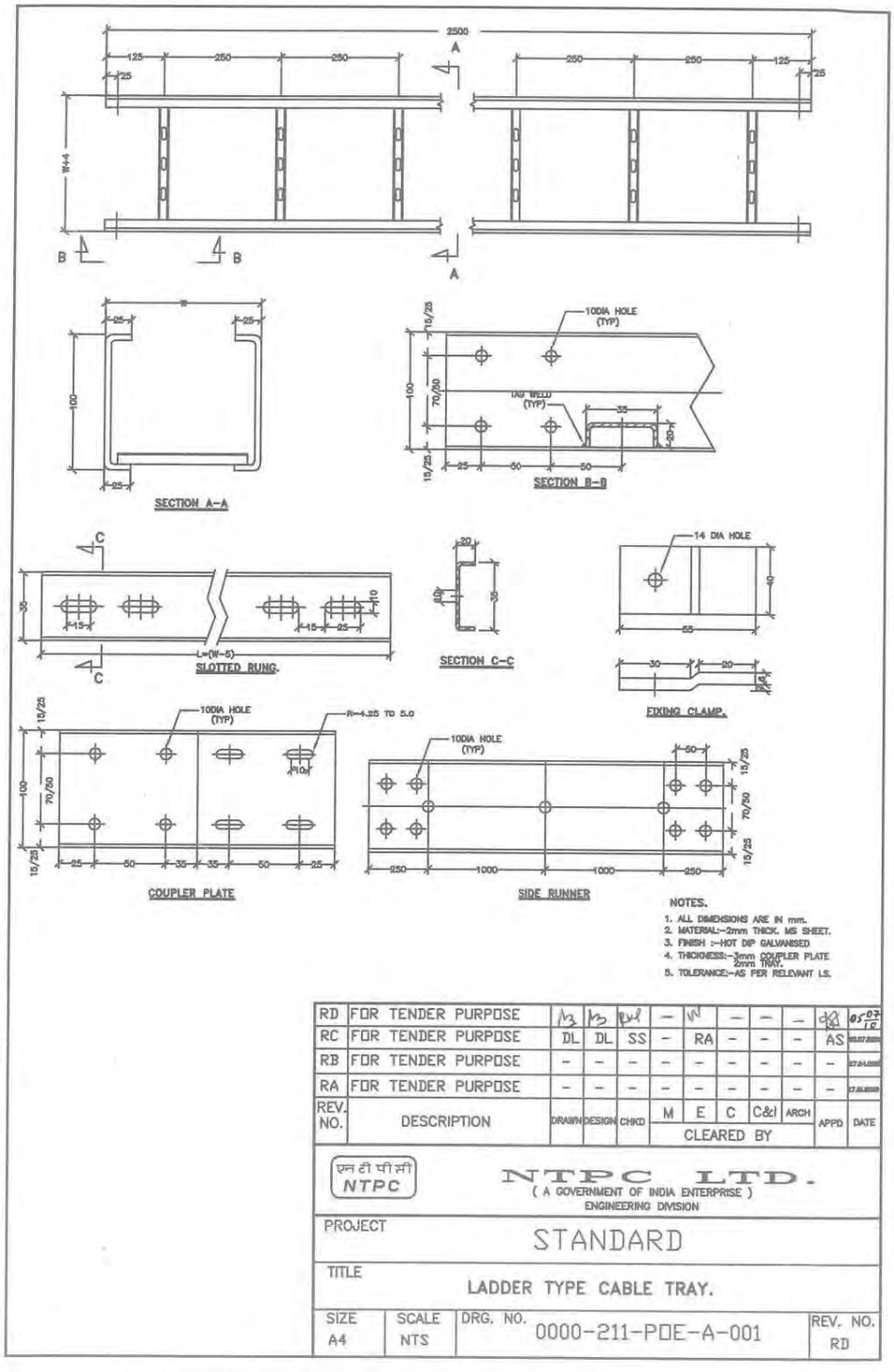
For LT switchgear/MCC room at EL 0.0M, minimum 1400 wide x 1400 deep cable trench shall be provided to route the cables. Horizontal cable trays shall be routed in cable trenches.

c) Minimum clear working space around the equipment 1200mm

d) In buildings having MCC, minimum 2 fire door along with one rolling shutter of adequate size/capacity shall be provided


TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (UPTO 12 NOS).
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).
TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (UPTO 9 NOS).
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).
TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (6 NOS).
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).
TYPICAL SECTION OF CABLE TRAY ARRANGEMENT (UPTO 18 NOS).
CABLE TRAYS & ITS SUPPORTING ARRANGEMENT TO BE PROVIDED BY CONTRACTOR
(ALL SUPPORT STRUCTURE & CABLE TRAYS ARE IN CONTRACTOR SCOPE).
NTPC Limited.
NORTH KARANPURA SUPER THERMAL POWER PROJECT
TYPICAL SECTION OF CABLE TRAY ARRANGEMENT IN TRESTLE
4410 -999-POE-J-004
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RELEASED FOR CONSTRUCTION
14-02-2018

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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE				–		–	–	–		
RC	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RB	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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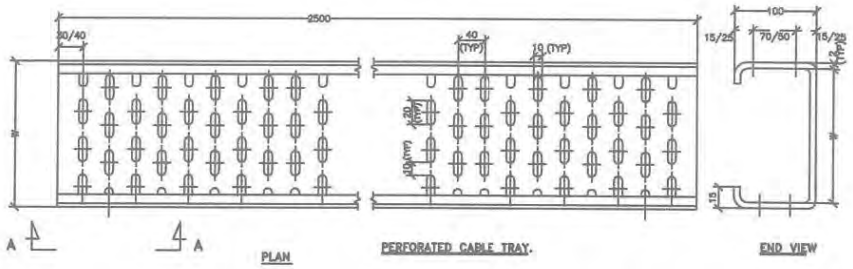
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ENGINEERING DIVISION

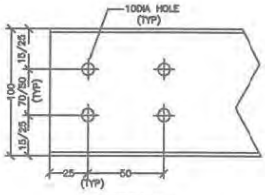
PROJECT: STANDARD

TITLE: LADDER TYPE CABLE TRAY.

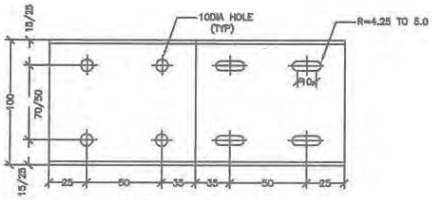
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-001	RD

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SECTION A-A



COUPLER PLATE

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL:-2mm THICK MS SHEET.
3. FINISH :-HOT DIP GALVANISED
4. THICKNESS:- 5mm COUPLER PLATE, 2mm TRAY.
5. TOLERANCE:-AS PER RELEVANT I.S.
6. INNER WIDTH (W) :- 150, 300 & 600mm.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE				-		-	-	-		
RC	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	
RB	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	

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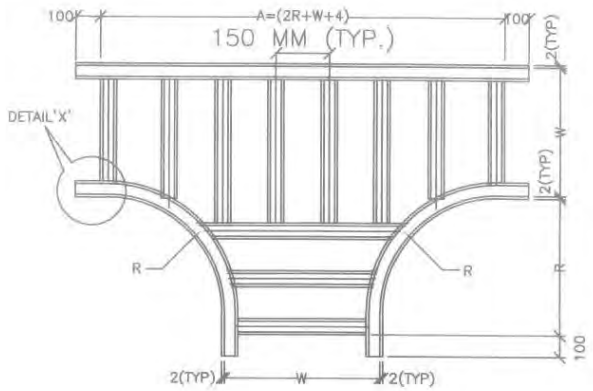
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PROJECT: STANDARD

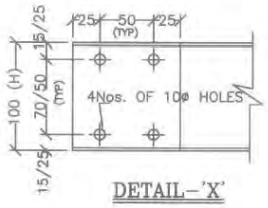
TITLE: PERFORATED TYPE CABLE TRAY.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-002	RD

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HORIZONTAL TEE



DETAIL–'X'

INNER WIDTH OF TRAY(W)	DEPTH OF TRAY (H)	BENDING RADIUS (R)	A		
150, 300 & 600	100		150	300	600
		1200	2554	2704	3004

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :– 150, 300 & 600mm.
3. MATERIAL :– 2mm. THICK MS SHEET.
4. TOLERANCE :–AS PER RELEVANT I.S.
5. FINISH :–HOT DIP GALVANISED
6. ALL HARDWARE SHALL BE GALVANISED AS PER STANDARD.

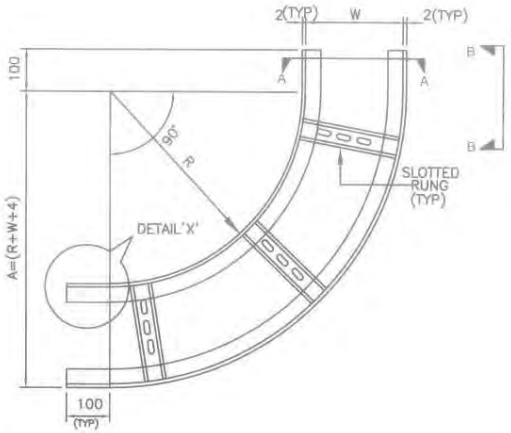
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RC	FOR TENDER PURPOSE	AB	AB	RKP	–	VV	–	–	–	DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

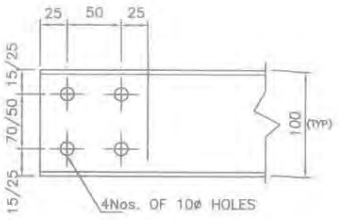
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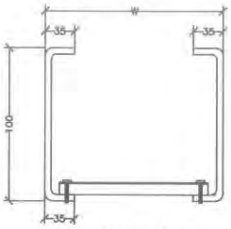
PROJECT	STANDARD		
TITLE	CABLE TRAY DETAILS HORIZONTAL TEE		
SIZE: A4	SCALE: NTS	DRG. NO.: 0000-211-POE-A-004	REV. NO.: RD

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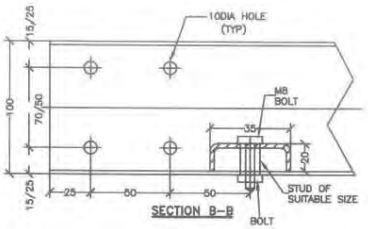




DETAIL–X



SECTION A–A



SECTION B–B

HORIZONTAL BEND 90° (BOTH LEFT & RIGHT)

INSIDE WIDTH OF TRAY(W)	DEPTH OF TRAY (H)	BENDING RADIUS(R)	A		
			150	300	600
150, 300 & 600	100	1200	1354	1504	1804

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :– 150, 300 & 600mm.
3. MATERIAL :– 2mm. THICK MS SHEET.
4. TOLERANCE :–AS PER RELEVANT I.S.
5. FINISH :–HOT DIP GALVANISED
6. ALL HARDWARE SHALL BE GALVANISED AS PER STANDARD.

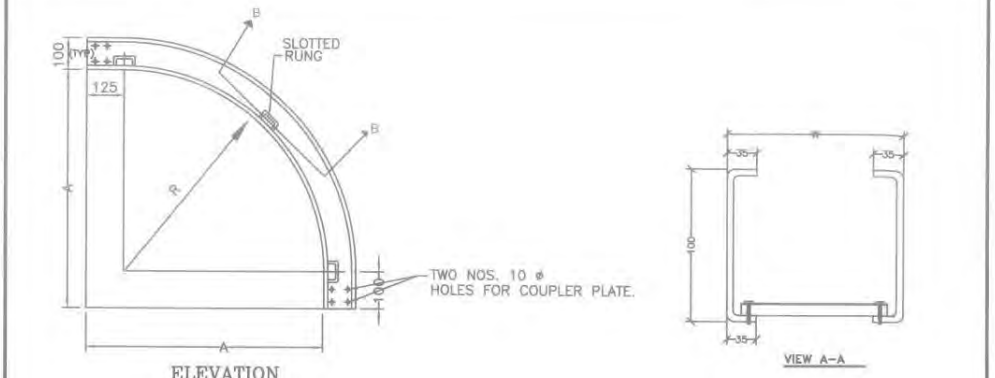
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE	√C	√C								
RC	FOR TENDER PURPOSE	AB	AB	RKP		VV				DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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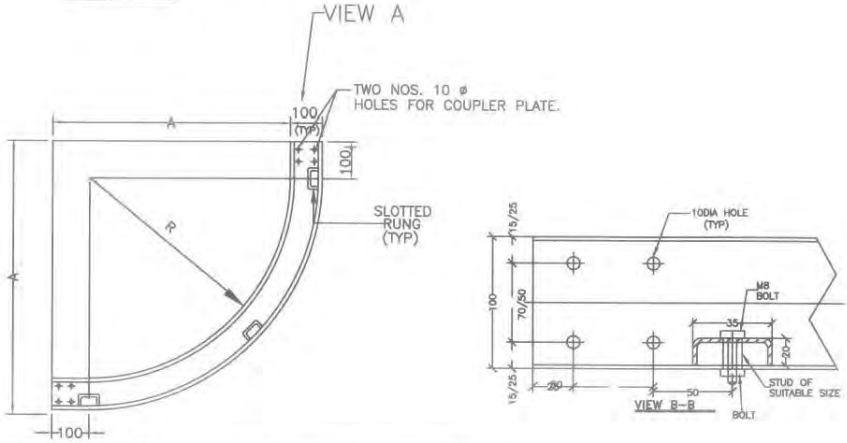
PROJECT: STANDARD

TITLE: CABLE TRAY 90ø BENDS (CTB 90ø)

SIZE	SCALE	ORG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-005	R0



ELEVATION
90° VERTICAL ELBOW
(UPSIDE)



90° VERTICAL BEND
(DOWNSIDE)

INSIDE WIDTH OF TRAY (W)	BENDING RADIUS (R)	A
150, 300 & 600	1050	1150

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :- 150, 300 & 600mm.
3. MATERIAL :- 2mm. THICK MS SHEET.
4. TOLERANCE :-AS PER RELEVANT I.S.
5. FINISH :-HOT DIP GALVANISED
6. ALL HARDWARE SHALL BE GALVANISED AS PER STANDARD.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE	VC	VC	RKP		VV				DT	
RC	FOR TENDER PURPOSE	AB	AB	RKP		VV				DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	

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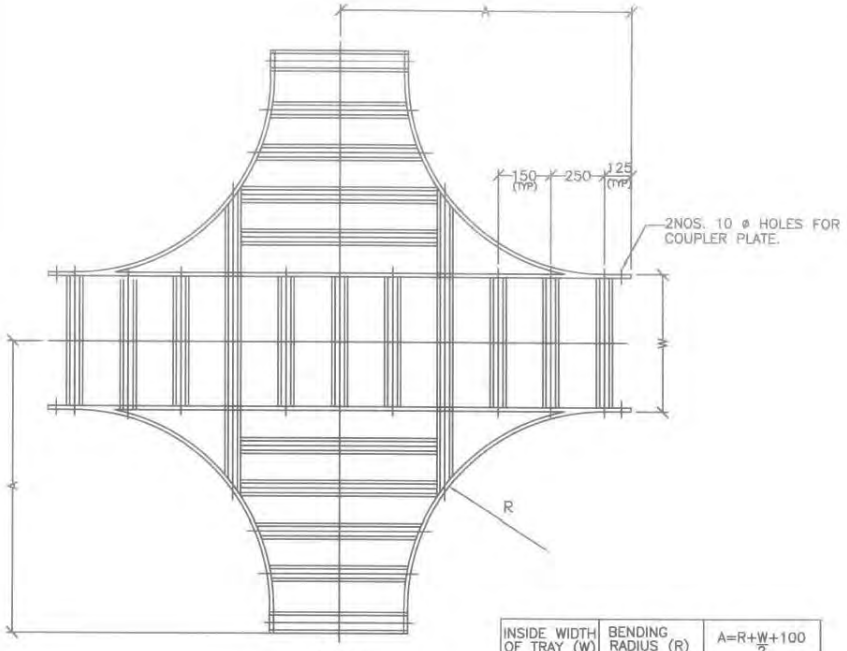
PROJECT: STANDARD

TITLE: CABLE TRAY 90° VERTICAL ELBOW (OUTSIDE)
90° VERTICAL ELBOW (INSIDE)

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-006	RD

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PLAN

INSIDE WIDTH OF TRAY (W)	BENDING RADIUS (R)	$A=R+\frac{W}{2}+100$
600	1050	1450
300	1050	1300

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :– 150, 300 & 600mm.
3. MATERIAL :– 2mm. THICK MS SHEET.
4. TOLERANCE :–AS PER RELEVANT I.S.
5. FINISH :–HOT DIP GALVANISED.
6. ALL HARDWARE SHALL BE GALVANISED AS PER STANDARD.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RD	FOR TENDER PURPOSE	VC	VC	KM		VV				IJT	
RC	FOR TENDER PURPOSE	AB	AB	RKP		VV				IJT	
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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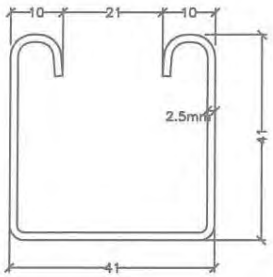
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PROJECT: STANDARD

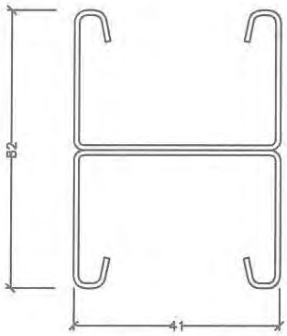
TITLE: CABLE TRAY DETAILS CROSS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-008	R0

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SINGLE CHANNEL–TYPE C1



DOUBLE CHANNEL–TYPE C2

TWO LENGTHS OF C1 WELDED BACK TO BACK

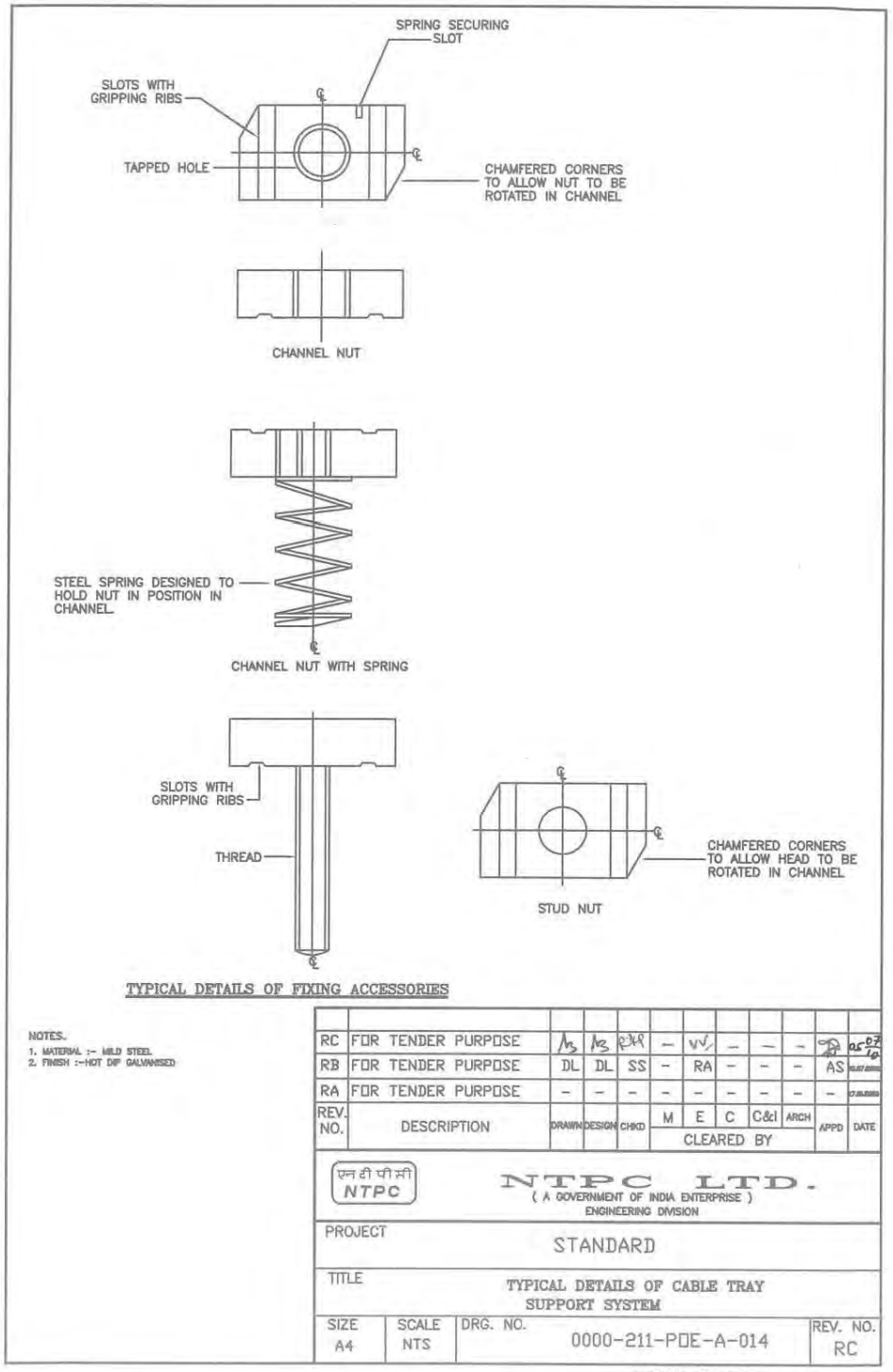
NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :– 2.5mm. THICK MS SHEET.
3. TOLERANCE :–AS PER RELEVANT I.S.
4. FINISH :–HOT DIP GALVANISED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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PROJECT	STANDARD		
TITLE	C1 & C2 CHANNEL, CABLE TRAY SUPPORT SYSTEM		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-013	REV. NO. RC



TYPICAL DETAILS OF FIXING ACCESSORIES

NOTES.
1. MATERIAL :- MILD STEEL
2. FINISH :-HOT DIP GALVANISED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

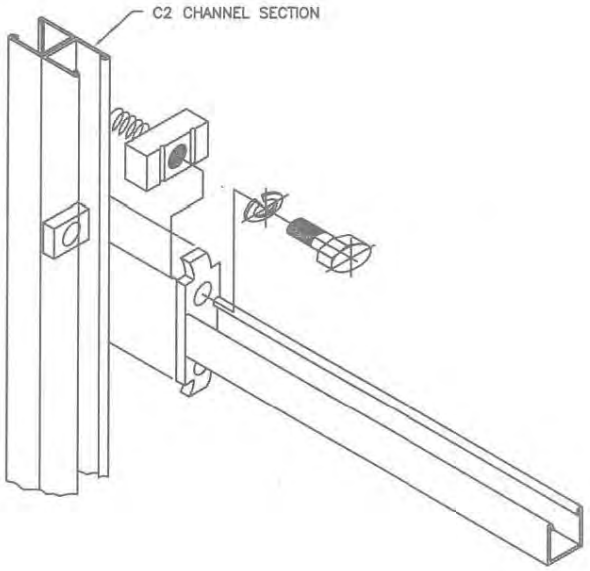
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PROJECT	STANDARD		
TITLE	TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-014	REV. NO. RC

TRAY1A-211-014

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NOTE.

1. FINISH :-HOT DIP GALVANISED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	M3	M3	RKJ	–	VV	–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

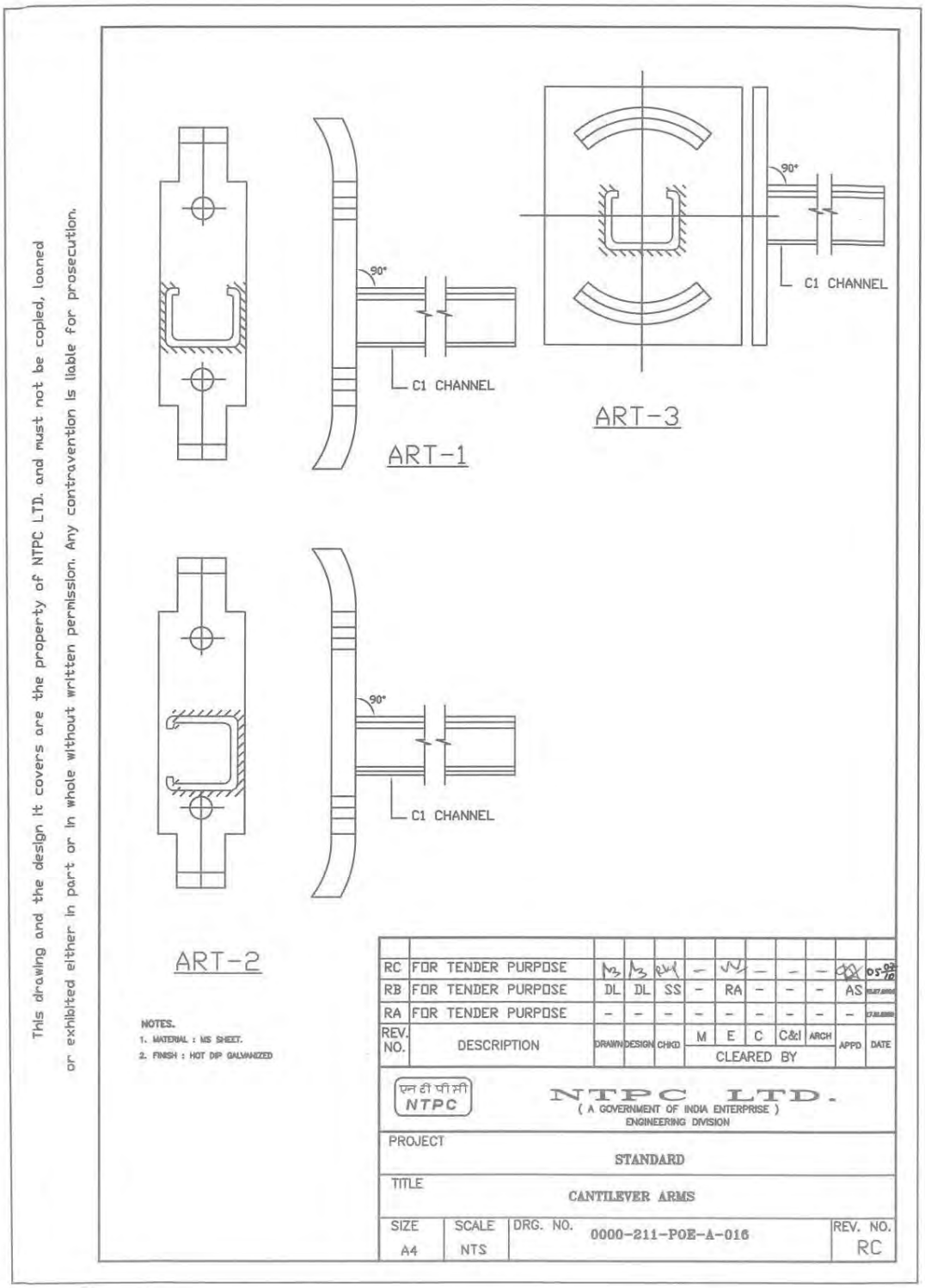
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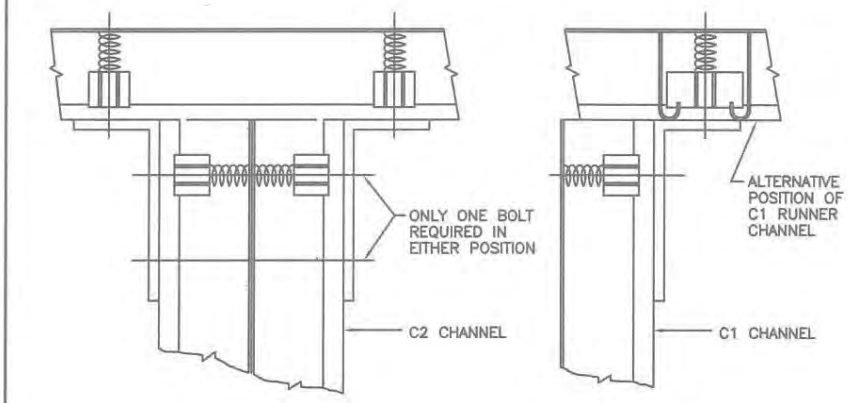
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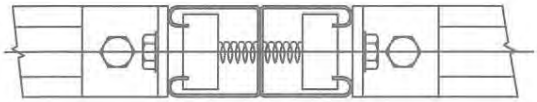
PROJECT: STANDARD

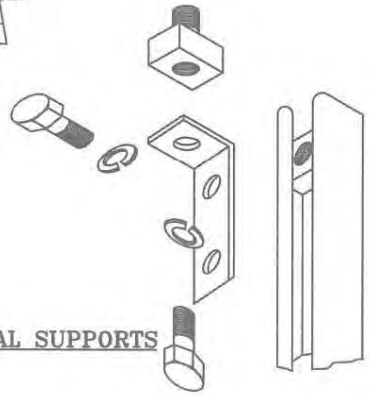
TITLE: TYPICAL DETAIL OF CABLE TRAY SUPPORT SYSTEM

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-015	RC


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90°
C1 CHANNEL
ART-1
90°
C1 CHANNEL
ART-3
90°
C1 CHANNEL
ART-2
NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED
RC FOR TENDER PURPOSE DL DL SS – RA – – – AS 05-02-10
RB FOR TENDER PURPOSE DL DL SS – RA – – – AS
RA FOR TENDER PURPOSE – – – – – – – – –
REV. NO. DESCRIPTION DRAWN DESIGN CHKD CLEARED BY M E C C&I ARCH APPD DATE
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NTPC LTD.
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ENGINEERING DIVISION
PROJECT
STANDARD
TITLE
CANTILEVER ARMS
SIZE A4
SCALE NTS
DRG. NO. 0000-211-POE-A-016
REV. NO. RC







ASSEMBLY–1
UPPER FIXING C2 CHANNEL

ASSEMBLY–2
UPPER FIXING C1 CHANNEL

UPPER FIXING FOR CHANNEL VERTICAL SUPPORTS

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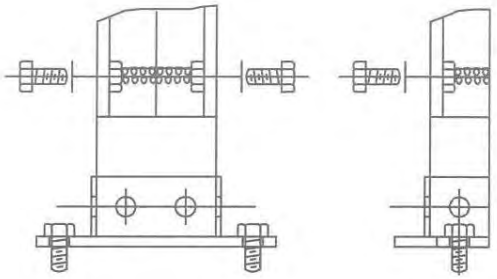
NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

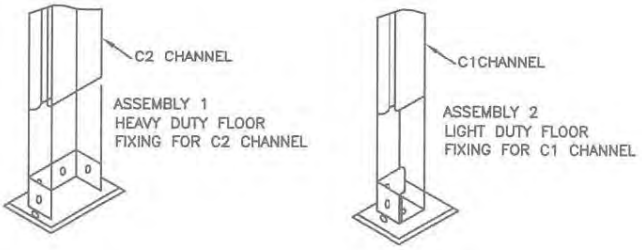
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	CLEARED BY M	E	C	C&I	ARCH	APPD	DATE
RC	FOR TENDER PURPOSE	M3	M3	RVK	–	VV	–	–	–		05.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM		
SIZE: A4	SCALE: NTS	DRG. NO.: 0000-211-POE-A-017	REV. NO.: RC

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FLOOR FIXING FOR CHANNEL VERTICAL SUPPORTS

NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

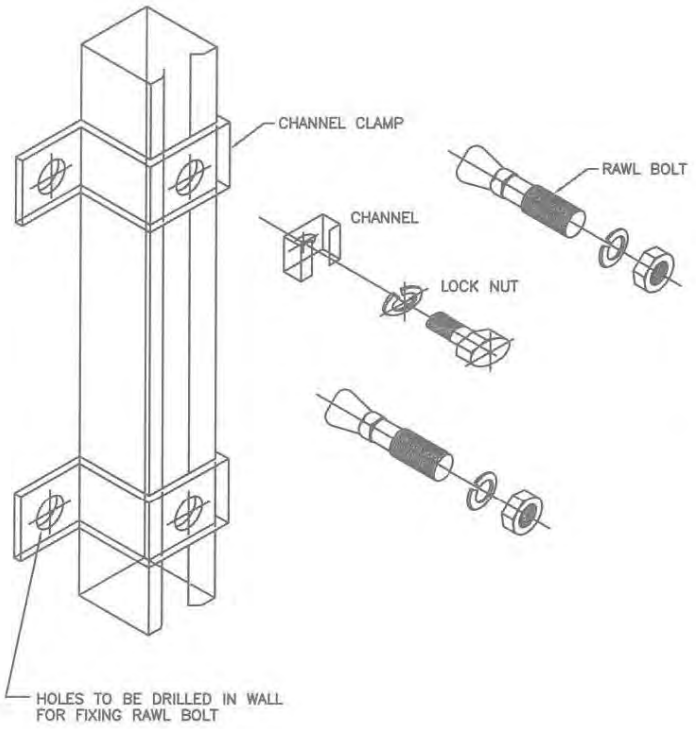
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-018	RC

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NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	MB	MB	BKP	–	WJ	–	–	–		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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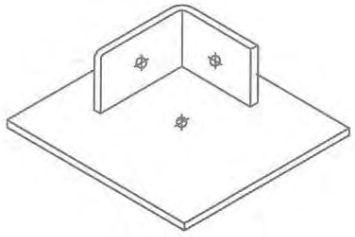
NTPC LTD.
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ENGINEERING DIVISION

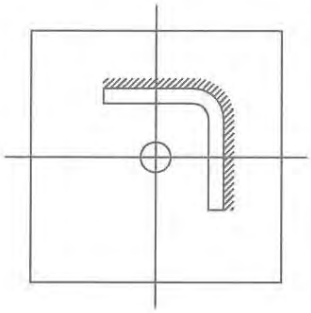
PROJECT: STANDARD

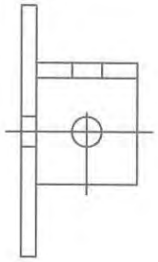
TITLE: FIXING OF CHANNEL IN TRENCH WALL

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-019	RC

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NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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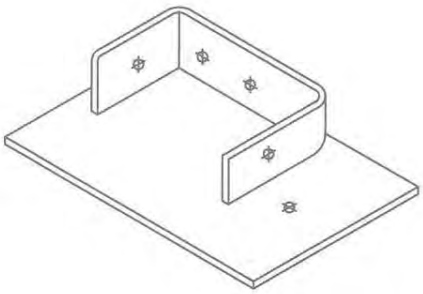
NTPC LTD.
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ENGINEERING DIVISION

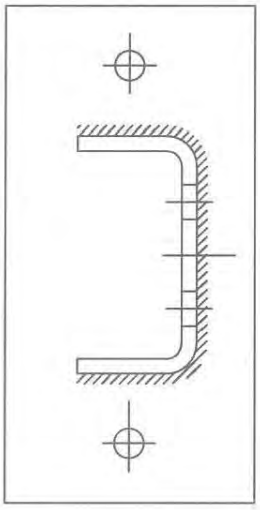
PROJECT: STANDARD

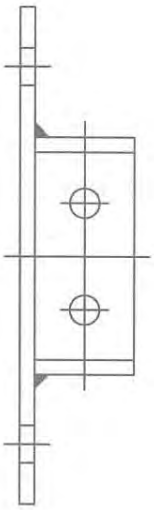
TITLE: BRACKET FLOOR PLATE LIGHT DUTY.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-020	RC

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NOTES.
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2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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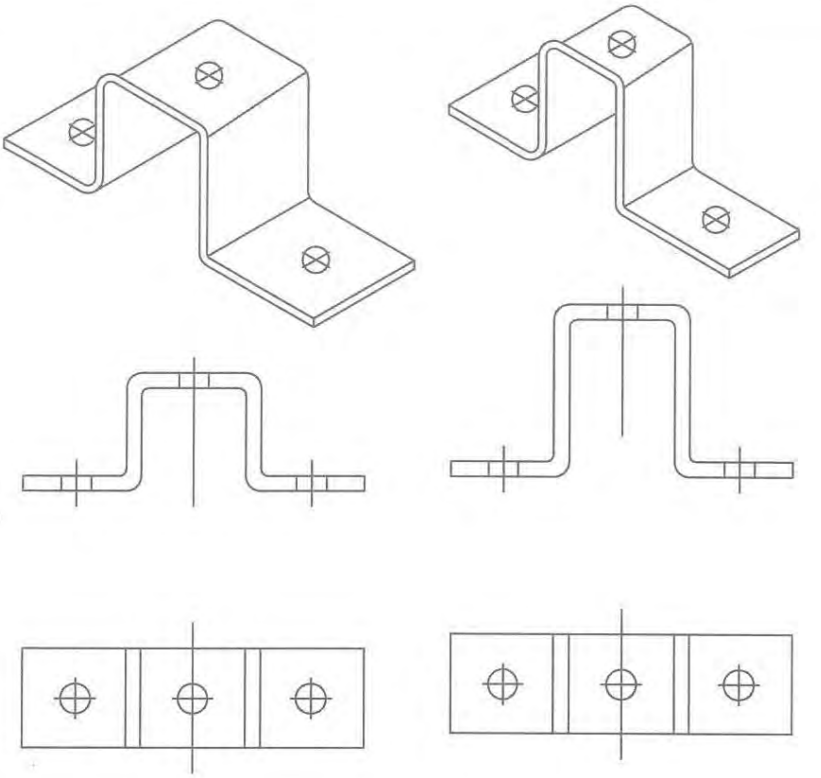
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BRACKET FLOOR PLATE HEAVY DUTY.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-021	RC

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BRACKET–C1 CHANNEL CLAMP HEAVY DUTY.

BRACKET–C2 CHANNEL CLAMP.

NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

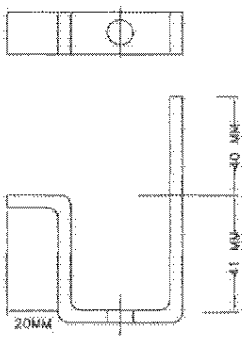
एन टी पी सी NTPC

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

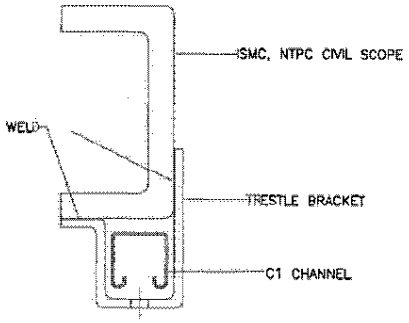
PROJECT: STANDARD

TITLE: BRACKET C1 CHANNEL CLAMP HEAVY DUTY. AND BRACKET C2 CHANNEL.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-022	RC



TRESTLE BRACKET



FIXING ARRANGEMENT OF TRESTLE BRACKET

NOTES

1) MATERIAL : MILD STEEL.

2) FINISH : HOT DIP GALVANISED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RA	FOR TENDER PURPOSE.	MV	RKP	VKM	–	SS	–	–	–	GT	30.12.2005

CLEARED BY

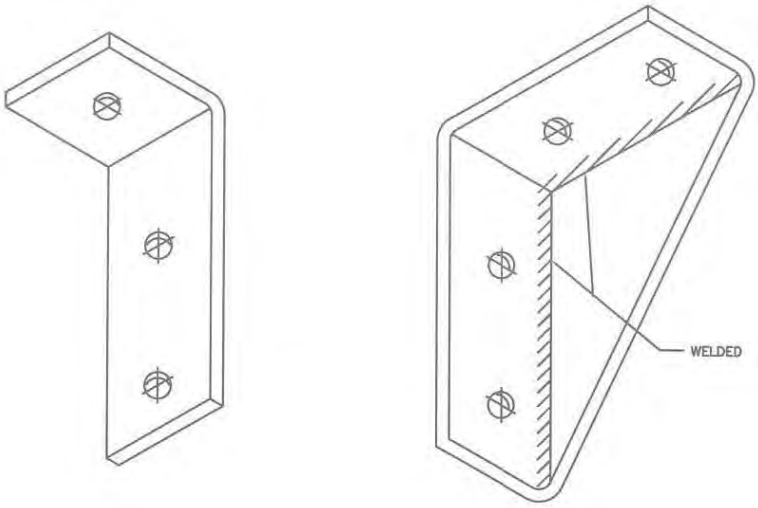
NTPC LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
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ENGINEERING DIVISION

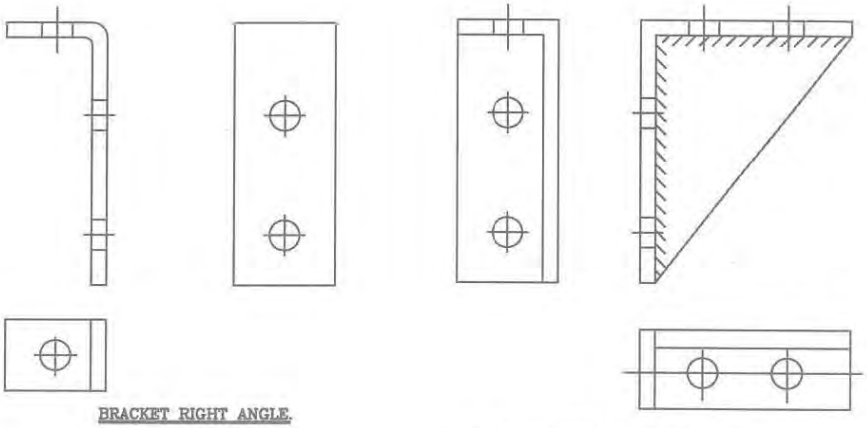
PROJECT	STANDARD
TITLE	FIXING OF CHANNEL FOR TRESTLE AND TRESTLE BRACKET.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-022A	RA

TRAY1A-211-022A

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BRACKET RIGHT ANGLE.

BRACKET RIGHT ANGLE HEAVY DUTY.

NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

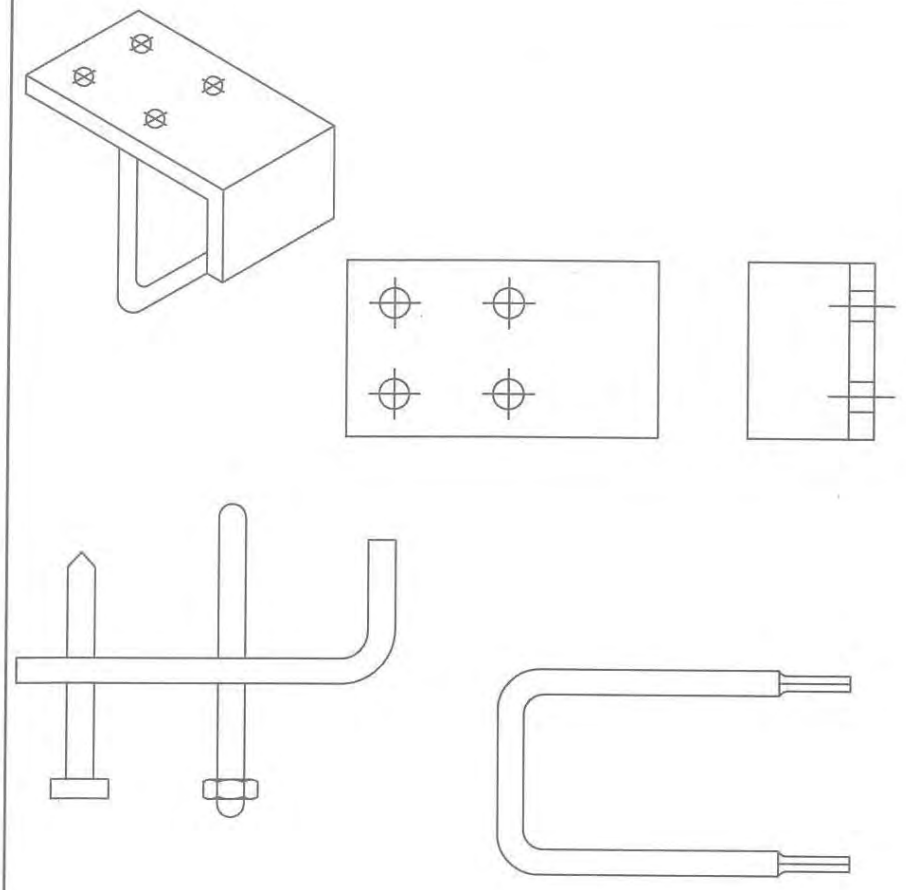
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	MS	MS	PVR	–	VV	–	–	–		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	BRACKET RIGHT ANGLE & BRACKET RIGHT ANGLE HEAVY DUTY.		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-023	REV. NO. RC

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NOTES.
1. MATERIAL : MILD STEEL
2. FINISH : HOT DIP GALVANIZED

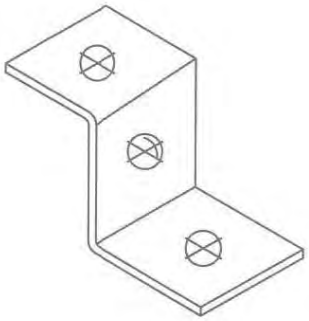
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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PROJECT	STANDARD		
TITLE	BEAM CLAMP.		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-024	REV. NO. RC

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BRACKET–C1 CHANNEL CLAMP.

NOTES.
1. MATERIAL : MILD STEEL
2. FINISH : HOT DIP GALVANIZED

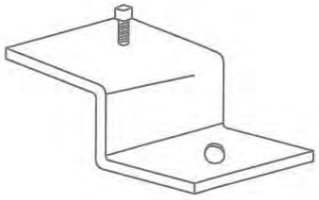
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	M3	M3	PW	–	W	–	–	–		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

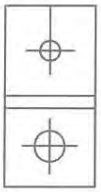
एन टी पी सी NTPC

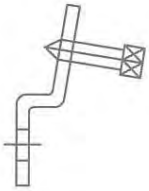
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	BRACKET C1 CHANNEL CLAMP.		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-025	REV. NO. RC

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NOTES.
1. MATERIAL : MILD STEEL
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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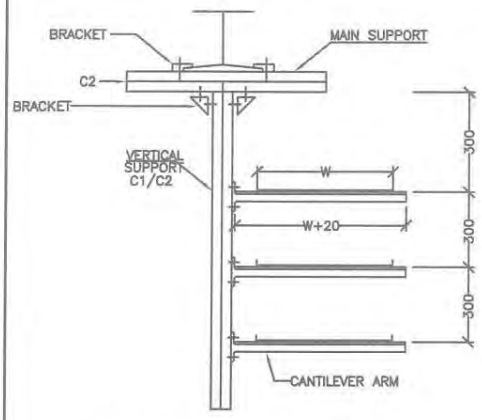
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(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BRACKET BEAM CLAMP

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-026	RC

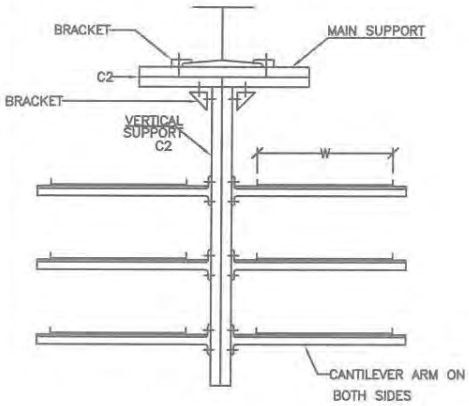
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VERTICAL SUPPORT

1) FOR 1 TO 6 TIER OF 600mm TRAY – C2 CHANNEL
2) FOR 1 TO 3 TIER OF 300mm TRAY – C1 CHANNEL
3) FOR 4 TO 6 TIER OF 300mm TRAY – C2 CHANNEL
4) FOR 1 TO 6 TIER OF 150mm TRAY – C1 CHANNEL

ARRANGEMENT TYPE–B1



NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. IN CASE OF HANGING SUPPORT C2 CHANNEL TO BE USED FOR MAIN SUPPORT

ARRANGEMENT TYPE–B2

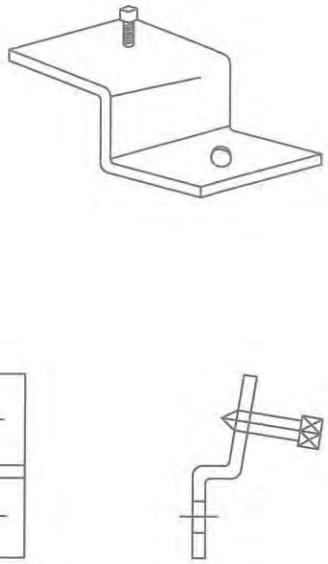
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-030	REV. NO. RC

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NOTES.
1. MATERIAL : MILD STEEL
2. FINISH : HOT DIP GALVANIZED

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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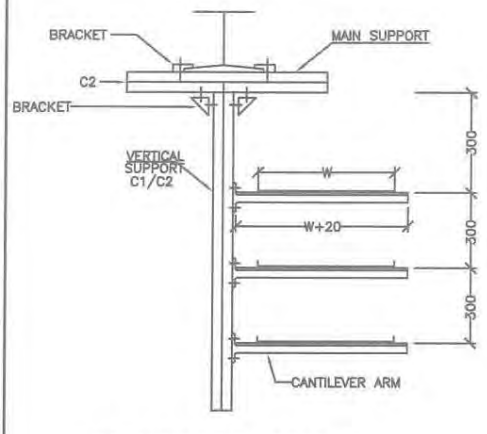
NTPC LTD.
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ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BRACKET BEAM CLAMP

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-026	RC

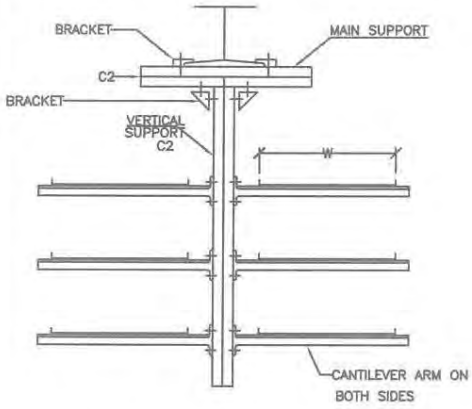
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VERTICAL SUPPORT

1) FOR 1 TO 6 TIER OF 600mm TRAY – C2 CHANNEL
2) FOR 1 TO 3 TIER OF 300mm TRAY – C1 CHANNEL
3) FOR 4 TO 6 TIER OF 300mm TRAY – C2 CHANNEL
4) FOR 1 TO 6 TIER OF 150mm TRAY – C1 CHANNEL

ARRANGEMENT TYPE–B1



NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. IN CASE OF HANGING SUPPORT C2 CHANNEL TO BE USED FOR MAIN SUPPORT

ARRANGEMENT TYPE–B2

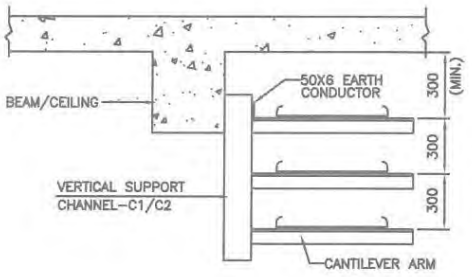
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					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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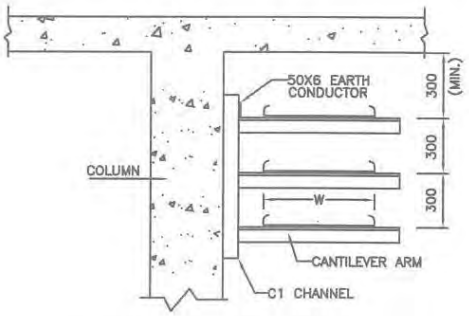
PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-030	REV. NO. RC

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VERTICAL SUPPORT

1) FOR 1 TO 6 TIER OF 600mm TRAY – C2 CHANNEL
2) FOR 1 TO 3 TIER OF 300mm TRAY – C1 CHANNEL
3) FOR 4 TO 6 TIER OF 300mm TRAY – C2 CHANNEL
4) FOR 1 TO 6 TIER OF 150mm TRAY – C1 CHANNEL



ARRANGEMENT TYPE–C1

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	01.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	[illegible]
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	[illegible]

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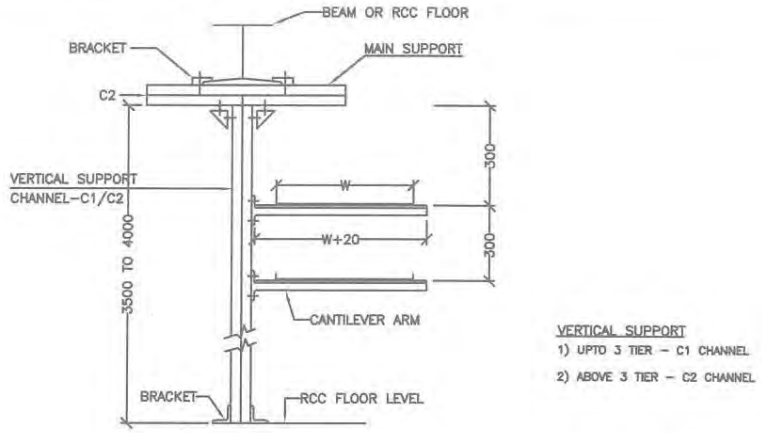
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PROJECT: STANDARD

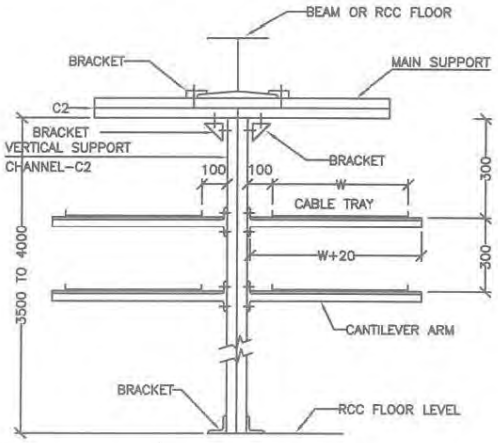
TITLE: STANDARD CABLE SUPPORT ASSEMBLY

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-031	RC

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ARRANGEMENT TYPE-D1



ARRANGEMENT TYPE-D2

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–	AS	
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

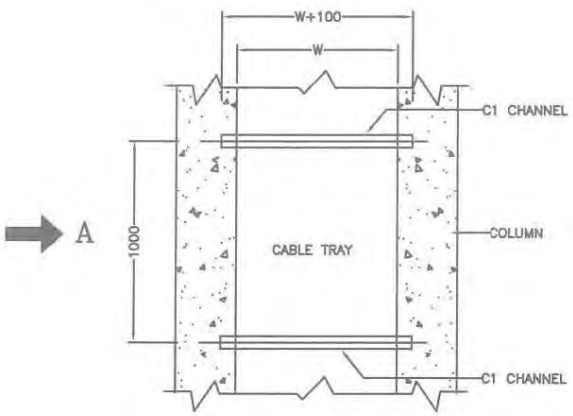
NTPC LTD.
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PROJECT: STANDARD

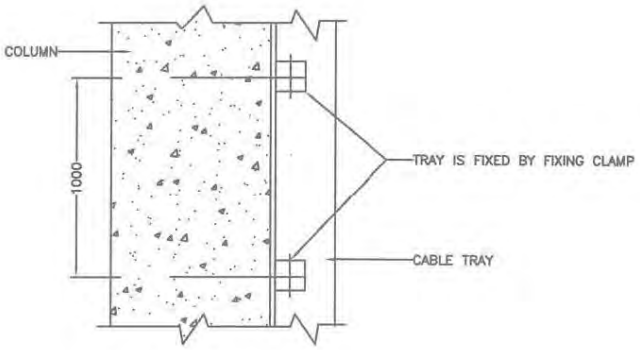
TITLE: STANDARD CABLE SUPPORT ASSEMBLY

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-032	RC

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(W=WIDTH OF CABLE TRAY)



VIEW–A

ARRANGEMENT TYPE–S1

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				—		—	—	—		05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	—	RA	—	—	—	AS	
RA	FOR TENDER PURPOSE	—	—	—	—	—	—	—	—	—	

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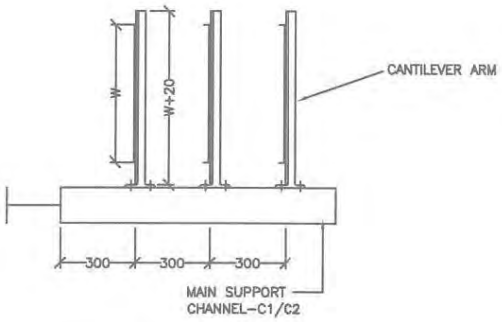
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PROJECT	STANDARD		
TITLE	STANDARD CABLE SUPPORT ASSEMBLY		
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-033	REV. NO. RC

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MAIN SUPPORT

1) FOR 1 TO 6 TIER OF 600mm TRAY – C2 CHANNEL
2) FOR 1 TO 3 TIER OF 300mm TRAY – C1 CHANNEL
3) FOR 4 TO 6 TIER OF 300mm TRAY – C2 CHANNEL
4) FOR 1 TO 6 TIER OF 150mm TRAY – C1 CHANNEL



ARRANGEMENT TYPE–S2

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05/10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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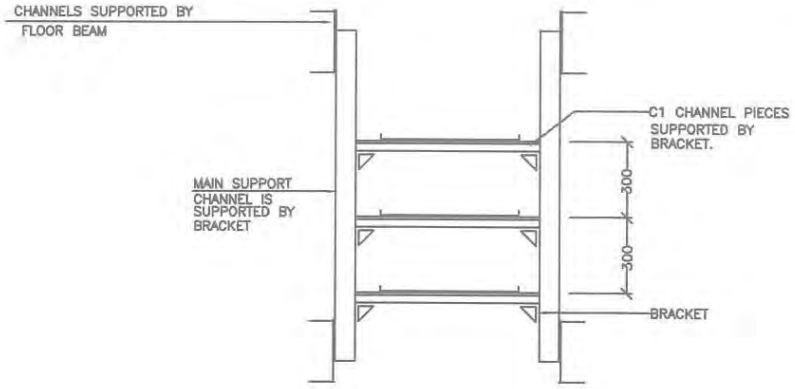
NTPC LTD.
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PROJECT: STANDARD

TITLE: STANDARD CABLE SUPPORT ASSEMBLY

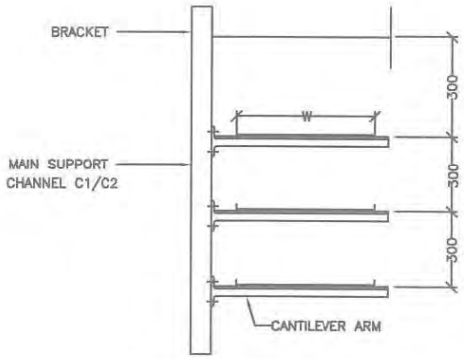
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-034	RC

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MAIN SUPPORT
1) UPTO 3 TIER – C1 CHANNEL
2) ABOVE 3 TIER – C2 CHANNEL

ARRANGEMENT TYPE–S3



ARRANGEMENT TYPE–S4

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	[illegible]	[illegible]	[illegible]	–	[illegible]	–	–	–	[illegible]	05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	–	RA	–	–	–	AS	05.07.2010
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.06.2010

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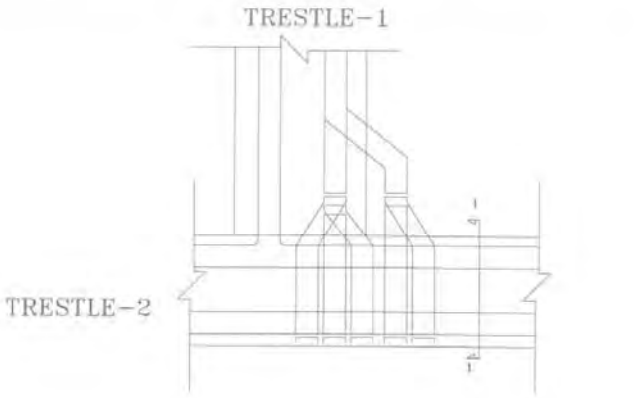
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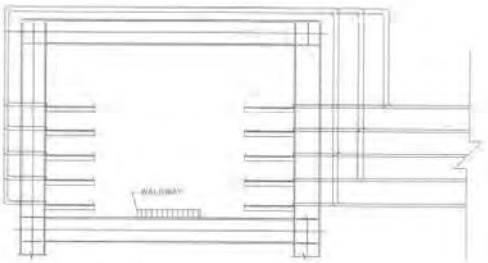
PROJECT: STANDARD

TITLE: STANDARD CABLE SUPPORT ASSEMBLY

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-PDE-A-035	RC

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SECTION 1-1

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH	APPD.	DATE
RA	FOR TENDER PURPOSE										

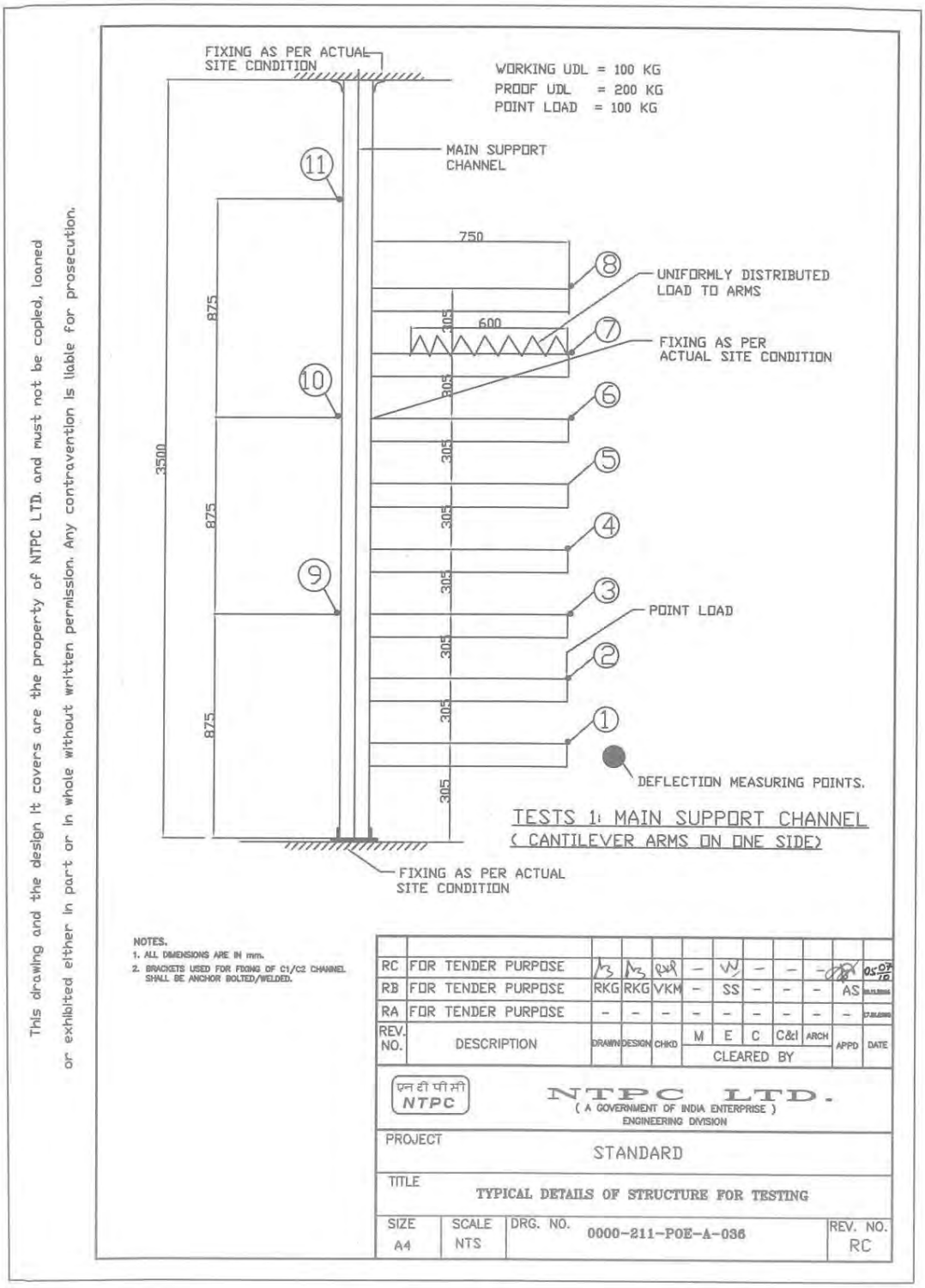
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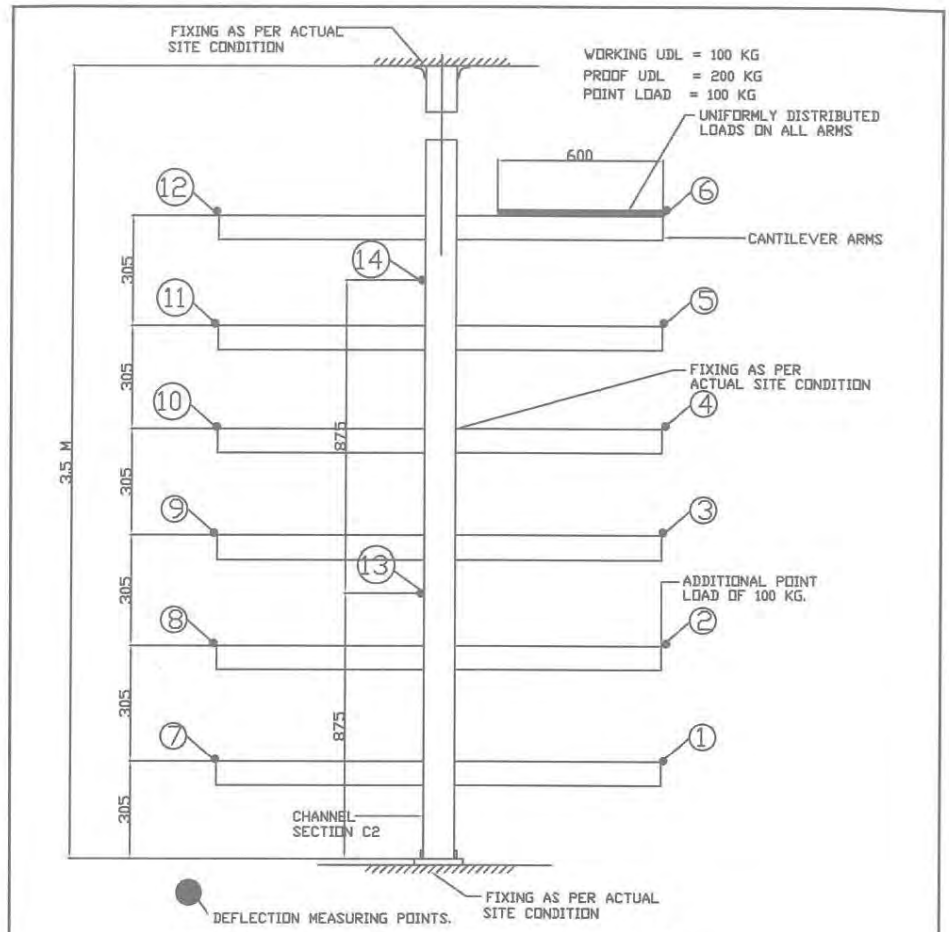
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PROJECT: STANDARD

TITLE: TYPICAL INTERCONNECTION DETAILS BETWEEN TWO PERPENDICULAR TRESTLES

SIZE	SCALE	DSG. NO.	REV. NO.
A4	NTS.	0000-211-POE-A-035A	RA


FIXING AS PER ACTUAL SITE CONDITION
WORKING UDL = 100 KG
PROOF UDL = 200 KG
POINT LOAD = 100 KG
MAIN SUPPORT CHANNEL
11
750
8
UNIFORMLY DISTRIBUTED LOAD TO ARMS
600
7
FIXING AS PER ACTUAL SITE CONDITION
10
6
5
4
9
3
POINT LOAD
2
1
DEFLECTION MEASURING POINTS.
875
875
875
3500
305
TESTS 1: MAIN SUPPORT CHANNEL
(CANTILEVER ARMS ON ONE SIDE)
FIXING AS PER ACTUAL SITE CONDITION
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NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.
RC FOR TENDER PURPOSE RKG RKG VKM – SS – – – AS
RB FOR TENDER PURPOSE
RA FOR TENDER PURPOSE
REV. NO. DESCRIPTION DRAWN DESIGN CHKD M E C C&I ARCH APPD DATE
CLEARED BY
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ENGINEERING DIVISION
PROJECT
STANDARD
TITLE
TYPICAL DETAILS OF STRUCTURE FOR TESTING
SIZE A4
SCALE NTS
DRG. NO. 0000-211-POE-A-036
REV. NO. RC



TEST 2A : MAIN SUPPORT CHANNEL

(CANTILEVER ARMS ON BOTH SIDES)

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–	AS	
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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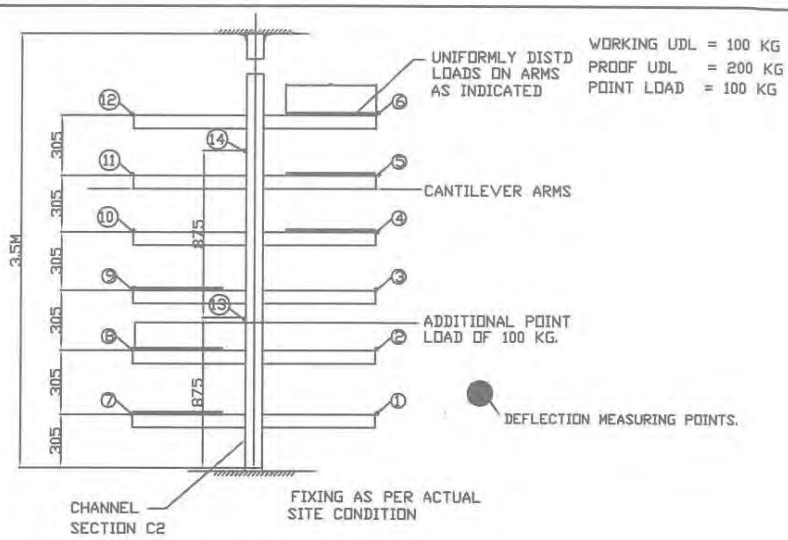
PROJECT: STANDARD

TITLE: TYPICAL DETAILS OF STRUCTURE FOR TESTING

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-037	RC

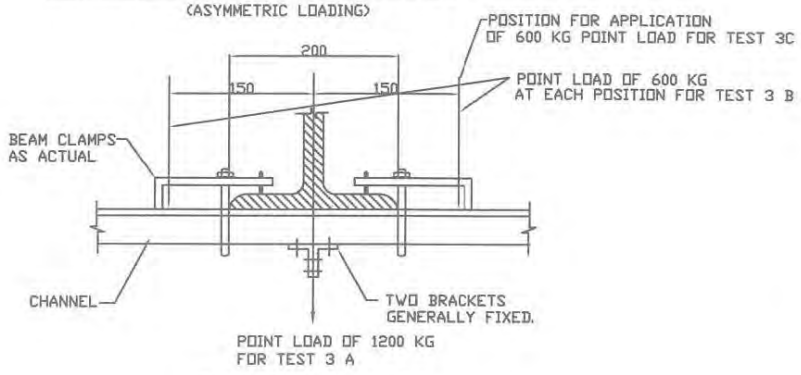
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TEST 2B MAIN SUPPORT CHANNEL

(ASYMMETRIC LOADING)



TEST 3A, 3B & 3C

NOTES.
1. ALL DIMENSIONS ARE IN mm.
2. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

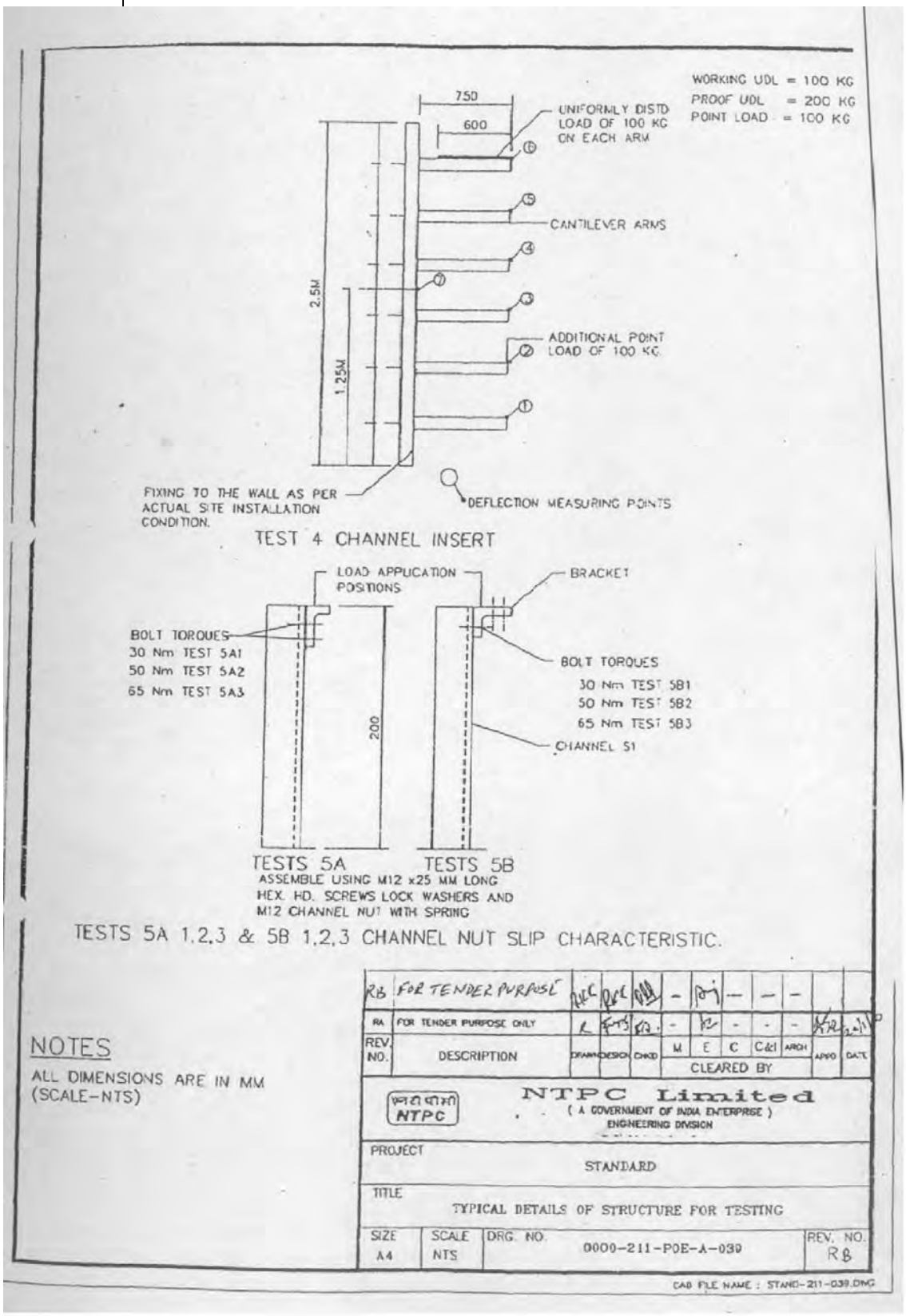
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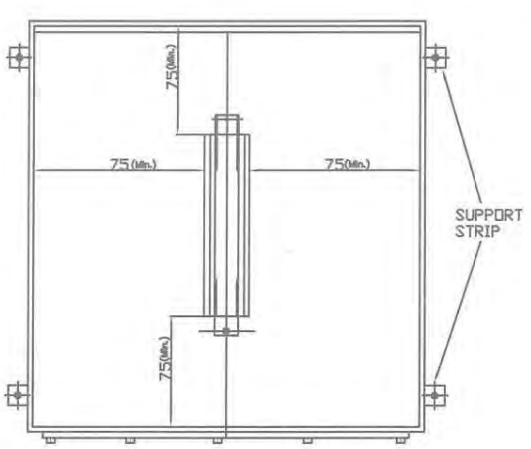
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ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: TYPICAL DETAILS STRUCTURE FOR TESTING

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-038	RC


WORKING UDL = 100 KG
PROOF UDL = 200 KG
POINT LOAD = 100 KG
750
600
UNIFORMLY DISTD LOAD OF 100 KG ON EACH ARM
CANTILEVER ARMS
2.5M
1.25M
ADDITIONAL POINT LOAD OF 100 KG
FIXING TO THE WALL AS PER ACTUAL SITE INSTALLATION CONDITION.
DEFLECTION MEASURING POINTS
TEST 4 CHANNEL INSERT
LOAD APPLICATION POSITIONS
BRACKET
BOLT TORQUES
30 Nm TEST 5A1
50 Nm TEST 5A2
65 Nm TEST 5A3
BOLT TORQUES
30 Nm TEST 5B1
50 Nm TEST 5B2
65 Nm TEST 5B3
CHANNEL S1
200
TESTS 5A
TESTS 5B
ASSEMBLE USING M12 x25 MM LONG HEX. HD. SCREWS LOCK WASHERS AND M12 CHANNEL NUT WITH SPRING
TESTS 5A 1,2,3 & 5B 1,2,3 CHANNEL NUT SLIP CHARACTERISTIC.
RB FOR TENDER PURPOSE
RA FOR TENDER PURPOSE ONLY
REV. NO. DESCRIPTION DRAWN DESIGN CHKD
CLEARED BY M E C C&I ARCH APPD DATE
NOTES
ALL DIMENSIONS ARE IN MM
(SCALE-NTS)
NTPC Limited
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ENGINEERING DIVISION
PROJECT
STANDARD
TITLE
TYPICAL DETAILS OF STRUCTURE FOR TESTING
SIZE A4
SCALE NTS
DRG. NO. 0000-211-P0E-A-039
REV. NO. RB
CAD FILE NAME : STAND-211-039.DWG



FRONT VIEW WITH COVER REMOVED

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NOTE.
1. ALL DIMENSIONS ARE IN mm.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

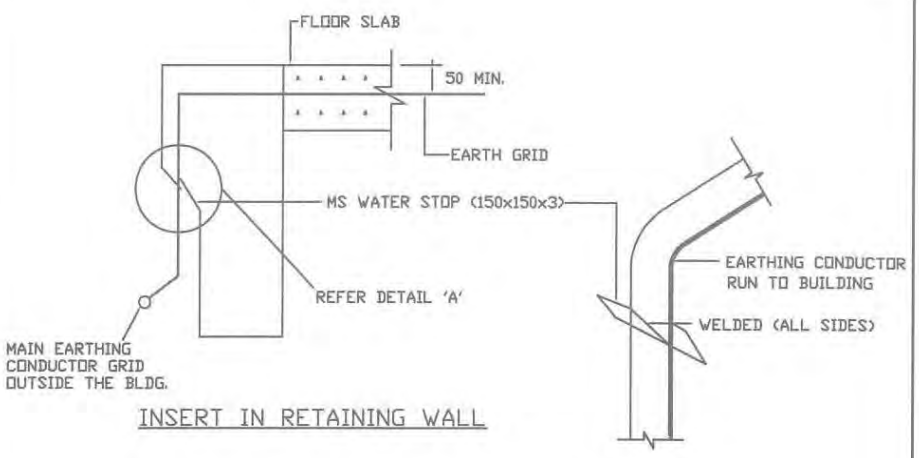
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PROJECT: STANDARD

TITLE: TYPICAL DRAWING FOR JUNCTION BOX

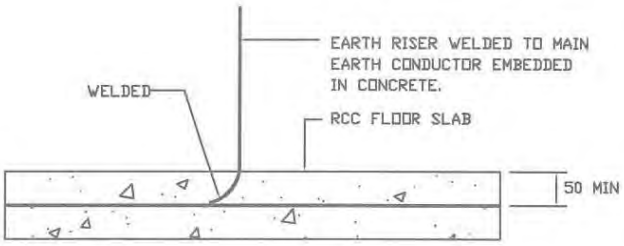
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-040	RC

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INSERT IN RETAINING WALL

DETAIL 'A'



EARTH RISER

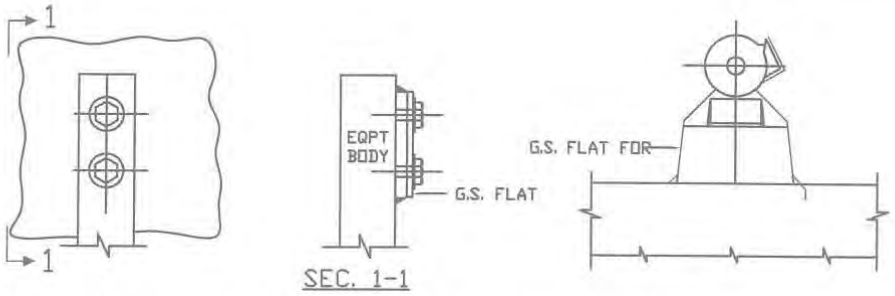
NOTE.
1. ALL DIMENSIONS ARE IN mm.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

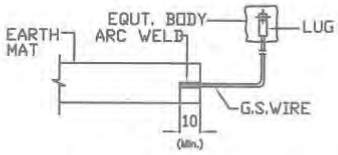
NTPC LTD.
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PROJECT	STANDARD		
TITLE	EARTHING DETAILS		
SIZE: A4	SCALE: NTS	DRG. NO.: 0000-211-POE-A-041	REV. NO.: RC

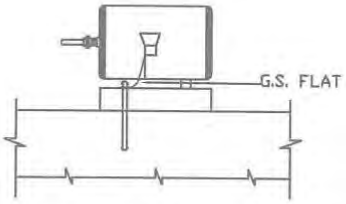
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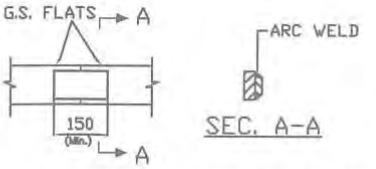
EQUIPMENT GROUNDING WITH G.S. FLAT



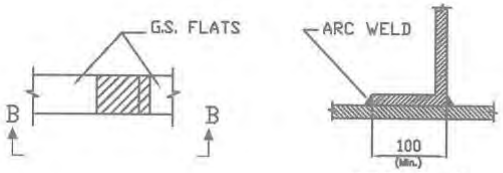
EQUIPMENT GROUNDING WITH G.S. WIRE



MOTOR TERMINAL BOX GROUNDING DETAIL



LAP JOINTS BETWEEN G.S. FLATS



ANGULAR JOINTS BETWEEN G.S. FLATS

NOTE.
1. ALL DIMENSIONS ARE IN mm.

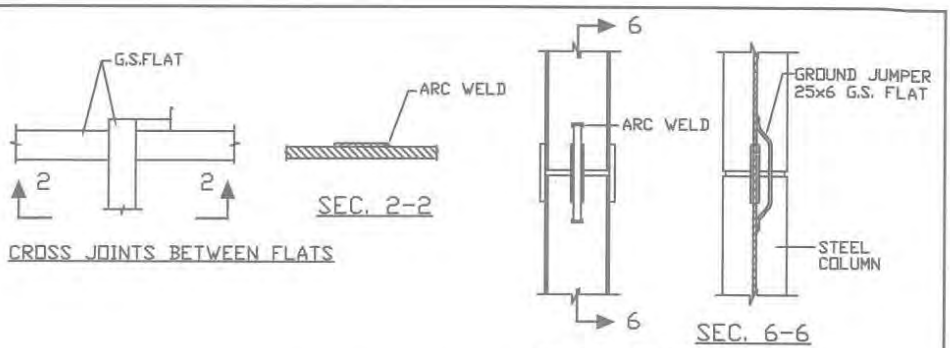
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

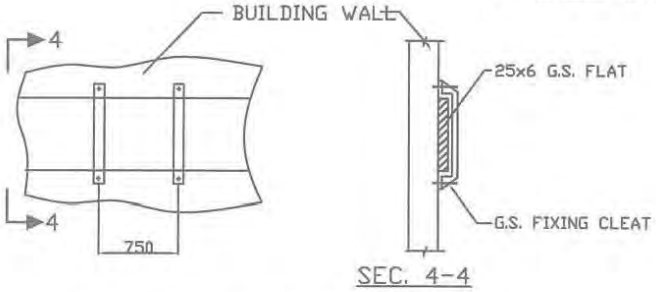
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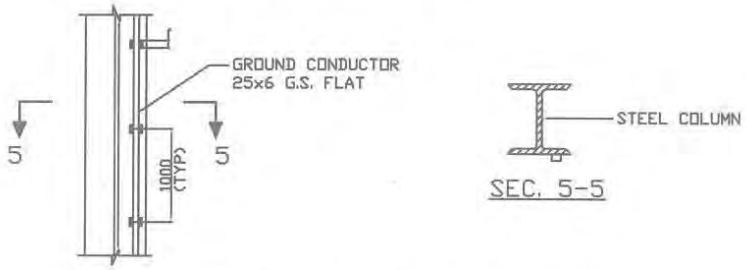
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ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE	EARTHING DETAILS		
SIZE: A4	SCALE: NTS	DRG. NO.: 0000-211-POE-A-042	REV. NO.: RC

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NOTE.
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REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.03.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

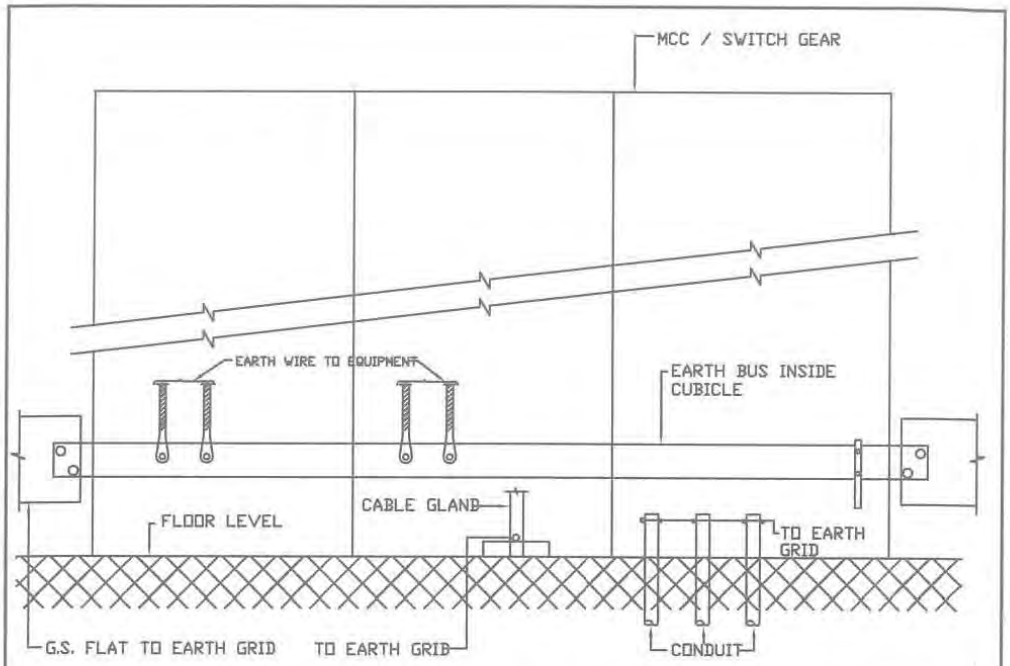
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PROJECT: STANDARD

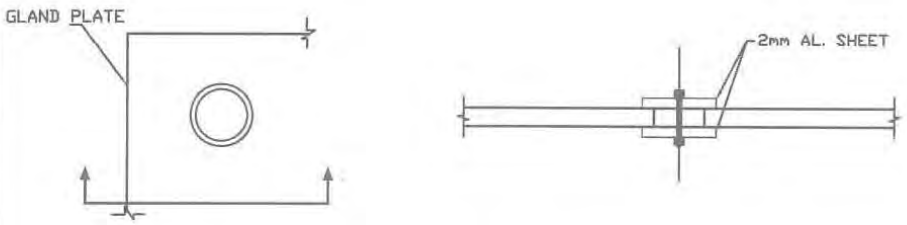
TITLE: EARTHING DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-043	RC

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EARTHING DETAILS MCC AND SWITCHGEAR



SEALING OF UNUSED CABLE OPENING

NOTE.
1. ALL DIMENSIONS ARE IN mm.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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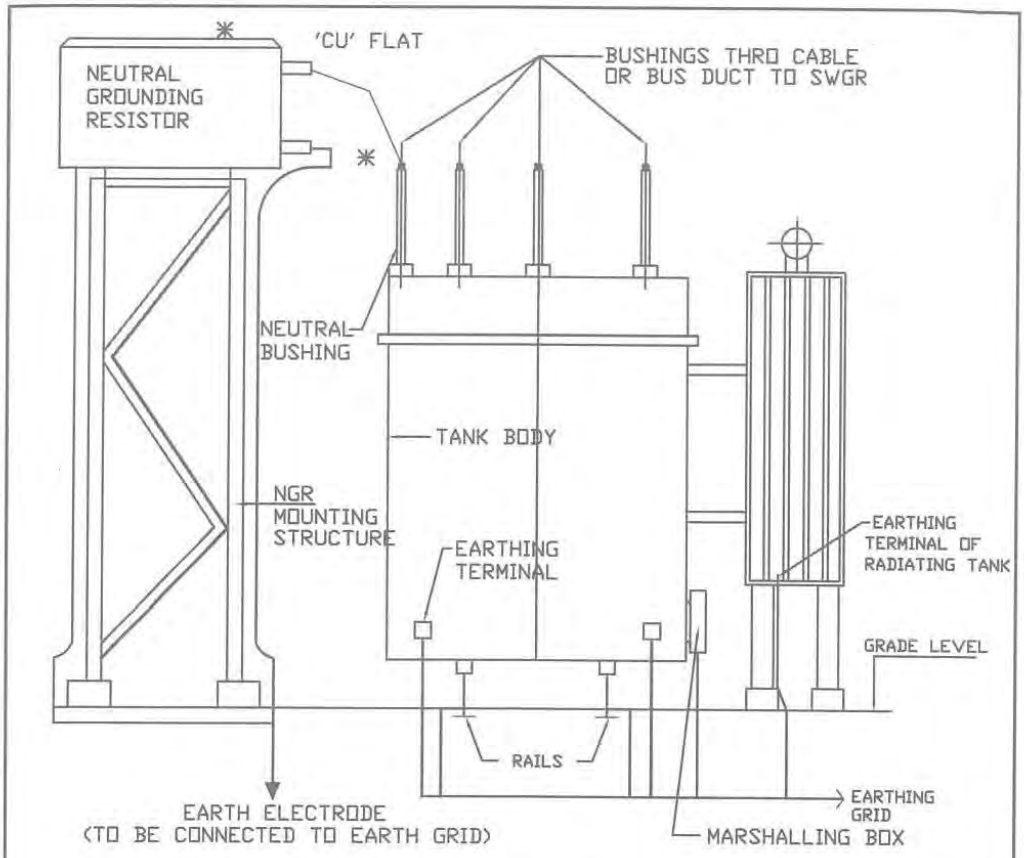
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ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: EARTHING DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-044	RC

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EARTHING DETAILS TRANSFORMER

NOTE.
1. ALL DIMENSIONS ARE IN mm.
2. THE TRANSFORMER NEUTRAL FOR HT TRANSFORMER SHALL BE EARTHED THROUGH FLATS AS SHOWN (SUPPLIED BY TRANSFORMER SUPPLIER)

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05-07-10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

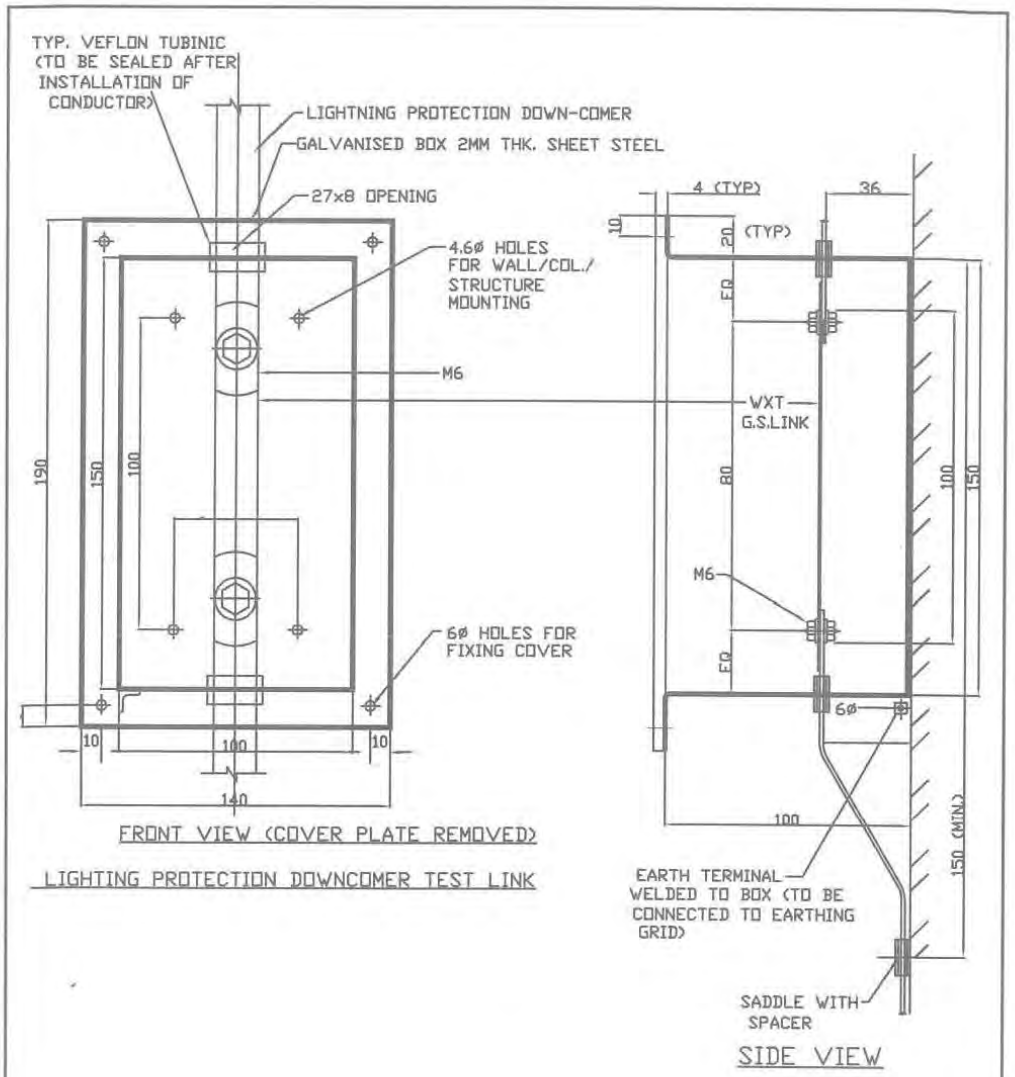
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PROJECT: STANDARD

TITLE: EARTHING DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-045	RC



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NOTE.
1. ALL DIMENSIONS ARE IN mm.
2. THE TEST LINK SHALL BE OF SAME WIDTH AND THICKNESS AS THE DOWNCOMER.THE NUTS BOLTS AND WASHER TO BE OF GSL.
3. THE DOWN COMER ENTRY AND EXIT POINTS IN TO BOX BE MADE WATER-TIGHT AFTER LAYING OF CONDUCTOR.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

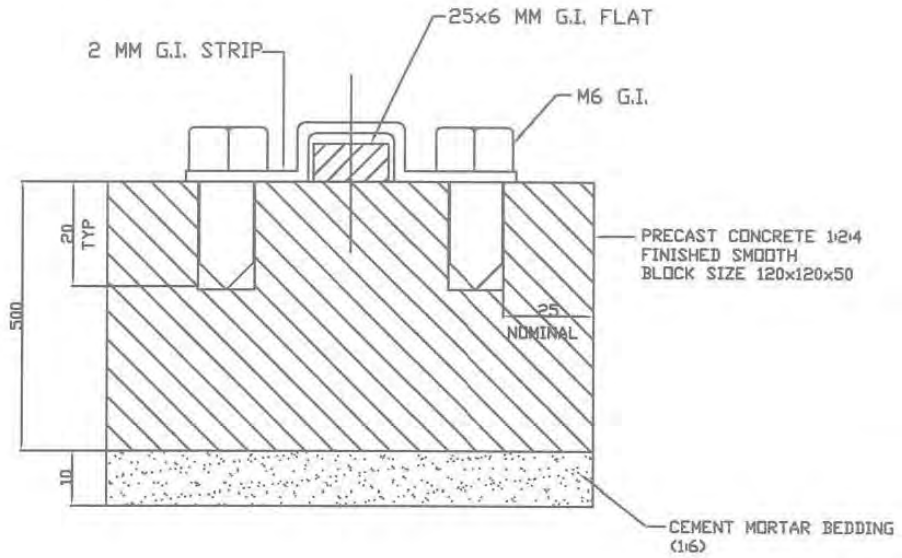
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PROJECT: STANDARD

TITLE: LIGHTNING PROTECTION DETAILS.

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-047	RC

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BLOCK SPACING 1000MM CENTRE TO CENTRE

TYPICAL DETAILS OF CLEATING HORIZONTAL CONDUCTOR OVER WATER PROOFING

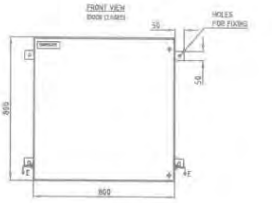
NOTE.
1. ALL DIMENSIONS ARE IN mm.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE				–		–	–	–		05.02.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	

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PROJECT	STANDARD
TITLE	LIGHTNING PROTECTION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-048	RC



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GENERAL TECHNICAL PARTICULARS

1. ALL DIMENSIONS ARE IN MM.
2. TYPE: WALL/COLUMN/PEDESTAL MOUNTING TYPE.
3. SHEET: CRCA SHEET min. 2mm THK.
4. GLAND PLATE SHOULD BE OF 3MM THK ALUMINIUM, REMOVABLE TYPE WITH KNOCKOUT HOLE FOR I/C CABLE–1Cx300SQ.MM AL.–6NOS.
   HOLE FOR O/G CABLE–1Cx185SQ.MM AL.–6NOS.
5. PAINT: PRETREATMENT POWDER COATING
6. SHADE: GREY RAL–9002
7. CABLE ENTRY: BOTTOM
8. BUSBAR: ELECTOLYTIC GRADE TINNED CU. OF Min. 40x10MM
9. IP–55
10. BUS BAR INSULATOR–SMC TYPE
11. BUS BAR ARRANGEMENT: HORIZONTAL
12. BUS BAR SHALL HAVE ONE HOLE DRILLED FOR CABLE CONNECTION OF EACH SIZE MENTIONED AT SL.NO 4 AND SUPPLIED WITH CORRESPONDING SIZE HIGH TENSILE STRENGTH ZINC COATED STEEL BOLTS.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
RA	FOR TENDER PURPOSE ONLY	VC	VC	RK		W					15.4.05

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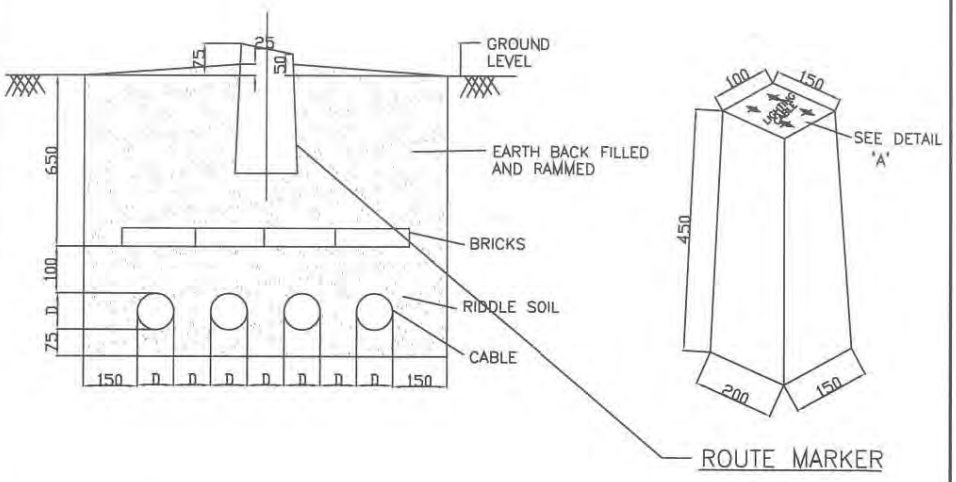
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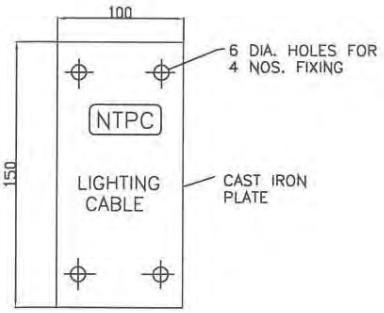
PROJECT: STANDARD

TITLE: ADAPTOR BOX FOR LT CABLES

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-048A	RA

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DETAIL–'A'

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ROUTE MARKERS SHALL BE CONSTRUCTED OF CONCRETE WITH CAST IRON PLATE, WITH THE ROUTE INFORMATION ENGRAVED ON IT, BOLTED ON TOP OF THE CONCRETE BLOCK AS SHOWN.
3. CAST IRON PLATE SHALL BE OF Min. 6.0mm THICKNESS.

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	CLEARED BY M	E	C	C&I	ARCH	APPD	DATE
RC	FOR TENDER PURPOSE				–		–	–	–		
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	–	SS	–	–	–	AS	30.11.2006
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.05.2006

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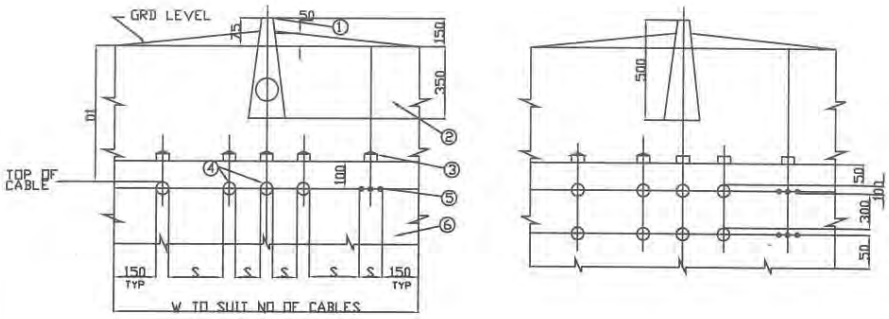
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ENGINEERING DIVISION

PROJECT: STANDARD

TITLE: BURIED CABLE TRENCH DETAILS FOR LIGHTING

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000–211–POE–A–049	RC

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DIRECTLY BURIED CABLES IN SINGLE LAYER

DIRECTLY BURIED CABLES IN TWO LAYER

LEGEND

① CABLE ROUTE MARKER
② EARTH BACK FILLED & RAMMED
③ PROTECTIVE COVERS
   a) BRICKS FOR LOW VOLTAGE CABLES
   b) RCC FOR HIGH VOLTAGE CABLES WITH HOLE AT EACH END TO TIE EACH OTHER WITH G.S. WIRE
④ ARMOURED POWER CABLE
⑤ ARMOURED CONTROL CABLE
⑥ FINE SAND/RIDDLED SOIL COMPACTED

DIMENSION MIN.	1100V GRADE CABLES	FOR 3.3 KV TO 11KV	ABOVE 11KV & UPTO 33KV
D1	750	900	1050
S	= d BETWEEN CABLES OF SAME CLASS = 300MM BETWEEN CABLES OF DEFT CLASS = 400MM BETWEEN 1/C POWER CABLE AND COMMUNICATION CABLE. = 300MM BETWEEN MULTICORE POWER CABLE & COMMUNICATION CABLE.		

d - OVERALL DIAMETER OF THE BIGGER OF THE TWO CABLES.
D1 - MINIMUM DEPTH OF LAYING FROM GROUND SURFACE TO TOP OF CABLES.

NOTE

1. SINGLE CORE CABLES SHALL BE RUN IN TREFOIL FORMATION AND SHALL BE BOUND BY SELFLOCKING CABLE TIES AT EVERY 750 MM.
2. CABLE IDENTIFICATION TAG SHALL BE TIED AT BOTH ENDS OF THE CABLE.
3. IF THE MINIMUM CLEARENCE AS INDICATED THE ABOVE TABLE FOR CABLES OF DIFFERENT CLASSES ARE NOT FEASIBLE BRICK BARRIERS SHALL BE USED BETWEEN ADJACENT CABLES.
4. G.I/HUME/HDPE. PIPES SHALL BE PROVIDED FOR ROAD CROSSING AT A MINIMUM DEPTH OF 600 FROM THE GRADE LEVEL AS DECIDED BY NTPC.
5. ALL DIMENSIONS ARE IN mm

REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
RC	FOR TENDER PURPOSE	MB	MB	RKP	–	VV	–	–	–	[illegible]	05.10.07
RB	FOR TENDER PURPOSE	RKG	RKG	SG	–	SS	–	–	–	AS	25.11.2006
RA	FOR TENDER PURPOSE	–	–	–	–	–	–	–	–	–	17.01.2006

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PROJECT: STANDARD

TITLE: BURIED CABLES TRENCH FOR HT & LT CABLES

SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-211-POE-A-050	RC

SUB-SECTION-II-E15

LIGHTING

1.00.00	**GENERAL**
1.01.00	This specification covers the general description of design, manufacture and construction features, testing, supply, installation and commissioning of the Lighting system equipment.
2.00.00	**CODES AND STANDARDS**
2.01.00	All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments & revisions as on date of bid opening. 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.
2.02.00	Lighting Fixtures and Accessories
	IS:1913 General and safety requirements for luminairies.
	IS:2148 Flame proof enclosures of electrical apparatus.
	IS:418 Tungsten filament general service electric lamps.
	IS:1258 Bayonet lamp holders.
	IS:1534 Ballast for fluorescent lamps.
	IS:1569 Capacitors for use in tubular fluorescent, high pressure mercury vapour and low pressure sodium vapour discharge lamp circuit.
	IS:1777 Industrial luminaire with metal reflectors.
	IS:2215 Starters for fluorescent lamps.
	IS:2418 Tubular fluorescent lamps for general lighting services.
	IS:3323 Bi-pin lamp holders for tubular fluorescent lamps.
	IS:3324 Holders for starters for tubular fluorescent lamps.
	IS:4013 Dust-tight electric lighting fittings.
	IS:8224 Electric Lighting fittings for Division 2 areas.
	IS:10276 Edison screw lamp holders.
	IS:10322 Luminaires.
	IS:13021 AC Supplied Electronic Ballasts for tubular fluorescent lamps.
2.03.00	Lighting Panels, Switch-boxes, Receptacles and Junction Boxes
	IS:2147 Degree of protection provided by enclosures for low-voltage switchgear and control gear.
	IS:1293 Plugs & socket outlets of rated voltage upto and Including 250volts & rated current upto and including 16 Amps.

	IS:2551	Danger notice plates.
	IS:13947	Low voltage switchgear and controlgear
	IS:3854	Switches for domestic and similar purposes.
	IS:6875	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto and including 1000 V AC and 1200 V DC.
	IS:13703	Low voltage fuses for voltages not exceeding 1000V AC or 1500 V DC.
2.04.00	**Conduits, Pipes and Accessories**	
	IS:2667	Fittings for rigid steel conduit for electrical wiring.
	IS:3837	Accessories for rigid steel conduits for electrical wiring.
	IS:9537	Conduits for electrical installations.
2.05.00	**Lighting Wires/Cables**	
	IS:694	PVC insulated cables for working voltages upto and including 1100 V
	IS:3961	Recommended current ratings for cables.(PVC Insulated and PVC sheathed heavy duty cables and light duty cables).
	IS:8130	Conductors for insulated electric cables and flexible cords.
	IS:10810	Methods of tests for cables.
2.06.00	**LED Luminaries**	
	16101:2012	General Lighting. LEDs and LED modules Terms and definitions
	16102(Part 1):2012	Self Ballasted LED Lamps for General Lighting Services. Part-1 Safety Requirements.
	16102(Part 2):2012	Self Ballasted LED Lamps for General lighting Services. Part-2 Performance Requirements.
	16103(Part I):2012	LED modules for General lighting Safety Requirements.
	15885(Part 2/Sec. 13) :2012	Lamp control gear Part 2 particular Requirements Section 13 d.c. or a.c.
	16104:2012	Supplied Electronic control gear for LED modules d.c. or a.c. Supplied Electronic control gear for LED modules - Performance Requirements.
	16105:2012	Method of Measurement of Lumen maintenance of Solid-state Light (LED)

		Sources.
	16106:2012	Method of Electrical and photometric Measurements of Solid State Lighting (LED) Products
	16107:2012	Luminaires Performance
	16108:2012	Photobiological safety of Lamps and Lamp Systems
	IS 513	Cold rolled low carbon steel sheets and strips
	IS 12063	Classification of degree of protection provided by enclosures.
	IS 14700 (Part 3/Sec. 2)	Electro magnetic compatibility (EMC) – Limits for Harmonic current emission – THD < 15% (equipment, input current < 16 Amps. per phase.
	IS 9000 (Part 6)	Environment testing: Test Z – AD: composite temperature/humidity cyclic test.
	IS 15885 (Part 2/Sec. 13)	Lamp control gear: particular requirements for DC or AC supplied electronic control gear IS 16004 – 1 and 2) for LED modules.
	IS 4905	Method for random sampling
2.07.00	**Electrical Installation Practices & Miscellaneous**	
	IS:1944	Code of practice for lighting of public thorough fare
	IS:3646	Code of practice for interior illumination.
	IS:5572	Classification of Hazardous areas (other than Mines) having flammable gases and Vapours for electrical installation
	S:6665	Code of practice for industrial lighting.
	.	National Electrical Code
	-	Indian Electricity Rules.
	IS:5	Indian Electricity Act Colour for ready mixed paints & enamels.
	IS:280	Mild steel wires for general engineering purposes.
	IS:374	Electric ceiling type fans & regulators.
	IS:732	Code of practice for electrical wiring installations.

IS:1255	Code of practice for installation and maintenance of power cables Upto and including 33KV rating.
IS:2062	Steel for general structural purposes
IS:2629	Recommended practice for hot-dip galvanizing of iron and steel.
IS:2633	Methods for testing uniformity of coating of zinc coated articles.
IS:2713	Tubular steel poles for overhead power lines.
IS:3043	Code of practice for earthing
IS:5216	Guide for safety procedures and practices in electrical work.
IS:5571	Guide for selection of electrical equipments for hazardous areas.
BS:6121	Mechanical cable glands

3.00.00 LIGHTING SYSTEM DESCRIPTION

3.01.00 The illumination of various indoor and outdoor areas in the main plant & offsite area shall be provided as described here. The lighting system of various areas shall comprise of the following systems as identified in Annexure-B:

(a) Normal AC Lighting System

(b) Emergency AC Lighting System

(c) DC Lighting System

3.02.01 **Normal AC Lighting System**

Normal AC lighting system 415V, 3Phase, 4wire, will be fed from lighting panels (LPs) which in turn will be fed from the lighting distribution boards (LDBs)/Switch board MCC.

3.02.02 **Emergency AC Lighting System**

This system shall be provided for certain important areas in the main plant. The lighting fixtures connected to this system shall be normally "ON" along with the normal AC system. These will be fed from emergency lighting panels (ELPs) which in turn will be fed 3-phase, 4-wire supply from the emergency lighting distribution boards (ELDB'S). These lights will go off for a few seconds in case of AC supply failure at Emergency Switchgear, but shall be automatically restored when Emergency Switchgear is energised by Diesel generator set.

3.03.00 **DC Lighting System**

3.03.01 At strategic locations in the main plant, a few lighting fixtures fed from 220V, DC supply, shall be provided to enable safe movement of operating personnel and access to important control points during an emergency, when both the normal AC and Emergency Lighting system fail. These lighting fixtures will be fed from 220V DC LDBs which in turn will be fed from DC lighting panels.

3.03.02 The supply to the DC lighting panels shall be automatically switched ON in case of loss of AC supply at station service switchgear as well as Emergency switch-gear. The DC supply will be automatically switched OFF after about 3 minutes following the restoration of supply to normal AC or emergency AC lighting system.

3.03.03 Emergency DC lighting is to be provided, through self-contained DC emergency fixtures with four hours back-up duration, at strategic locations, in auxiliary/offsite buildings wherever DC supply system is not available. The fixtures shall be switched 'ON' automatically in case of failure of AC supply.

3.03.04 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, each drive floor of TPs, staircases of various TPs and buildings and each local control area. DC lighting fixtures shall be fed from 220V DC LDB which in turn will be fed from CHP DC system. The supply to the DC lighting panels shall be automatically switched ON in case of loss of normal AC supply.

4.00.00 DESIGN PHILOSOPHY

1. A comprehensive illumination system shall be provided in the entire areas.

2. All outdoor lighting system shall be automatically controlled by synchronous timer. Provision to bypass the timer shall be provided in the panel.

3. The system shall include distribution boards, normal/ emergency lighting panels, lighting fixtures, junction boxes, receptacles, switch boards, lighting pole/masts, conduits, cables and wires, etc. The system shall cover all interior and exterior lighting such as area lighting etc. The constructional features of lighting distribution boards shall be similar to AC/DC distribution boards described in chapter of LT Switchgear. Outgoing circuits in LPs shall be provided with MCBs of adequate ratings.

4. The illumination system shall be designed on the basis of best engineering practice and shall ensure uniform, reliable, aesthetically pleasing and glare free illumination. The lighting fixtures shall be designed for minimum glare. The design shall prevent glare/luminous patch seen on VDU/ Large video screens, when viewed from an angle. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection. The diffusers/ louvers used in fixtures shall be made of impact resistant polystyrene sheet and shall have no yellowing property over a prolonged period. The Lux levels to be adopted for various area are indicated at Annexure - A. (placed at the end of this Chapter).

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.

6. **LED Luminaires:**

LED Luminaires shall be used for the lighting of all the indoor & outdoor areas in bidder's scope. However for DC lighting, hazardous areas lighting etc. conventional type luminaires shall be used. In false ceiling area LED luminaires shall be recessed mounting type & in non-false ceiling area the LED luminaires shall be surface mounting type.

The individual lamp wattage for LED shall be upto 3 watt. Fractional wattage LEDs are also acceptable. The LED chip efficacy shall be min 120 Lm/W. The luminaire efficacy shall be not less than 80 Lm/W. Suitable heat sink shall be designed & provided in the luminaire. The LED used in the luminaires shall have colour rendering index (CRI) of Min 80. Colour designation of LED shall be "cool day light" (min 5700K) type for indoor areas. However for outdoor areas, the colour temperature of LED shall be min. 4000K, including rough & dust prone areas. LED shall conform to the LM 80 requirements. The LED luminaires shall have minimum life of 25,000 burning hours with 80% of lumen maintenance at the end of the life.

The max. junction temperature of LED shall be 85 deg C. Further the lumen maintenance at this temperature shall be min 90%. The THD of LED Luminaires shall be less than 10%. Further the EMC shall be as per IS 14700. The power factor of the luminaire shall not be less than 0.9. The marking on luminaire & safety requirements of luminaire shall be as per IS standards. Suitable heat sink with proper thermal management shall be designed & provided in the luminaire.

The connecting wires used inside the system, shall be low smoke halogen free, fire retardant type and fuse protection shall be provided in input side specifically for LED luminaires.

Care shall be taken in the design that there is no water stagnation anywhere in the housing of luminaire. The entire housing shall be dust and water proof protection as per IS 12063.

7. **Driver Circuit**

LED modules and drivers shall be compatible to each other. The LED module driver's ratings and makes shall be as recommended by corresponding LED chip manufacturer.
LED Drivers shall have following control & protections:-

- Suitable precision current control of LED.
- Open Circuit Protection
- Short Circuit Protection
- Over Temperature Protection
- Overload Protection

8. Apart from maintenance factor as given below, Temperature correction factor shall be considered in the lighting design for fixtures located in non air conditioned area.

(a.)	Office area (air conditioned)	:	0.8
(b.)	Office area (non air conditioned) and other indoor area	:	0.7
(c.)	Dust prone indoor and outdoor area	:	0.6
(d.)	Coal Handling area, Ash Handling Conveyor /Transfer Points etc.	:	0.5

9. (i) All outdoor fixtures shall be weather proof and of min. IP65 degree of protection.
(ii) For Indoor type of fixtures:-

(a) Surface/Pendent mounting: - IP 54 class of protection.

(b) Recess Mounting (False ceiling):- IP 20 class of protection

10. (a) Lighting panels shall be constructed out of 2 mm thick CRCA sheet steel. The door shall be hinged and the panel shall be gasketted to achieve specified degree of protection. Lighting panels shall be powder coated with color shade RAL9002. Lighting panels shall have min. IP55 degree of protection.

(b) All MCBs/Isolators/Switches/Contactors etc. shall be mounted inside the panel and a fibre glass sheet shall be provided inside the main door such that the operating knobs of MCBs etc., shall project out of it for safe operation against accidental contact.

(c) Terminal bocks shall be 1100 V grade, clip-on stud type, made up of polymide 6.6 or better suitable for terminating multicore 35 or 70 Sq. mm. stranded aluminium conductor incoming cable and 10 Sq. mm. stranded aluminium conductor for each outgoing circuits voltage. All terminals shall be shrouded, numbered and provided with identification strip for the feeders.

(d) MCB's shall be current limiting type with magnetic and thermal release suitable for manual closing and automatic tripping under fault condition. MCB's shall have short circuit interrupting capacity of 9 KA rms. MCB knob shall be marked with ON/OFF indication. A trip free release shall be provided to ensure tripping on fault even if the knob is held in ON position. MCB terminal shall be shrouded to avoid accidental contact.

(e) Contactors of AC lighting panels shall be 3 no's, 32 A, 3 pole continuous duty MCB, load make-break type suitable for 415 V, 3 phase 4 wire system. HRC fuses with suitable mounting base of 125A shall be provided in the incomer of Contactors in the LP.

(f) DC switches shall be rotary type, 2 pole, continuous duty, load break type, quick make quick break, suitable for 220 V DC, 2 wire system. Switch knob shall be provided with ON/OFF indication.

(g) Programmable Digital Timer shall be Electronic Astronomical Almanac Time switch with battery back up of min. TEN years, 4 Digit LED display, 24 hours range, manual override facility, 10 Amp 3 relay output, with NO/NC Contacts suitable for operation on 240V single phase AC supply.

(h) Each lighting panel (LP-3) shall be fed from a 415V/42V, 3 phase-4 wire, 3 KVA transformer. The transformer shall be located inside the lighting panel itself. Transformers shall be dry type, natural air cooled with class F insulation or better. Impedance of transformer shall be 5%. Transformers shall be tested as per IS:11171. Off-circuit tap changer with +/- 5% in steps of +/- 1.25% tapping shall be provided. One minute power frequency withstands voltage for lighting transformer shall be 2.5 KV.

(i) Lighting Panels shall be of following types:

TYPE	INCOMER FEEDER	OUTGOING FEEDERS	DETAILOFCONTENTS
LP-1	3No. 415V, 32 A, TP MCB (31/2Cx70sq.mm cable)	18Nos.,20A, 240V MCB	415V, 63A(min.), AC2 duty contactor and Programmable Digital Timer of 24 hour range 10A, 240V selector switch, fuse, etc. outdoor type and IP:55 degree of protection
LP-2	3No. 415V, 32 A, TP MCB (31/2Cx35sq.mm cable)	9 Nos.,20A, 240V MCB	415V, 63A(min.), AC2 duty contactor and Programmable Digital Timer of 24 hour range 10A, 240V selector switch, fuse, etc. outdoor type and IP:55 degree of protection
LP-3	1 No., 4A fuse 3 KVA transformer,40A TPN MCB	24 Nos., 16A, 45V MCB	IP 55 degree of protection. Incomer shall be suitable for receiving 4Cx16 sq. mm cable and outgoing circuit shall be suitable for 2Cx16 sq. mm cable.
LP-D1	1No. 220V,32 A, DP Isolator (2Cx35sq.mm cable)	6Nos.,16A, 220V DP Switch & Fuse	220V,32A DC Fuse, etc. outdoor type IP:55 degree of protection.

11. Wires of different phase shall normally run in separate conduit.

12. Power supply shall be fed from 415 / 240 V normal AC supply, emergency AC supply and 220V DC supply through suitable number of conveniently located lighting distribution boards (LDB) and lighting panels (LP). AC lighting supply shall be isolated from main supply by 2x100% isolation transformers of max. rating of 100KVA for 10/15 nos. outgoing feeder with changeover switch facility. The isolation transformer shall be fed from two different bus sections of MCC and fault level restricted to 3 KA at Lighting Panels.

13. Atleast one 6/16A, 240V AC universal socket outlet with switch shall be provided in offices, cabins, etc. Further 20A, 240V AC industrial receptacle with switch shall be provided strategically in all industrial areas.
Suitable number of 63A, 3ph, 415V AC industrial receptacles shall be provided for entire plant for welding purposes, particularly near all major equipment and at an average distance of 50m. Atleast one 63A, 3ph, 415V AC receptacle shall be provided in each floor of off-site buildings/ structures.

Receptacles boxes shall be fabricated out of 2 mm thick MS steel hot dip galvanized or of not less than 2.5 mm thick die-cast aluminium alloy or fabricated out of 2 mm thick CRCA sheet with electro static powder coating. IP-degree of protection shall be applicable to receptacles Type 'RA &''RC' only

Receptacles shall be of following types :

Type	Switch rating	Socket & plug rating	Type & make of plug & Socket	Terminal Block size
RA	20 A, SP240V AC(Industrial)	20A, 3 pin240 V AC	NTPC appd. make	1-4 way, suitable for loop-in loop- out of 10 sq.mm. Al. Conductor
RB	16A, S.P240V AC	6A+16A6 Pin decorative Piano-key Type Switch	NTPC appd.make	1-4 way, suitable for loop-in loop- out of upto 10 sq.mm. Al. Conductor
RC	20 A, SP24 V AC(Industrial)	20A, 3 pin24 V AC	NTPC appd. make	1-4 way, suitable for loop-in loop- out of 2 core -16 sq.mm. Al. Cable.

14. In the hazardous areas like Hydrogen generation plant, fuel oil handling areas or any other gas/ liquid fuel storage/ handling areas in bidder's scope, lighting shall be flame proof.

15. The type of fixtures, LP, JB, and receptacle used in Hydrogen generation plant building shall be suitable for group II C as per IS: 2148 or class I, Division II as per NEC 70-428.

16. All flouresent lamps shall be have "Cool day light" colour designation. The mirror optics type flouresent fixtures shall have no irridescence effect. Fixtures with better efficiency and upgraded proven system may also be considered
In candescent lamps may be used only with DC Lighting.

17. Aviation warning lights shall be provided as per the recommendations of ICAO and Director general of civil aviation, India. The arrangement of light should be marked such that the object is indicated from every angle in azimuth. The aviation warning lighting system shall also conform to the latest Indian standard IS 4998.

18. Contractor shall demonstrate the average lux level achieved for different areas as per specification requirements, after completion of the lighting work, at site to the satisfaction of engineer-in-charge.

19. In the Off site 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.

4.01.00 **Ballasts**

4.01.01 All fluorescent fixtures except for Class-I, Div-II fittings/ increased safety fittings (Div-II/Hazardous Area) shall be provided with electronic ballasts.

4.02.00 All luminaires and their accessories and components shall be of type readily replaceable by available Indian makes.

4.03.00 **Fans & Regulator**

4.03.01 Ceiling Fans, to be provided in non air-conditioned office/control room area. Further tentatively one (1) no. ceiling fan shall be provided for 10 sq.m area, at suitable mounting height. The ceiling fans shall be suitable for operation on 240 V +/-10%, 50 Hz, AC supply comprising of class 'E' or better insulated copper wound single phase motor, 1200mm sweep, aerodynamically designed well balanced AL blades (3 Nos.), down rod, die cast aluminium housing, capacitor, suspension hook, canopies etc. finished in stove enameled white or with electro static powder coating. Power factor of fans shall not be less than 0.9. Fan regulators shall be stepped electronic type suitable for operation on 240V +/-10% AC supply.

4.04.00 Junction Boxes, Conduits, Fitting & Accessories, Pull Out Boxes:

Junction box for indoor lighting shall be made of fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type.

Junction boxes for street lighting poles and lighting mast if applicable , shall be deep drawn or fabricated type made of min. 1.6 mm thick CRCA Sheet. The box shall be hot dip galvanized. The degree of protection shall be IP55.

All switches and receptacles upto 16A shall be modular type. These shall be provided with pre-galvanized/galvanized modular switchbox & plate.

Conduits, Pipes and Accessories Galvanised heavy duty steel conduits for normal area and galvanised heavy duty steel conduits with an additional epoxy coating for corrosive area shall be offered. Alternatively glass reinforced epoxy conduits with comparable compressive and impact strength with that of heavy duty steel conduits may be offered.

Rigid steel conduits shall be heavy duty type,hot dip galvanised conforming to IS : 9537 Part-I & II shall be suitable for heavy mechanical stresses, threaded on both sides and threaded length shall be protected by zinc rich paint. Conduits shall be smooth from inside and outside.

Flexible conduit shall be water proof and rust proof made of heat resistant TERNE coated steel.

Pull out boxes shall be provided at suitable interval in a conduit run .Boxes shall be suitable for mounting on Walls, Columns, Structures, etc.. Pull-out boxes shall have cover with screw and shall be provided with good quality gasket lining. Pull out boxes

used outdoor shall be weather proof type suitable for IP: 55 degree of protection and those used indoor shall be suitable for IP: 52 degree of protection. Pull out box & its cover shall be hot dip galvanized.

4.05.00 **Lighting Wires**

4.05.01 Lighting wires shall be 1100 V grade, light duty PVC insulated unsheathed, stranded copper/aluminium wire for fixed wiring installation. Colour of the PVC insulation of wires shall be Red, Yellow, Blue and Black for R, Y, B phases & neutral, respectively and white & grey for DC positive & DC negative circuits, respectively. Minimum size of wire shall not be less than 1.5.sq.mm. for copper and 4 sq.mm. for aluminium.

4.06.00 **Lighting Poles**

4.06.01 The Street Light system and peripheral lighting shall be designed generally in line with design guidelines. The Poles shall be mounted above ground using base plate and minimum height of pole shall be 8 mtrs The poles shall be hot-dip galvanized as per IS2629/ IS2633/ IS4759. The average coating thickness of galvanizing shall be min. 70 micron. The System shall be capable of withstanding the appropriate wind load etc as per IS 875 considering prevailing soil/ site condition considering all accessories mounting on pole.

The street light poles shall have loop in loop out arrangement for cable entry and light fixture / wiring protected with suitably rated MCB.

4.07.00 **Occupancy based Passive Infra-red sensors**

The sensors shall be recess mounted, programmable type suitable for lighting load of 6A with variable off delay settings. The detection area shall be minimum 5 metres for standard room height of 3mt. All the calibrated settings shall be stored in non-volatile memory of PIR sensor which shall be unaffected by power supply fluctuations. Necessary 16A contactor shall be supplied alongwith each sensor & shall be located inside the switch box

5.00.00 TESTS

5.01.00 For LED Fixture

a) The contractor shall carry out the type tests as listed in this specification on the following types of LED fixtures to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant price schedule of bid document and the same shall be considered for the evaluation of the bids.
LED fixtures (Type test shall be conducted on one rating each of following type of LED fixtures. Rating for test conduction shall be decided by the employer during detailed engineering)
   a) High bay fixture.
   b) Well glass fixture.
   c) Street light fixture
   d) Surface mounted type fixture.
   e) Recessed mounted type fixture.

   The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.

b) The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer's approval for the type test procedure before conducting the type 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.

c) In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the owner for waival of conductance of such type test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The owner reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.

5.02.00 **For all other lighting equipment:**

a) All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

b) However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.

5.03.00 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.

5.04.00 Selection of samples for type test, acceptance test & routine test and acceptance criteria for all the items shall be as per relevant IS

5.05.00 Type test reports of the following items as per technical specification requirements/ standards shall be submitted for approval.

SL NO.	DESCRIPTION
i.	Lighting fixtures of each type
ii.	Lighting panel of each type (Degree of Protection)
iii.	Junction Box of each type.

Type test reports for LED as per standards for following shall be submitted for approval.

1. Visual and Dimension check
2. Proof of procurement of LEDs
3. Safety tests

a) Marking
b) Construction
c) Provision for Earthing
d) External and Internal wiring
e) Protection against electrical shock
f) Endurance and Thermal
g) Insulation resistance & electrical strength
h) Resistance to heat fire & tracking
i) Resistance to Humidity
4. Fire Retardant test
5. Performance tests (electrical, Photometric color and Life)
6. Burn-in Test
7. Power Cycling
8. Temperature rise test
9. Emission Tests
a) Radiated & conducted emission
b) Harmonics & flickers
10. Immunity tests

In addition, following test reports to be submitted for LED chip/LED luminaire:

a) LED parameters like Lumen per watt, CRI, Beam angle from manufacturer.
b) LM 80/IS: 16105 report.
c) LM 79/IS: 16106 report.

5.06.00 Acceptance Test and Routine Test

5.06.01 All lighting fixtures, lamps and other items shall be subjected to acceptance and routine test, as per relevant specified standards.

5.06.02 Junction boxes, switch boxes, receptacle enclosure etc. shall be subjected to physical and dimensional checks also. Switch boxes shall be made of 1.6 mm thick MS sheet with 3 mm thick decorative, Perspex cover. Switch box shall be hot dip galvanized.

Switch boxes shall be of following types :

TYPE No.	Switch	Fan Regulator*	Socket
SWB 1	5 A - 2 Nos.	-	-
SWB 2	5 A - 3 Nos.	-	5A - 1.No.
SWB 3*	5 A - 5 Nos.	1	5A - 1.No
SWB 4*	5 A - 7 Nos	3	5A - 1.No.
SWB 5**	5 A - 5 Nos	-	5A - 1.No.

* Space provision shall be kept for fan regulator in switch boxes.

** Shall have the provision for mounting the 16 A contactor.

5.07.00 **Galvanizing Tests**

5.07.01 The quality of galvanizing shall be smooth, continuous, free from flux stains and shall be inspected visually.

5.07.02 In addition following tests shall be conducted as acceptance tests.

(a) Uniformity of coating - The coating of any article shall withstand for one (1) minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.

(b) The quality of cadmium/zinc plating on items with screw threads shall be free from visible defects such as unplated areas, blisters and modules and shall be inspected visually.

(c) In addition, the plating thickness shall be determined microscopically/ chemically or electronically.

6.00.00 COMMISSIONING CHECKS

1. On completion of installation work, the Contractor shall request the Project manager for inspection and test with minimum of fourteen (14) days advance notice.

2. The Project manager shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor.

3. The installation shall be then tested and commissioned in presence of the Project manager.

4. The contractor shall provide all, men material and equipment required to carry out the tests.

5. All rectifications, repair or adjustment work found necessary during inspection, testing and commissioning shall be carried out by the Contractor without any extra cost. The handing over the lighting installation shall be effected only after the receipt of written instruction from the Employer/his authorized representative.

6. The testing shall be done in accordance with the applicable Indian Standards and codes of practices. The following tests shall be specifically carried out for all lighting installation.

   (a) Insulation Resistance.

   (b) Testing of earth continuity path.

   (c) Polarity test of single phase switches.

   (d) Functional checks.

7. The lighting circuits shall be tested in the following manner:

   (a) All switches ON and consuming devices in circuit, both poles connected together to obtain resistance to earth.

   (b) Insulation resistance between poles with lamps and other consuming devices removed and switches ON.

ANNEXURE-A

Sl No.	Location**	Average Illumination Level (Lux)	Type of Fixture
(a)	Switchgear rooms, Charger, Rectifier room	200	Industrial type LED Luminaire
(b)	Control room, computer room, control equipment room	350	LED luminaire equivalent to Mirror optics with anti-glare features or downlighter.
(c)	Offices, conference rooms, etc.	300	Decorative mirror optics Type LED luminaire or LED downlighter
(d)	Battery rooms	100	totally enclosed corrosion Proof LED Luminaire
(e)	Transformer Area	20 (general) 50 (on equipment)	LED Luminaire
(f)	Diesel generating room /enclosure, Compressor room, pump house etc.	150	LED medium bay/ Industrial type LED Luminaire
(g)	Cable galleries/vault	50	Industrial type LED Luminaire
(h)	Street lighting- primary roads secondary roads	 20 10	LED street lights
(i)	Outdoor storage handling and unloading area	20	LED Luminaire
(j)	Cement stores	150	Industrial dust proof type LED Luminaire
(k)	Chemical stores/House	150	Corrosion proof LED Luminaire
(l)	Permanent stores	150	LED high/medium bay / Industrial trough LED Luminaire
(m)	Workshop. Building	150	LED high/medium bay / Industrial trough LED Luminaire
(n)	Laboratory General Analysis area	 150 300	 Corrosion proof LED Luminaire
(o)	Garage/Car Parking	50	Industrial type LED Luminaire

(p)	Transfer points, Sheds, tunnels, bunker house, Conveyor Gallery etc. in bidders scope	100	LED Dust tight/Well glass type Luminaire
(q)	Facility building, canteen etc.	150	Industrial type LED Luminaire
(r)	Corridors, Walkways	50	LED Luminaire
(s)	Building Periphery Lighting	10	LED Street Light fixture

SUB-SECTION-II-E13

ELEVATOR ELECTRICALS

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/IEC 60034

2.00.00 **Electric motor:**

The driving motors shall conform to IS/IEC 60034 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.

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).

c. Contractor shall provide electronic door detector (Infra red curtain type).

d. Digital hall position indicator at all floors, tell lights at all floors shall also be provided by the Contractor.

e. For facilitating the movement of visually & hearing impaired persons, hall lantern and car arrival chimes shall be provided

f. All fixtures shall be in stainless steel face plates.

g. Push buttons shall be fixed in the car for holding the doors open for any length of the time required.

h. All other safety/protection/operation interlocks as required by IS:14665 (latest edition).

4.00.00 **POWER SUPPLY**

Each elevator shall be provided with a separate three phase, three wire 415V feeder of adequate rating

5.00.00 **Controls:**

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:**

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.

a) Oxygen index of min. 29 (as per IS:10810 Part-58)
b) Acid gas emission of max. 20% (as per IEC-754-I).
c) Smoke density rating shall not be more than 60% (as per ASTMD-2843).

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.

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:**

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.

SUB-SECTION-II-E10

LT SWITCHGEAR & LT BUSDUCT

2.00.00 **CODES AND STANDARDS**

2.01.00 All equipment shall, generally, comply with the updated issues of

(a.) Applicable Indian Standards

(b.) Indian Electricity Act.

(c.) Indian electricity rules

2.02.00 Equipment complying with any other authoritative / internationally recognized standards such as IEC, British, U.S.A., German, etc. will also be considered if it ensures performance equivalent or superior to Indian Standards. In such cases the contractor shall clearly indicate the standard adopted and furnish the copy of latest English version of the same along with the bid and bring out the salient features for comparison.

2.03.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as published one month prior to the date of opening of bids. 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 codes and standards.

IS: 5	Colours for ready-mixed paints and enamels.
IS: 694	PVC insulated cables for working voltages up to and including 1100V.

IS: 722	A.C. Electricity Meters
IS: 1248	Electrical Indicating instruments
IS/IEC: 60947–1	Degree of protection provided by enclosures for low voltage Switchgear and Control gear
IS/IEC: 60947-2	A.C. circuit Breakers
IS: 2551	Danger Notice Plates
IS: 2629	Hot dip galvanising
IS: 2705	Current Transformers
IS/IEC: IEC-60947-4-1	Contactors and motors starter for voltages not exceeding 1000 V AC or 1200 V DC
IS: 3043	Code of practice for earthing.
IS: 3072	Code of practice for installation and maintenance of Switchgear
IS: 3156	Voltage Transformers
IS: 3202	Code of practice for climate proofing of electrical equipment.
IS: 3231	Electrical relays for power system protection.
IS/IEC 60947	Air-Break Switches, air break disconnectors, air break disconnector and fuse combination units for voltages not exceeding 1000V AC or 1200 V DC.
IS/IEC 60947-1 / IEC-60947-1	General Requirements for Switchgear and Control gear for voltages not exceeding 1000 V.
IS: 5082	Wrought Aluminium and Aluminium alloys for electrical purposes.
IS: 6005	Code of practice of phosphating of iron and steel.
IS/IEC 60947-5-1 / IEC-60947-5-1	LV switchgear and Control gear Control current devices and switching element.
IS: 8623 / IEC: 61439-1/2	Low Voltage Switchgear & Control gear assemblies
IS: 8686	Static Relays
IS: 13703 / IEC: 60269	HRC Cartridge fuses
IS: 10118 (4 parts)	Code of practice for selection, installation and maintenance of switchgear and control gear.

IS: 11171	Specification for dry type transformers.
IEC: 60255	Electrical Relays
IEC: 61850	Communication networks and systems in substations
IS: 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals
IS: 12021	Specification of control transformers for switchgear and Control gear for voltage not exceeding 1000V AC.
IEC: 60947-7-1	Terminal blocks for Copper conductors
IS :513 (2008)	Cold Rolled Low Carbon Steel Sheets and Strips

3.00.00 TECHNICAL PARAMETERS

3.01.00 **Power Supply**

3.01.01 AC SYSTEM

1)	Voltage	415 V ± 10%,3 Phase, 4 wire, solidly earthed
2)	Frequency	50 Hz +/- 5%
3)	Combined variation (in volts & frequency)	10% absolute sum
4)	Fault Level	50 kA(RMS)

3.01.02 DC SYSTEM

1)	System Voltage	240 V DC 2-Wire, Unearthed
2)	Fault Level	20 kA

3.01.03 CONTROL SUPPLY VOLTAGE

1)	Trip & closing coil of circuit breaker	240 V DC/120 V DC
2)	Spring charging motor	240 V DC/120 V DC
3)	MCC control supply	110 V AC Neutral solidly earthed
4)	Space heater & lighting	240 V AC Neutral solidly earthed

3.02.00 **CUBICLE DATA**

Busbar Rating

1)	Continuous Current rating	As per requirement
2)	Short time rating where	
	a) CB is used as incomer	50 kA(RMS) for one sec
	b) Fuse protection is used in Incomer	Prospective current of 50 kA(RMS) for the fuse clearing time
3)	Dynamic Rating where	
	a) CB is used as incomer	105 kA(PEAK)
	b) Fuse Protection is used in incomer	Prospective current of 105 kA (PEAK) as limited by fuse
4)	Busbar insulation	
	a) For switchgear	PVC Sleeve insulated
	b) For MCC	PVC Sleeve insulated
	c) ACDB	PVC Sleeve insulated
	d) DCDB	PVC Sleeve insulated
	e) For fuse boards	PVC Sleeve insulated/ epoxy coated

3.03.00 **CIRCUIT BREAKER**

1)	Type	Air break spring charged stored energy type
2)	Operating duty	O-3 min-CO-3 min-CO
3)	Symmetrical interrupting	50 kA(RMS)
4)	Short circuit rating	105 kA(PEAK)
5)	Short Circuit Breaking current	
	a) AC Component	50 kA(RMS)
	b) DC Component	As per IS/IEC 60947
6)	Short time withstand	50 kA(RMS) for 1 s
7)	No of aux. contacts	4 NO + 4 NC for DDCMIS interface

3.04.00	**METERS**		
	1)	Accuracy class	2.0
	2)	One min. power frequency withstand test voltage	2.0 kV (rms)
3.05.00	**Current Transformers**		
	1)	Type	Cast Resin Bar Primary / Nylon Casing
	2)	Voltage class and frequency	650 V, 50 HZ
	3)	Class of insulation	E or better
	4)	Rated Secondary Current	1 A
	5)	Accuracy class & burden	
		a) For protection	5P20, 5VA
			PS Class for REF
		b) For metering	class 1.0, 5VA (min)
			class 0.2s, 5VA (min) for feeders indicated in SLD ,if any
	6)	Instrument Security Factor (ISF) for metering CT	5
	7)	Short time withstand	
		a) For CT Associated with circuit breaker	50 kA(RMS) for 1 sec
		b) For CT Associated with fuse protected feeders	Prospective current of 50 kA(RMS) for the Fuse clearing time
	8)	Dynamic withstand	
		a) For CTs Associated with circuit breaker	105 kA(PEAK)
		b) For CT Associated with fuse protected feeders	Prospective current of 105 kA(PEAK) as Limited by fuse
3.06.00	**BUSDUCT**		
	1)	Type	Non-Segregated
	2)	One minute power frequency withstand voltage	2.5 kV

	3)	One second short ckt withstand current	50 kA(RMS)
	4)	Momentary dynamic current withstand	105 kA(PEAK)
	BUSDUCT (SANDWICH TYPE)		
	1)	Type	Bus Trunking
	2)	Rated Insulation voltage	1000V
	3)	One second short ckt withstand current	50KA(RMS)
	4)	Momentary dynamic current withstand	105KA(PEAK)
	5)	Power frequency withstand voltage	3.5kv
	6)	Impulse withstand voltage	8kV
	7)	Insulation	Class F
3.07.00	**VOLTAGE TRANSFORMERS**		
	1)	Type	Cast Resin
	2)	Voltage Ratio	415 / 110 V for line PT 415/√3 / 110/√3 V for Bus PT
	3)	Method of Construction	V-V
	4)	Accuracy Class	0.5 0.2 for feeders indicated in SLD ,if any
	5)	Rated Voltage factor	1.1continuous, 1.5 for 30 sec.
	6)	Class of insulation	E or better
	7)	One minute power frequency withstand voltage	2.5 KV
3.08.00	**HRC FUSES**		
	1)	Voltage Class	650 Volts
	2)	Rupturing capacity	80 kA (rms) for AC ckt. 20 kA for DC ckt.

3.09.00	**CONTACTORS**		
	1)	Type	Air break electro magnetic
	2)	Utilising Category	AC3 of IS/IEC 60947 for non reversible AC4 of IS/IEC 60947 for reversible drives
3.10.00	**Relays**		
	1)	Power frequency withstand voltage	2.5 kV for 1 sec. or 2.0 kV for 1 min.
3.11.00	**CONTROL TRANSFORMERS**		
	1)	Type	Dry / Cast Resin
	2)	Voltage Ratio	415 / 110 with taps $\pm$ 5% in steps of 2.5%
	3)	Class of insulation	Class-B or better
	4)	One minute power frequency withstand voltage	2.5 kV
	5)	Rating	1.5 X Adequate for application.
3.12.00	**LIGHTING TRANSFORMER / WELDING TRANSFORMER**		
	1)	Type & Rating	Dry type / 100 KVA(Welding TRF), 50KVA(Minimum)(Lighting TRF)
	2)	Voltage Ratio	415/415V, +/- 5% taps in steps of 2.5%
	3)	Class of insulation	B or better
	4)	One minute power frequency withstand voltage	2.5 KV
	5)	Enclosure protection	IP-42
3.13.00	**TRANSDUCERS**		
	1)	Current transducers	
		a) Input	0-1 A (CT secondary)

	b)	Rated frequency	50 Hz
	c)	Output	4-20 mA (2 Nos. decoupled)
	d)	Over current	Transducer for motor current ammeters shall be capable of withstanding min. 6 times CT sec. current of 1A for a min period of 30 seconds
	e)	Accuracy	1.0
2)	Voltage Transducers		
	a)	Input	110 V / 415 V / 240 V, 50 Hz (for AC) / 220 V / 110 V DC (for DC)
	b)	Output	4-20 mA (2 Nos. decoupled)
	c)	Accuracy	1.0

3.14.00 **MCCB**

1)	Rated voltage	415V
2)	Rated insulation level	690V
3)	Rated ultimate &Service S.C. breaking capacity	50 kA
4)	Rated making capacity	105 kA
5)	Utilization category	A

4.00.00 CONSTRUCTIONAL DETAILS OF SWITCHBOARDS

4.01.00 All Switchboards i.e., 415 V Switchgears, Motor Control Centres (MCCs), AC Distribution Boards (ACDBs), 220 V DC Distribution Boards (DCDBs) and Solenoid Valve Distribution Boards, shall be of metal enclosed, indoor, floor-mounted, free-standing type.

4.02.00 All switchboard frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material.

4.03.00 All panel edges and cover / door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. The top covers of the panels should be designed such that they do not permanently bulge/ bend by the weight of maintenance personnel working on it.

4.04.00 The switchboards shall be of bolted design. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cut-outs shall be true in shape and devoid of sharp edges.

4.05.00 All switchboards shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 5X as per IS/IEC 60947. However, the busbar chambers having a degree of protection of IP: 42 are also acceptable where continuous busbar rating is

	1600A and above. Provision shall be made in all compartments for providing IP: 5X degree of protection, when circuit - breaker or module trolley has been removed. All cut-outs shall be provided with EPDM / Neoprene gaskets.
4.06.00	Provision of louvers on switchboards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating is 1600 A and above.
4.07.00	The switchboards shall comply to the Internal arc fault containment tests of 50 kA for 0.3s.
4.08.00	The enclosure for outdoor panels shall be constructed of stainless steel sheets in order to have protection against corrosion. The Degree of protection for outdoor panels shall be IP: 55. The panels shall be mounted on a pedestal at a height of 500mm from ground level.
4.09.00	All switchboards shall be of uniform height not exceeding 2450 mm. The height of the operating handle, push buttons etc shall be restricted between 300mm and 2000mm.
4.10.00	Switchboards shall be easily extendable on both sides by the addition of vertical sections after removing the end covers.
4.11.00	Switchboards shall be supplied with base frames made of structural steel sections, along with all necessary mounting hardware required for welding down the base frame to the foundation / steel insert plates. The base frame height shall be such that floor finishing (50 mm thick) to be done by Contractor after erection of the switchboards does not obstruct the movement of doors, covers, withdrawable modules etc.
4.12.00	All switchboards shall be divided into distinct vertical sections (panels), each comprising of the following compartments: (a.) BUSBAR COMPARTMENT A completely enclosed bus bar compartment shall be provided for the horizontal and vertical bus bars. Bolted covers shall be provided for access to horizontal and vertical busbars and all joints for repair and maintenance, which shall be feasible without disturbing any feeder compartment. Auxiliary and power bus bars shall be in separate compartments. (b.) SWITCHGEAR / FEEDER COMPARTMENT All equipment associated with an incomer or outgoing feeder shall be housed in a separate compartment of the vertical section. Two-tier breaker arrangement in a vertical section shall be offered for outgoing breaker feeders of rating up to 1600A. The design of the vertical section for such an arrangement shall ensure ease of termination of power cables of size & quantity appropriate to respective feeder rating. The compartment shall be sheet steel enclosed on all sides with the withdrawable units in position or removed. Insulating sheet at rear of the compartment is also acceptable. No live parts shall be accessible with equipment drawn out and degree of protection within the compartment shall be IP2X. The front of the compartment shall be provided with the hinged single leaf door with captive screws for positive closure. (c.) CABLE COMPARTMENT OR CABLE ALLEY A full-height vertical cable alley of adequate width shall be provided for power and control cables. Cable alley shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations located in cable alley shall be designed to meet the Form 4b as per IEC 61439 for safety purpose. Necessary grommets shall be provided at the cable entry of individual modules. Wherever cable alleys are not provided for distribution boards, segregated cable boxes for individual feeders shall be provided at the rear for direct termination of cables. For circuit breaker external cable connections, a separately enclosed cable compartment shall also be acceptable. The contractor shall furnish suitable plugs to

	cover the cable openings in the partition between feeder compartment and cable alley. Cable alley door shall be hinged.
	(d.) CONTROL COMPARTMENT
	A separate compartment shall be provided for relays and other control devices associated with a circuit breaker.
4.13.00	Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. EPDM / Neoprene gasket shall be provided between the panel sections to avoid ingress of dust into panels.
4.14.00	After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose. Wherever two breaker compartments are provided in the same vertical section insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.
4.15.00	All 415V switchgear (circuit-breaker) panels shall be of single-front type. MCCs and DBs shall be of single-front / double-front construction as per the requirements. All single-front switch boards shall be provided with single-leaf, hinged or bolted covers at the rear. The bolts shall be of captive type. The covers shall be provided with "DANGER" labels. All panel doors shall open by 90 deg or more. In case of double-front MCCs, if this cannot be achieved for panels adjacent to a breaker panel, suitable dummy panel shall be provided by the Contractor wherever necessary.
4.16.00	All ACDBs, DCDBs and Solenoid Valve DBs shall be of fixed module type. All 415V circuit-breaker modules and contactor controlled motor modules shall be of fully draw-out type having distinct 'Service' and 'Test' positions. The equipment pertaining to a draw-out type incomer or feeder module shall be mounted on a fully withdrawable chassis which can be drawn out without having to unscrew any wire or cable connection. Suitable arrangement with cradle/ rollers, guides along with tool/lever operated racking in/out mechanism shall be provided for smooth and effortless movement of the chassis. For modules of size more than half the panel height, double guides shall be provided for smooth removal or insertion of module. All identical module chassis of same size shall be fully interchangeable without having to carry out any modifications. Suitable interlock shall be provided in DCDB for prevention of opening of Isolator (Incomer) when the bus coupler is open and vice-versa.
4.17.00	All draw-out modules shall be provided with “Closed door operation” feature wherein movement of the module from “Isolated” position to “Service” position & vice-versa and power ON / OFF operation of the module shall be possible only with the module door closed condition.
4.18.00	All disconnecting contacts for power and control circuits of draw-out modules shall be of robust and proven design, fully self-aligning and spring-loaded. Both fixed and moving contacts shall be silver-plated and replaceable. The spring-loaded power and control draw-out contacts shall be on withdrawable chassis and the same on fixed portion shall not be accepted.
4.19.00	Individual opening in the vertical bus enclosure shall permit the entry of moving contacts from the draw-out modules into vertical droppers.
4.20.00	As indicated in schematic drawings of DDCMIS controlled modules, contractor shall supply & mount two (2) coupling relays in the corresponding modules.
4.21.00	All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to Employer's approval. The Contractor shall submit dimensional drawings showing complete internal

	details of busbars and module components, for each type and rating for approval of Employer.
4.22.00	Employer reserves the right to alter the cable entries, if required during detailed engineering, without any additional commercial implication.
4.23.00	Each switchboard shall be provided with undrilled, removable type gland plate, which shall cover the entire cable alley. Contractor shall ensure that sufficient cable glanding space is available for all the cables coming in a particular section through gland plate. For all single core cables, gland plate shall be of non-magnetic material. The gland plate shall preferably be provided in two distinct parts for the easy of terminating addition cables in future. The gland plate shall be provided with gasket to ensure enclosure protection. Recommended drilling chart of gland plates for all power and control cables in the vertical panels shall be indicated by the Contractor in the respective G.A. drawings of the boards.
4.24.00	The Contractor shall consider layout of panels in a switchboard consisting of various feeder modules in a straight line, unless specified otherwise. The actual composition and disposition of various modules in a switchboard shall be finalised during detailed engineering. The Contractor shall provide adopter panel / dummy panel required to meet various configuration / arrangement of busbars adopted by the Contractor. The Switchboards fed from indoor transformer will be flange connected to the same and the same shall be located as close as desirable to the transformer. The details of transformer flanges for those transformers not being supplied under this package shall be given to the contractor for matching the connections. The switchboards fed from outdoor transformers of rating 1000kVA and above shall be connected through busducts. For transformers of 1000kVA rating, cable connection may also be acceptable in case of layout constraints. For lower rated transformers, the connection shall be through cables. Busduct connections wherever applicable shall be preferably in a straight line alignment. Adopter panels and dummy panels shall be provided wherever required.
4.25.00	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.
4.26.00	CLEARANCES The minimum clearance in air between phases and between phases and earth for the entire run of horizontal and vertical busbars and bus-link connections at circuit-breaker shall be 25 mm. For all other components, the clearance between "two live parts", "a live part and an earthed part", shall be at least ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal and vertical busbars the clearances specified above should be maintained even when the busbars are sleeved or insulated. All connections from the busbars up to switch / fuses shall be fully shrouded / insulated and securely bolted to minimize the risk of phase to phase and phase to earth short circuits.

7.00.00	**POWER BUSBARS AND INSULATORS**
7.01.00	All 415 V Switchboards, MCCs and ACDBs shall be provided with three phase and neutral busbars. Two separate sets of vertical busbars shall be provided in each panel of double front MCCs / DBs. Interleaving arrangement for busbars shall be adopted for switchboards with a rating of more than 1600A. DCDBs shall be provided with two (2) busbars. Entire busbar system shall be insulated with PVC sleeves. Busbar sleeves shall be compliant to UL224 (Extruded insulating tubing), CE/UL certified, having fire retardant properties and working temperature of 105^0C.

7.02.00	Vertical busbars of non-breaker panels shall be completely phase segregated by suitable insulating supports / walls made of fire-retardant, non-hygroscopic, track-resistant material to minimise the occurrence of arc faults.
7.03.00	All busbars and jumper connections shall be of high conductivity Aluminium alloy / Copper of adequate size.
7.04.00	The cross-section of the busbars shall be uniform throughout the length of switchboard section and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Neutral busbar short circuit strength shall be same as main busbars.
7.05.00	All busbars shall be adequately supported by non-hygroscopic, non-combustible, track-resistant and high strength sheet moulded compound or equivalent type polyester fibre glass moulded insulator. Separate supports shall be provided for each phase and neutral busbar. If a common support is provided, anti-tracking barriers shall be provided between the supports. Insulator and barriers of inflammable material such as Hylam shall not be accepted. The busbar insulators shall be supported on the main structure.
7.06.00	All busbar joints shall be provided with high tensile steel bolts, belleville / spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated busbar joints shall be thoroughly cleaned at the jointed locations and suitable contact grease shall be applied just before making a joint. All bolts shall be tightened by torque spanner to the recommended value. The overlap of the busbars at each joint surface shall be such that the length of overlap shall be equal to or greater than the width of the busbar. All Copper to Aluminium joints shall be provided with suitable bimetallic washers.
7.07.00	All busbars shall be colour coded as per IS: 375.
7.08.00	The Contractor shall furnish calculations establishing the adequacy of bus bar sizes for specified current ratings.
8.00.00	**AUXILIARY BUSBARS AND CONTROL TRANSFORMERS**
8.01.00	**AC CONTROL SUPPLY BUSBAR** Each bus-section of all Switchgears and MCCs shall be provided with two (2) nos. 415V / 110V control transformers. The 110V AC control supply from the control transformers shall be run through the MCC by means of two sets of control supply busbars of electrolytic Copper. In case of one transformer failure, whole bus section can be fed through single transformer. The control supply to different modules shall be tapped individually from the control supply busbars.

8.03.00	**SPACE HEATER BUSBARS** Panel and motor space heaters shall be fed from separate AC auxiliary busbars running throughout the switchboard. The supply for these busbars shall be tapped from incomer, before the isolating switch/ circuit breaker. Incoming circuit to space-heater bus shall have an isolating switch, HRC fuse and neutral link of suitable rating. Suitable terminals shall also be provided to facilitate energisation of space-heater bus from outside during long shutdowns of unit / switch-board.
9.00.00	**EARTH BUS AND EARTHING**
9.01.00	A galvanized steel / Copper / Aluminium earth bus shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded / bolted to the framework of each panel and breaker earthing contact bar. Vertical earth bus shall be provided in each vertical section which shall in turn be bolted / welded to main horizontal earth bus.
9.02.00	The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current to earth, as indicated in "Technical Parameters", without exceeding the allowable temperature rise.
9.03.00	Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to Contractor's earthing conductors. The horizontal earth bus shall project out of the switchboard ends and shall have predrilled holes for this connection. All joint splices to earth bus shall be made through at least two bolts, and taps by proper lug and bolt connection.
9.04.00	All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosure framework and truck shall be maintained even after painting.
9.05.00	The carriage and breaker frame shall get earthed while being inserted in the panel and positive earthing of the breaker frame shall be maintained in all positions, i.e. SERVICE & ISOLATED, as well as throughout the intermediate travel.
9.06.00	Each module frame shall get engaged to the vertical earth bus before the disconnecting contacts on the module are engaged to the vertical busbars.
9.07.00	All metallic cases of relays, instruments and other panel-mounted equipment shall be connected to earth by independent stranded Copper wires of size not less than 2.5 sq. mm. All the equipment mounted on the door shall be earthed through flexible wire/braids. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors, soldering is not acceptable. Looping of earth connections, which would result in loss of earth connections to other devices, when a device is removed, is not acceptable. However, looping of earth connections between equipment to provide alternative paths to earth bus is acceptable.
9.08.00	VT and CT secondary neutral point earthing shall be at one place only, i.e. on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.

9.09.00	All hinged doors having potential carrying equipment mounted on it shall be earthed by flexible wire/ braid. For doors not having potential carrying equipment mounted on it, earth continuity through scraping hinges/ hinge pins of proven design may also acceptable. The Contractor shall establish earth continuity at site also.

12.00.00	**AIR BREAK SWITCHES**
12.01.00	Air break switches shall be of heavy duty, single throw, group operated, load break, fault make type when associated with fuses. All switches for motor circuits shall be of utilization category AC-23A with 1NO +1NC auxiliary contact, which shall be wired to the control circuit as shown in the schematic drawings. All switches for other outgoing feeders shall be of utilization category AC-22A. All switches for DC circuits shall be suitable for 240 V DC and shall be of DC-22 utilization category.
12.02.00	Continuous current rating of the switches shall be selected from the 'Module Selection tables' for various feeders.
12.03.00	The combination of switch-fuse unit would be preferred. However, if separate switch and fuses are provided, switch shall be located before fuses.
12.04.00	The main switches shall be operable from outside the module door. The switch handle shall clearly indicate the position of switch. Switch operating handles shall be provided with padlocking facilities. However, incomer switches of switchboards shall be provided with padlocking facility in both 'ON' and 'OFF' positions.
12.05.00	Interlocks shall be provided such that the cubicle door will not open when the switch is in closed position and the switch will close only when the door is closed.
12.06.00	Switches and fuses for AC/DC control supply and heater supply wherever required, shall be mounted inside the cubicles. Toggle switch is not acceptable.
12.07.00	Even if a single phase feeder is required for certain applications, Contractor shall provide TPN switch, fuse-bases and cable/ link connections between switch/fuse and vertical busbars for all the three phases, so that changing from single phase feeder to three phase feeder is possible without any modification other than inserting fuses at site.
13.00.00	**MCCB**
13.01.00	MCCB shall be fixed type / part of withdrawable feeder module as per specification, three pole, air break type having trip free mechanism with quick make and quick break type contacts. MCCB shall have current limiting feature. MCCB of identical ratings shall be physically and electrically interchangeable. MCCB shall be provided with 1 NO and 1NC auxiliary contacts.

13.02.00	MCCB shall be provided with Microprocessor based inbuilt front adjustable releases (Overload & Short-circuit) and shall have adjustable Earth Fault protection unit also. The protection settings shall have suitable range to achieve the required time & current settings. LED indications shall also be provided for faults, MCCB status (on/off etc.).
13.03.00	MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit rating. Extended cable terminal arrangement for higher size cable may also be offered. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB to prevent opening of the door unless the MCCB is in OFF position. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked. The MCCBs being offered shall have common / interchangeable accessories for all ratings like aux. switch, shunt trip, alarm switch etc. The MCCBs shall have the current discrimination up to full short circuit capacity and shall be selected as per manufacturer's discrimination table.
13.04.00	Auxiliary contacts of the MCCBs pertaining to critical feeders, to be decided during detailed engineering, shall be connected to the digital inputs available in the numerical relays of Incomer / Bus-coupler / Outgoing circuit breaker feeders, for integration into the numerical relay network.

16.00.00	**FUSES**
16.01.00	All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC circuits shall be rated for 80kA rms (prospective) breaking capacity at 415V AC and for DC circuits, 20kA rms breaking capacity at 240V DC.
16.02.00	Fuse shall have visible operation indicators. Insulating barriers shall be provided between individual power fuses.
16.03.00	Fuse shall be mounted on insulated fuse carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchboard.
16.04.00	Fuse ratings shall be selected by the Contractor from the 'Module Selection Tables' for various feeder ratings. However, the fuse ratings for motor feeders given in the 'Motor Module Selection Table' are indicative only, and the same shall be coordinated by the Contractor to achieve class-II protection coordination and also to match the motor characteristics. Switch rating shall in no case be less than the fuse rating.
16.05.00	The Neutral links shall be mounted on fuse carriers which shall be mounted on fuse bases.
17.00.00	**Instrument Transformers**
17.01.00	All current and voltage transformers shall be of cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated condition and the specified ambient temperature. The class of insulation shall be 'E' or better.
17.02.00	Alternatively, current transformers with unbreakable, flame retardant, self-extinguishing Nylon casing of UL94 grade are also acceptable.
17.03.00	All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum RMS short circuit breaking and peak making current ratings of the associated switchgear.
17.04.00	All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to separate terminals on an accessible terminal block where star point formation and earthing shall be done.
17.05.00	Current transformers may be multi or single-core type. All voltage transformers shall be single phase type.
17.06.00	The bus VTs shall be housed in a separate compartment. All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides.
17.07.00	All CTs shall be provided with supports independent of busbar / busbar supports.

17.08.00	The CTs shall be located in such a way that they can be easily approached for maintenance without necessitating shut down of adjacent feeders.

20.00.00	**INDICATING INSTRUMENTS**
20.01.00	All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96mm square size with 90 degree linear scale and shall have an accuracy class of 1.0 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.
20.02.00	All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustment without removing or dismantling the instruments.

20.03.00 All instruments shall have white dials with black numerals & lettering. Black knife edge pointer shall be provided for meters.

20.04.00 Ammeters provided for motor feeders (for motors of rating ≥ 30kW & < 100kW) shall have a compressed scale at the upper current region to cover the starting current up to 6.0 times the CT primary current.

20.05.00 All motor feeders of rating ≥ 30 kW and < 110 kW shall be provided with Multifunction Digital Energy Meter with communication facility to display the current, voltage, power factor, power energy related data locally as well as communicate these for remote metering/audit/analysis purposes. These meters shall The technical specification for Digital indicating energy meter shall be as follows:

a) Input Voltage:110VAC / 240VDC
b) Input Current:1A
c) Size:96X96 SQ.MM
d) Power & Energy Accuracy: 1.0
e) Mounting: Flush mounting
f) Type: True RMS 3-PHASE V,I, kW,PF & kWH indication
g) 4 Digit, seven segment LED display/LCD display, with floating decimal
h) Communication: In built RS 485 bus port
i) Operating Frequency: 45 HZ-65HZ
j) Dielectric Test: 2KV RMS for 1 minute
k) Over Current: 10 times for 3 sec.
l) Aux supply: 90V-300V AC/DC
m) Compliance: EMC/EMI
n) Field programmable CT ratio
o) Analog Current Output (4-20 mA)

22.00.00	**Indicating Lamps**
22.01.00	Indicating lamps shall be of CLUSTER LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary.
22.02.00	Lamps shall have translucent lamp-covers of the following colours, as warranted by the application : **Red** for motor ON, valve / damper OPEN, breaker CLOSE. **Green** for motor OFF , valve / damper CLOSE, breaker OPEN. **White** for motor AUTO TRIP. **Blue** for all healthy conditions (e.g. control supply, and also for SPRING CHARGED"). **Amber** for all Alarm Conditions (e.g. overload). Also for "SERVICE" and "TEST" position indications.
22.03.00	Bulbs and lamp covers shall be easily replaceable from the front of the cubicle. The method of mounting indicating lamp fittings on panels shall prevent their rotation under the action of lamp removal or replacements, reliance upon the tightness of ring nut for the purpose is not sufficient.
22.04.00	Indicating lamps should be located just above the associated push-button / control switches. Red lamps shall invariably be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along the centre line of control switch / push button pair. Blue and Amber should normally be located above the Red and Green lamps.
22.05.00	When associated with push-buttons, red lamps shall be directly above the green push-button and green lamp shall be directly above the red push button.
22.06.00	All indicating lamps shall be suitable for continuous operation at 90% to 110% of their rated voltage.
23.00.00	**Space Heater**
23.01.00	Space heaters shall be provided in the switchboards wherever the manufacturer considers them necessary and recommends their provision for preventing harmful moisture condensation.

23.02.00	The space heaters shall be suitable for continuous operation on 240 V AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary switches and fuses shall be provided.
23.03.00	The circuit for each panel and motor space heater should have an isolating switch, HRC fuse and isolating link. In addition, the space heater circuit of each panel shall also have a thermostat of suitable rating.
24.00.00	**INTERNAL WIRING**
24.01.00	All switchboards shall be supplied completely wired internally upto the terminals, ready to receive external cables.
24.02.00	All inter-cubicle and inter-panel wiring and connections between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided by the Contractor.
24.03.00	All auxiliary wiring shall be carried out with 650V grade, single core stranded Copper conductor, colour coded, PVC insulated wires. Conductor size shall be 1.5 mm^2 (min.) for control circuit wiring and 2.5 mm^2 (min) for CT and space heater circuits.
24.04.00	Extra flexible wires shall be used for wiring to devices mounted on moving parts such as hinged doors. The wire bunches from the panel inside to the doors shall be properly sleeved or taped.
24.05.00	All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminal blocks.
24.06.00	All internal wiring terminations shall be made with solderless crimping type tinned Copper lugs which shall firmly grip the conductor or an equally secure method. Similar lugs shall also be provided at both ends of component to component wiring. Insulating sleeves shall be provided over the exposed parts of lugs to the extent possible. Screw-less (spring loaded) / cage clamp type terminal shall also be provided with lugs.
24.07.00	Printed single tube ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The wire identification marking shall be in accordance with IS: 375. Red Ferrules should be provided on trip circuit wiring.
24.08.00	Wiring for equipment, which are to be supplied by the Contractor and for which the Contractor has to provide mounting arrangement in his panels, shall also be provided by the Contractor, up to the terminal blocks.
24.09.00	All connections from vertical busbars for individual modules above 100 A shall be by Copper / Aluminium links only. The cable connections for modules less than 100 A shall be selected in such a way that there will not be any melting / shorting in case of a short circuit inside the module and the cable shall have current rating to carry the let through energy of the corresponding fuses in case of a fault. The insulation of the cable and its cross section shall be decided considering the high ambient temperature within the module. For all modules where use of cable is envisaged by the Contractor specific approval from the Employer regarding cable details are to be taken. For power wiring colour coded wire insulation / tapes shall be provided.

25.00.00	**CONTROL TERMINAL BLOCKS**
25.01.00	Terminal blocks shall be 650V grade, 10Amps rated, made up of unbreakable polyamide 6.6 grade. The terminals shall be either screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design.
25.02.00	Terminal blocks for CT and VT secondary leads shall be of stud type, made up of unbreakable polyamide 6.6 grade. They shall be provided with links to facilitate testing, isolation star / delta formation and earthing. Terminal blocks for CT secondary shall have the short circuiting facility. The terminals for remote ammeter connection etc. shall also be disconnecting type only. All metal parts shall be of non-ferrous material. Screws shall be captive.
25.03.00	In all circuit breaker panels MCC modules at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks.
25.04.00	All terminal blocks shall be suitable for terminating on each side two (2) nos. stranded Copper conductors of size up to 2.5 sq. mm each, or alternatively, the terminal blocks shall have the possibility of double shorting space to facilitate looping. However for DDCMIS terminals shall be suitable for 1.5 mm^2 cable.
25.05.00	All terminals shall be numbered for identification and grouped according to the function. Engraved white-in-black labels shall be provided on the terminal blocks.
25.06.00	Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.
25.07.00	Terminal blocks shall be arranged with at least 100mm clearance between two sets of terminal blocks. The minimum clearance between the first row of terminal blocks and the associated cable gland plate shall be 250 mm.
26.00.00	**Power Cable Termination**
26.01.00	Cable termination compartment and arrangement for power cables shall be suitable for heavy duty, 1.1 kV grade, stranded Aluminium conductor, PVC/ XLPE insulated, armored / unarmored and PVC sheathed cables. The size and type of cable for individual modules shall, preferably, be as indicated in the 'Module Selection Tables'. All necessary cable terminating accessories such as supporting clamps and brackets, hardware etc. for cables shall be provided by the contractor to suit the final cable sizes.
26.02.00	All power cable terminals shall be of stud type and the power cable lugs shall be of tinned Copper solderless crimping ring type conforming to IS: 8309. All lugs shall be insulated/ sleeved.

29.00.00	**Name Plates and Labels**
29.01.00	All Switchgears, MCCs, Distribution Boards, Fuse boards, all feeders, local push-button stations and local motor starters shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear switchgear also.
29.02.00	All name plates shall be of non-rusting metal or 3-ply Lamicoid, with white engraved lettering on black background. Letter size shall be of at least 10mm height.
29.03.00	Suitable stenciled paint mark shall be provided inside the panel/module for identification of all equipment in addition to the plastic sticker labels, if provided. These labels shall be positioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring drawings.
29.04.00	Caution name plate "Caution Live Terminals" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end.

32.00.00	**LIGHTING / WELDING TRANSFORMERS** 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. Otherwise, the same shall be located by the side of respective LDB / Welding DB. Lighting / Welding transformers shall be dry type, natural air cooled with class B insulation or better. Impedance of lighting / Welding transformer shall be so selected that the fault level of lighting /Welding system shall be reduced to 3 to 5 KA. Lighting / Welding transformers shall be tested as per IS: 2026. Off-circuit tap changer with ± 2.5% and ± 5% tapping shall be provided. In case the transformers are not mounted inside the LDB panels, the same shall be housed in a separate 2 mm thick

CR sheet steel enclosure with IP-42 degree of protection as per IS/IEC 60947. However, the transformer terminal box shall have IP-52 degree of protection.

33.00.00 PAINTING

All sheet steel work shall be pre-treated, in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "Class-C" as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated. After passivation, Electrostatic Powder Coating shall be used. Powder should meet requirements of IS 13871 (Powder costing specification). Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the Employer. The paint thickness shall not be less than 50 microns. Finished parts shall be suitably packed and wrapped with protective covering to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

34.00.00 GASKETS

The gaskets, wherever specified, shall be of good quality EPDM / Neoprene with good ageing, compression and oil resistance characteristics suitable for panel applications.

35.00.00 TEMPERATURE –RISE

The temperature rise of the horizontal and vertical busbars and main bus links including all power draw-out contacts when carrying 90% of the rated current along the full run shall in no case exceed 55^0 C with silver plated joints and 40^0C with all other types of joints over an outside ambient temperature of 50^0C. The temperature rise of the accessible parts/external enclosures expected to be touched in normal operation shall not exceed 20^0C. The temperature rise of manual operating means shall not exceed 10^0C for metallic & 15^0C for insulating material. Temperature rise for the busbars shall be carried out at 90% of the rated current. The above temperature rise limits are applicable for busducts also without any current derating.

36.00.00 DERATING OF EQUIPMENTS

The Contractor shall ensure that the equipment offered will carry the required load current at site ambient conditions specified and perform the operating duties without exceeding the permissible temperature as per Indian Standards / Specification. Continuous current rating at 50^0C ambient in no case shall be less than 90% of the normal rating specified.

The Contractor shall indicate clearly the derating factors if any employed for each component and furnish the basis for arriving at these derating factors duly considering the specified current ratings and ambient temperature of 50^0C.

38.00.00 TESTS AND TEST REPORTS

38.01.00 **GENERAL**

(a.) All equipment to be supplied shall be of type tested design. The Contractor shall

submit for Employer's approval the reports of all the type tests as listed in this specification and carried out not earlier than ten years prior to the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

(b.) In case the Contractor is not able to submit report of the type test(s) conducted not earlier than ten years prior to the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract at no additional cost either at third party lab or in presence of client/Employer's representative and submit the reports for approval.

(c.) All routine tests as per the specification and relevant standards shall be carried out.

38.02.00 The following type test certificates of LT Switchgear and MCC panels shall be submitted.

1)	Circuit breaker of each rating	
	a)	Test sequence 1
	b)	Combined test sequence (With Circuit breakers mounted inside the Switchgear panel)
2)	Complete design verification of Switchgear/MCC Panels as per IEC 61439 Part-1, Annexure-D	
3)	Internal arc test for Personnel and Assembly Protection as per IEC/TR 61641	
4)	MCC modules of any three ratings, as selected by the Employer, for class - II protection Co-ordination.	
5)	Test for single phasing protection feature on 3 nos. bimetallic thermal overload relay selected by Employer. The relay shall be tested for compliance with manufacturer's printed / declared characteristic curve.	

38.03.00 For the following equipment 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. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. In case the Contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employer's representative and submit the reports for approval.

(a.) NUMERICAL RELAYS

(b.) LOCAL PUSH BUTTON STATION

(c.) LOCAL MOTOR STARTER

(d.) MCCB

38.04.00 Type test reports for the following tests on the model of the Numerical relays, Ethernet switches shall be submitted for Employer's review.

S. No.	TEST ITEMS	Standard
1	Dimensions of structure and visual inspection	IEC 60297-3-101
2	Functional requirements:	Relevant IEC 60255-100 series
	– Steady-state simulation	
	– Dynamic simulation	
3	Product safety requirements	IEC 60255-27
	(including the dielectric tests and thermal short time rating)	
4	EMC requirements:	IEC 60255-26
	– Emission	
	– Immunity	
5	Energizing quantities:	
	– Burden	N/A
	– Change of auxiliary energizing quantity	IEC 60255-11
6	Contact performance	N/A
7	Communication requirements	Relevant IEC protocol standards
8	Climatic environmental requirements:	IEC 60068-2-14, IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-78, IEC 60068-2-30, IEC 60255-27
	– Cold	
	– Dry heat	
	– Change of temperature	
	– Damp heat	
9	Mechanical requirements: – Shock	IEC 60255-21-1, IEC 60255-21-2, IEC 60255-21-3
	– Vibration	
	– Bump	
	– Seismic	
10	Enclosure protection	IEC 60529, IEC 60255-27

38.05.00 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

38.06.00 All routine tests as per the specification and relevant standard IS 8623 shall be carried out.

38.07.00 An indicative lists of tests / checks is mentioned as QA chapter. However, the manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

38.08.00 All procedures for type tests shall be approved by Employer before commencement of type tests. However, the following points may be specifically noted.

1)	For temperature rise tests, the connection arrangement between the source and the test equipment shall be such that the temperature gradient in the connection piece of cable at a distance of one meter away from the test equipment shall be restricted to 5^0C.
2)	Milli-Volt drop test shall be done on switching devices before and after the type tests.
3)	Bolt tightness of busbar joints shall be checked with torque wrench before and after short time rating tests on the circuit breaker and MCC panels.

38.09.00 Routine checking to observe compliance to degree of protection, first numeral, on switchboard enclosures and busbar chambers shall be as under :

1) IP -4 X	It shall not be possible to insert a one mm dia. Steel wire into the enclosure from any direction, without using force.
2) IP-5X	It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.

39.00.00 ERECTION / INSTALLATION OF SWITCHBOARDS AND OTHER EQUIPMENTS

39.01.00 Each equipment shall be installed in a neat, workman-like manner so that it is levelled, plumbed, squared and properly aligned and oriented. Tolerances shall be as established in Contractor's drawings or as stipulated by Employer. No equipment shall be permanently fixed down to foundations until the alignment has been checked and found acceptable by the Employer.

39.02.00 Contractor shall furnish all supervision, labour, tools, equipment, rigging materials, bolts, wedges, anchors, etc.., in proper time, required to completely install, test and commission the equipment.

39.03.00 Manufacturer's and Employer's instructions and recommendations shall be correctly followed in handling, setting, testing and commissioning of all equipment.

39.04.00 Contractor shall move all equipment into the respective rooms through the regular door or openings specifically provided for this purpose. No part of the structure shall be utilised to lift or erect any equipment without prior permission of Engineer.

39.05.00 All switchboards shall be installed in accordance with Indian Standard, IS: 3072, and Employer's instructions.

39.06.00	Switchboard panels shall be installed on concrete floor or supported on steel channel / edge angle in concrete trenches. The Contractor shall provide steel insert plates in the concrete floor and / or steel channels / edge angle on the trenches as applicable. The base frame of switchboards shall be welded to the insert plates by the Contractor. The Contractor shall be required to install and align the panels using suitable metallic shims before welding the base frame. In joining shipping sections of switchboards together, adjacent housing of panel sections or flanged throat sections shall be bolted together after alignment has been completed.
39.07.00	Contractor shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever the instruments and relays are supplied separately they shall be mounted only after the associated panels have been erected and aligned. the blocking materials employed for safe transit of instruments and relays shall be removed after ensuring that panels have been completely installed and no further movement of the same would be necessary. Any damage shall be immediately reported to Engineer.
39.08.00	Equipment furnished with finished coats of paint shall be touched up by Contractor if their surface is spoiled or marred during erection / commissioning.
39.09.00	The room and floor finishing work would be done after erection of the panels and the Contractor shall suitably cover up the panels to protect them from injury and marring of finish.
40.00.00	**COMMISSIONING CHECKS / TESTS**
40.01.00	After installation of panels, power and control wiring and connections, Contractor shall perform operational tests on all switchboards, to verify proper operation of switchboards / panels and correctness of all equipment in each and every respect.
40.02.00	The Contractor shall carry out the following commissioning checks, in addition to other checks and tests recommended by the manufacturers.
40.03.00	GENERAL (a.) Check name plate details according to the approved drawings. (b.) Check for physical damage. (c.) Check tightness of all bolted connections, by torque wrench. (d.) Check earth connections. (e.) Check cleanliness. (f.) Check all moving parts for proper lubrication.
40.04.00	Circuit Breakers (a.) Check alignment of breaker truck for free movement. (b.) Check correct operation of shutters. (c.) Check control wiring for correctness of connections, continuity And IR values.

(d.) Manual operation of breakers completely assembled.

(e.) Closing /opening operation, manually and electrically.

(f.) Trip free and anti-pumping operation.

(g.) I.R. values of contacts.

(h.) Contact resistance.

(i.) Check on spring charging motor, correct operation of limit switches and time or charging.

(j.) All functional checks

(k.) Breaker closing and tripping time, if required.

40.05.00 Current Transformers

(a.) Visual inspection.

(b.) IR Value

(c.) Ratio check.

(d.) Magnetising current.

(e.) Wiring connection.

(f.) Spare CT cores, if any, to be shorted and earthed

40.06.00 Voltage Transformers

(a.) Visual inspection.

(b.) IR Value

(c.) Ratio check

(d.) Magnetising current

(e.) Line connection as per connection diagram

40.07.00 Cubicle Wiring

(a.) Check all switch developments

(b.) Each wire shall be traced by continuity tests and it shall be ensured that the wiring is as per relevant drawing. All inter-connections between panels / equipment shall be similarly checked.

(c.) IR Value of all the wires shall be checked to earth.

(d.) Functional checking of all control circuit e.g., closing, tripping, control, interlock, supervision and alarm circuit.

40.08.00 Relays

1. Check connections and wiring.
2. IR Value to be checked for
   a) all terminals to body.
   b) AC to DC terminals.
3. Check operating characteristics by secondary injection.
4. Check minimum pick up voltage of DC coils.
5. Check operation of electrical / mechanical targets.
6. Relay settings.
7. Check CT and VT connections with particular reference to their polarities.

40.09.00 Meters

(a.) Visual inspection.

(b.) Check IR Value of all insulated partitions.

(c.) Check CT and VT connections with particular reference to their polarities for power type meters.

(d.) Calibration.

43.00.00 **SELECTION TABLES**

43.01.00 **Feeder Module, Other than Motor Selection Table (415 V AC)**

Sl. No.	Feeder Rating (Amp.)	Switch/MCCB Rating (Amp.)	Fuse Rating (Amp.)
1.	0-16	16	16
2.	17-32	32	32
3.	33-45	63	63
4.	46-63	63	63
5.	64-99	100	100
6.	100	100A MCCB	
7.	101-160	160A MCCB	
8.	161-250	250A MCCB	
9.	251-400	400A MCCB	
10.	401-1120 (Breaker)		
11.	1121-1680 (Breaker)		

44.00.00	**COMMISSIONING OF LT SWITCHGEARS** Commissioning of LT switchgears at site shall only be carried out either by the switchgear manufacturer himself or under the supervision of the switchgear manufacturer.

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. 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

LT CONTROL CABLES

Control 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	Lay length & Sequence	Armour coverage, cross over,	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after ageing on outer sheath & insulation	Thermal stability	Anti termite coating on	Constructional requirements feature as per NTPC	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

MODULE NO. SQE-16

CABLING, EARTHING, LIGHTNING PROTECTION

ATTRIBUTES / CHARACTERISTICS 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-QE7

STATION LIGHTING

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

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.

SUB-SECTION-V-QE2

LT SWITCHGEARS & BUSDUCTS

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							

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.

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

ELEVATOR

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

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 - 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

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

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:NKP-C2005:20

VOLUME -III

PRICE SCHEDULE-REV-00

FOR

CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

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

JOB: CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

TENDER NO PSER:SCT:NKP-C2005:20

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.
2	The work shall be carried out strictly as per specifications, description of the items in these schedule and / or engineer's instructions. Drawings enclosed with the tender are only preliminary and for tender purposes and giving some idea of the work involved. The work is to be executed as per 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 different 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, an 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 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.
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 available 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.
13	No splitting of the job is envisaged. 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."
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.
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.
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 Grand 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
PRICE SCHEDULE, REV-00

JOB: CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

TENDER NO PSER:SCT:NKP-C2005:20

SCH-1 : TOTAL PRICE

SL NO	DESCRIPTION	PRICE SCHEDULE REF	TOTAL PRICE (IN INR)
1.0	TOTAL PRICE FOR CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.	**SCH 2 - PRICE BREAK UP**	***IN FIGURES:-*** ***IN WORDS:-***
2.0	NON-SCHEDULE ITEM For items not covered in Price Schedule , quote % above or below or at par 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 materials.	_____% above /_____% below/ at par of CPWD Rate Schedule 2018	

NOTE

1.0	Bidder shall quote total price for SCH-1 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-1 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	Bidder to note that percentage break-up of above total price into supply part, service part are frozen and indicated in SCH-2. Based on this break-up and further break-up in subsequent schedules, separate orders will be placed for Supply and Service part as per respective price components.
5.0	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.
6.0	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.3 above.
7.0	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.
8.0	Price format shall not be changed by bidder in any case and it may lead to cancellation of their offer.
9.0	The quoted price shall be excluding GST including freight on FOR site basis.
10.0	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.
11.0	For payment of non schedule items, the rate shall be derived from CPWD Schedule - 2018.

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TENDER NO PSER:SCT:NKP-C2005:20

SCHEDULE - 2 : BREAK UP

SL NO	DESCRIPTION	WEIGHTAGE
1.0	TOTAL SERVICE PART OF SCH-3	0.84516118
2.0	TOTAL SUPPLY PART OF SCH-4	0.15483882
3.0	**TOTAL**	**1.00000000**

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TENDER NO PSER:SCT:NKP-C2005:20

SCHEDULE - 3 : SERVICE

ITEM SL NO.	Description of Item	Unit	Quantity (Unit 1)	Quantity (Unit 2)	Quantity (Unit 3)	Total Quantity	Weightage
PART 1A	Civil Works						
1	Earth work in **excavation in all types of soil** including moorum, 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), dressing the sides & bottom, all lifts, ramming/compacting the excavated bottom, stacking, disposal of surplus excavated materials within a lead upto 1 km, spreading/levelling of disposed materials etc all complete for following depths below ground level including necessary men/women, materials, equipment, loading, transportation, unloading etc as per specification, drawing and as directed by engineer- in-charge. [Measurement of excavation shall be paid as per clause 5.2.0 of Technical Specification, Section D, Sub-Section D1 sheet 20 0f 23]						
a	Depth from ground level but not exceeding 2 m	cum	2760	2760	2760.0	8280	0.00217708
b	Depth exceeding 2 m but not exceeding 4 m	cum	2050	2050	2050.0	6150	0.00199475
c	Depth exceeding 4 m but not exceeding 6 m	cum	1250	1250	1250.0	3750	0.00163994
d	Depth exceeding 6 m but not exceeding 8 m	cum	650	650	650.0	1950	0.00112454
2	Extra over Item No. 1 for **dewatering of ground water by well point method** as per IS 9759.	cum	800	800	800.0	2400	0.00015903
3	Earth work in **excavation in soft rock** (rock without any recovery of exacavated materials in the form of hard stone/boulder) including weathered rock which can be excavated by means of crow bar, pick axe, pneumatic rock breaker attachment with excavator machine etc but does not require chiselling or blasting including setting out, levelling, dewatering (wherever required), shoring & strutting (wherever required), dressing the sides & bottom, all lifts, ramming/compacting the excavated bottom, stacking, disposal of surplus excavated materials within a lead upto 1 km, spreading / levelling of disposed materials etc all complete for following depths below ground level including necessary men/women, materials, equipment, loading, transportation, unloading etc as per specification, drawing and as directed by engineer- in-charge. [Measurement of excavation shall be paid as per clause 5.2.0 of Technical Specification, Section D, Sub-Section D1 sheet 20 0f 23]						
a	Depth from ground level but not exceeding 2 m	cum	200	200	200.0	600	0.00018706
b	Depth exceeding 2 m but not exceeding 4 m	cum	300	300	300.0	900	0.00033165
c	Depth exceeding 4 m but not exceeding 6 m	cum	700	700	700.0	2100	0.00100087
d	Depth exceeding 6 m but not exceeding 8 m	cum	650	650	650.0	1950	0.00117724
5	Earth work in **excavation in hard rock requiring controlled blasting** including wedging, line drilling, pre shearing etc as required, setting out, levelling, dewatering (wherever required), shoring & strutting (wherever required), dressing the sides & bottom, all lifts, necessary licenses/statuatory clearances for blasting, supply, storage & handling of blasting materials, stacking/disposal of surplus excavated material within a lead upto 1 km, spreading / levelling of disposed materials etc all complete for following depths below ground level including necessary men/women, materials, equipment, loading, transportation, unloading etc as per specification, drawing and as directed by engineer- in-charge. [Measurement of excavation shall be paid as per clause 5.2.0 of Technical Specification, Section D, Sub-Section D1 sheet 20 0f 23]						
c	Depth exceeding 4 m but not exceeding 6 m	cum	100	100	100.0	300	0.00024404
d	Depth exceeding 6 m but not exceeding 8 m	cum	100	100	100.0	300	0.00030897
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 thickness using/with selected materials **from compulsorily excavated soil** available within a lead upto 1 km and compacted as specified including re-excavation of stacked earth, 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.]						
a	Each layer compacted so as to achieve at least 95% maximum dry density as per IS-2720 (Part-VII)	cum	370	370	370.0	1110	0.00025877
b	Each layer compacted so as to achieve at least 90% maximum dry density as per IS-2720 (Part-VII)	cum	3260	3260	3260.0	9780	0.00205553
c	Each layer compacted so as to achieve at least 85% maximum dry density as per IS-2720 (Part-VII)	cum	370	370	370.0	1110	0.00025285
d	Each layer compacted so as to achieve at least 80% relative density as per IS-2720 part XIV in case of sandy soils.	cum	200	200	200.0	600	0.00014724
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 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						
a	Each layer compacted so as to achieve at least 95% maximum dry density as per IS-2720 (Part-VII)	cum	100	100	100.0	300	0.00002536
b	Each layer compacted so as to achieve at least 90% maximum dry density as per IS-2720 (Part-VII)	cum	200	200	200.0	600	0.00004801
c	Each layer compacted so as to achieve at least 85% maximum dry density as per IS-2720 (Part-VII)	cum	100	100	100.0	300	0.00002535
d	Each layer compacted so as to achieve at least 80% relative density as per IS-2720 part XIV in case of sandy soils.	cum	100	100	100.0	300	0.0000267
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	12250	12250	12250.0	36750	0.00036936
10	**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 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.]						
a	Each layer compacted so as to achieve at least 95% maximum dry density as per IS-2720 (Part-VII)	cum	210	210	210.0	630	0.00045279
b	Each layer compacted so as to achieve at least 90% maximum dry density as per IS-2720 (Part-VII)	cum	1580	1580	1580.0	4740	0.00333857
c	Each layer compacted so as to achieve at least 85% maximum dry density as per IS-2720 (Part-VII)	cum	210	210	210.0	630	0.00043486
d	Each layer compacted so as to achieve at least 80% relative density as per IS-2720 part XIV in case of sandy soils.	cum	100	100	100.0	300	0.00020293
11	**Supplying and filling sand** upto any depth below grade slab, around foundations, etc. in layers not exceeding 300 mm 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	150	150	150.0	450	0.00050889

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TENDER NO PSER:SCT:NKP-C2005:20

SCHEDULE - 3 : SERVICE

ITEM SL NO.	Description of Item	Unit	Quantity (Unit 1)	Quantity (Unit 2)	Quantity (Unit 3)	Total Quantity	Weightage
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	856	856	856.0	2568	0.00871833
13	Providing and 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. [Cement will be issued by BHEL Free of cost]	cum	140	140	140.0	420	0.00183882
14	Providing and 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: [Cement will be issued by BHEL Free of cost]						
i	For all works below ground level (except chimney shell)						
b	Grade M-30 (foundations, etc)	cum	3200	3200	3200.0	9600	0.0459295
ia	Extra over St. No. 14(i) for **controlling of temperature** of fresh concrete for raft/pilecap 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	3200	3200	3200.0	9600	0.01458926
ii	For all other works						
a	Grade M-25 grade level slab, pit, trenches,drain etc.	cum	72	72	72.0	216	0.00097881
c	Grade M-35 for chimney shell, corbels and external platforms and other shell attachments.	cum	4000	4000	4000.0	12000	0.11510643
d	Grade M-30 for all other components of the super structure, roof slab, mini -shells, beams, columns wall etc.	cum	45	45	45.0	135	0.00130197
15	Providing and applying **two 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	1020	1020	1020.0	3060	0.00106933
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	350	350	350.0	1050	0.0117553
ii	For all other works						
a	Mild steel reinforcement bars [Mild steel reinforcement procurement in vendors scope]	MT	10	10	10.0	30	0.00237898
b	High strength deformed bars [Reinforcement bars will be issued by BHEL Free of cost]	MT	460	460	460.0	1380	0.01679476
17	Providing and fixing **formwork** of approved quality for cast-in-situ, plain or reinforced concrete works of any type and section (including curved surfaces and chimney shell) for all elevations, 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.						
i	For all works below ground level (except chimney shell)	Sqm	902	902	902.0	2706	0.00226517
ii	For all other works						
a	Inner and outer faces of wind shield with slip form shuttering	Sqm	18850	18850	18850.0	56550	0.08808157
b	All other components of the superstructure including slabs, beams, columns, walls, enclosures, mini shells, external platforms, corbels, other shell attachments, chases/recesses in shell etc.	Sqm	450	450	450.0	1350	0.00243271
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	120	120	120.0	360	0.00056437
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	70	70	70.0	210	0.00002357
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	32	32	32.0	96	0.0001414
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	475	475	475.0	1425	0.00032323
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.[Material supply including structural steel parts is in scope of contractor]	MT	3	3	3.0	9	0.00115568
A23	Supply, fabrication and erection of **high strength structural steel (E350)** in built up section at shop conforming to IS:2062, in columns, beams, struts, monorails, stays, safety chains, ladders, 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),connection design & preparation of fabrication drgs, straightening, cutting, bending, rolling, grinding, machining, drilling, welding, electrodes and other consumables, alignment, erection bolts & nuts (weight of erection bolts, nuts and welds not payable), assembly, edge preparation, preheating (However, permanent bolts are payable separately), assembly, edge preparation, preheating (min preheat and interpass temperature of 120-140o C for welding over 20 mm thickness & use of low hydrogen/ radiogenic electrodes), 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, installation of temporary structures, setting column bases, surface preparation by means of manual or mechanical power tools as per IS:1477 part 1, touch-up painting, rectification, dismantling and removal of all temporary structures (weight of temporary structures not payable), etc all complete. Including appointment of a seperate agency, approved by BHEL, for review and approval of fabrication drgs, in consultation with BHEL. [Structural steel shall be issued by BHEL free of cost] **Payment terms : (a) Fabrication - 65 % (b) Erection - 25% (c) Alignment - 10%**	MT	55	55	55.0	165	0.01982623

JOB: CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

TENDER NO PSER:SCT:NKP-C2005:20

SCHEDULE - 3 : SERVICE

ITEM SL NO.	Description of Item	Unit	Quantity (Unit 1)	Quantity (Unit 2)	Quantity (Unit 3)	Total Quantity	Weightage
B23	Supply, fabrication and erection of structural **steel of grade E 250 in rolled/ built up section at shop** 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), connection design & preparation of fabrication drgs, straightening, cutting, bending, rolling, grinding, machining, drilling, welding, electrodes and other consumables, alignment, erection bolts & nuts (weight of erection bolts and nuts not payable), 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, 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, touch-up painting, rectification, dismantling and removal of all temporary structures (weight of temporary structures not payable), etc all complete. Including appointment of a seperate agency, approved by BHEL, for review and approval of fabrication drgs, in consultation with BHEL. [Structural steel shall be issued by BHEL free of cost] **Payment terms : (a) Fabrication - 65 % (b) Erection - 25% (c) Alignment - 10%**	MT	165	165	165.0	495	0.05489034
C23	Extra over ST NO. A23 & 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	220	220	220.0	660	0.00404863
D23	Extra over ST NO. A23 & 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	220	220	220.0	660	0.00234113
E23	Extra over ST NO. A23 & 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	220	220	220.0	660	0.00225855
A24	Supplying, fabrication, erection and alignment of 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 2 coats of redoxide zinc-chromate primer (one coat at shop and one coat after erection), fixing clamps, fittings, fixtures, all taxes, duties, packing, grinding, drilling, welding, edge preparation, etc. all complete. [Structural steel & chequered plate shall be issued by BHEL free of cost]	MT	55	55	55.0	165	0.0040928
25	Fixing in positing of **high strength structural bolts (Material as per Sl No. S25 of SCH-4 SUPPLY)** for structural steel work at all level etc. complete.	Quintal	50	50	50.0	150	0.00112623
26	Preparing detailed fabrication drawings and after approval by the Engineer, providing, fabricating and erecting, at all levels, **structural steel flues (liners)** complete with all bends, flanges, stiffeners, all other flue attachments, support system, collars, access manholes and gas sampling ports alongwith gaskets and other accessories, staying system, including the cost of all labour, material and equipment, transporting, lifting to all heights, setting in place, cutting, grinding, drillings, bending, bolts and bolting, welding, preheating and post-heating for welding, testing, etc. complete as per drawings and specifications. [Structural steel shall be issued by BHEL free of cost] . **The Flue can to be transported inside the concrete shell horizontally during erection activity . All necessary arrangement for horizontal movement of flue liner shall be in the scope of contractor .**	MT	360	360	360.0	1080	0.05720134
26 (i)	Supply & application including blast cleaning of outer surface of steel flue liner 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.	SqM	2800	2800	2800.0	8400	0.05152806
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	2800	2800	2800.0	8400	0.02979623
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	2800	2800	2800.0	8400	0.02874523
A26	Application of suitable epoxy primer including grit/shot blasting of inner flue surface(Sa 2 ½ finish) , to fully cover the substrate material over all heights of chimney including cost of labour, material, tools & tackles etc. all complete as per drawings, specification, manufacturer's recommendation and engineer in charge. (Epoxy Primer shall be supplied by BHEL free of cost. Onsite supervision of borosilicate glass block lining work shall be provided by BHEL Free of Cost through the Borosilicate Glass Block Lining System supplier.)	SqM	2800	2800	2800.0	8400	0.05432597

VOLUME-III
PRICE SCHEDULE, REV-00

JOB: CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

TENDER NO PSER:SCT:NKP-C2005:20

SCHEDULE - 3 : SERVICE

ITEM SL NO.	Description of Item	Unit	Quantity (Unit 1)	Quantity (Unit 2)	Quantity (Unit 3)	Total Quantity	Weightage
C26	Installing borosilicate glass block lining over all heights of chimney by attaching it to inside surface of cleaned MS flue can, external exposed surface and internal surface of minishell, using suitable adhesive / membrane material under controlled temperature and humidity conditions mentioned in specification, including cost of skilled labour, material, tools & tackles, equipment required to create controlled temperature & humidity conditions inside chimney during installation, under the expert supervision by borosilicate glass manufacturer during installation, mixing of two components adhesive membrane by automated mixing machines etc. all complete. Nominal adhesive/ mebrane thickness shall be minimum 3 mm behind & between each block. A 1.5 mm thick layer should be troweled onto the liner as well as to the sides and back of each block before installation. Double buttering technique shall be used to ensure full bond of each block to the liner and to each other.Cost of application of adhesive/membrane is included in this item and shall not be paid separately. Installation of blocks shall be carried out as per specification, drawings, direction of engineer in charge and accepted by the customer. The surface properties of the installed lining system allow, without any significant re-entrainment of flue gas condensate, a flue velocity of atleast 18.3 m/s, contractor shall get the required surface properties of the lining system approved from customer. Contractor shall get installation procedure approved by BHEL/NTPC before installation including verification of installation procedure & workmanship standards of the lining system. (Borosilicate Glass Blocks, Adhesive / membrane material and mixing machine shall be provided by BHEL free of cost. Onsite supervision of borosilicate glass block lining work shall be provided by BHEL Free of Cost through the Borosilicate Glass Block Lining System supplier.)	SqM	2800	2800	2800.0	8400	0.04843621
26F	Fabricating and erecting C276 strips, plates, gutters / vanes / pipes, bends, fittings and any other appurtenances as required **(Material as per Sl No. S26F of SCH-4 SUPPLY)** 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).	Kg	1800	1800	1800.0	5400	0.00327758
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	9	9.0	27	0.00425795
b	32 / 40 mm nominal bore medium class **tubular hand railing** for stair case and internal and external platforms.	MT	13	13	13.0	39	0.00635837
c	Providing minimum 275 gsm **Hot dipped galvanisation** on mild steel parts as per specification.	MT	11	11	11.0	33	0.00186044
d	Providing minimum 610 gsm **Hot dipped galvanisation** on mild steel parts as per specification.	MT	11	11	11.0	33	0.00232555
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	80	80	80.0	240	0.00067342
30AA	Fabricating and erecting above roof level 2mm thick titanium sheet (**Material as per Sl S30AA of SCH-4 SUPPLY**) wrapped over chimney mini-shell (as described in item no. 30AAA and insulation over it) external surface, including weldables/consumables, equipment, material, acid resistant 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.	MT	2.00	2.00	2.00	6	0.00238258
30AAA	Preparing detailed fabrication drawings after approval by the Engineer, providing, fabricating and erecting, Mini Shell above roof level made of solid titanium plate((**Material as per Sl S30AAA of SCH-4 SUPPLY**) including all stiffeners, accessories, cover at top fixing arrangement, nut, bolts, washers, screws etc , weldables/consumables, equipment, material, surface finishing, sealing, testing for quality , etc. all complete as per drawing and specifications.	MT	12.00	12.00	12.00	36	0.01429549
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 316L **and lead sheets** 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	120	120.0	360	0.05932232
b	**Lead** Sheets.	KG	40	40	40.0	120	0.00008865
32	Preparing detailed fabrication drawings and after approval by the Engineer and as per actual site condition to withstand the wet flue gas, providing, fabricating and installing **expansion compensator joints** including bolster in the flue liner including all labour, material and equipment transporting, hoisting, fixing in position, drilling, cutting, bolts and bolting, etc. along with the user handbooks (giving details of installation, dismantling and maintainance procedures for the expansion joints), testing, approval form BHEL/NTPC etc complete as per drawings and specifications.	Sqm	40	40	40.0	120	0.00436676
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	0.5	0.5	2	0.00140558
42	Supplying and installing ready mix castable refractory **concrete at opening** of chimney shell baffle wall and at other locations including all necessary arrangement for keeping them in position as per drawings and approval of Engineer.	Cum	5	5	5.0	15	0.00063475
43	Providing, laying and packing, at all levels, **asbestos ropes** at expansion joints including the cost of all labour material, etc. complete as per drawing and specifications.						
b	**12 mm (diameter)** at expansion joints between linig segments.	Rm	320	320	320.0	960	0.00026715
47	Providing and installing, at all levels, **resin bonded rock wool insulation** slabs of density not less than 100 kg/cu.m with an installed thickness of not less than 100 mm, on the outside surface of steel flue liners,on the outside surface of brick liner, on the inside surface of concrete windshield, inside surface of concrete minishells, under the cast iron caps and wherever as directed by the Engineer, in two layers (each 50 mm thick) including the cost of all labour, material and equipment, transporting, lifting to all heights, etc., inclusive of plated or galvanised accessories such as pins/studs/anchors/wire netting, speed washers, tying wires, etc. welding of pins/studs to steel surfaces or embedding of pins/studs/anchors in concrete surfaces, fixing, cutting, cutting, lapping, binding, testing, etc. complete as per drawings and specifications.	Sqm	300	300	300.0	900	0.00168608
49	Providing and packing, at all levels, **loose rock wool insulation** to a density not less than 100 kg/cu.m between the insulated minishells and brick liners at expanjoints between the lining segments and wherever as directed by the Engneer including the cost of all labour, material and equipment, filling, ramming, testing, etc. complete as per drawings and specifications.	Cum	10	10	10.0	30	0.00049354

VOLUME-III
PRICE SCHEDULE, REV-00

JOB: CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

TENDER NO PSER:SCT:NKP-C2005:20

SCHEDULE - 3 : SERVICE

ITEM SL NO.	Description of Item	Unit	Quantity (Unit 1)	Quantity (Unit 2)	Quantity (Unit 3)	Total Quantity	Weightage
50	Providing and painting, at all levels, inside surface of chimney shell, inside and outside surfaces of minishells, underside of roof slab and other concrete components/surfaces of the chimney as indicated in the drawings and wherever as directed by the Engineer, with **acid and heat resisting black bituminous paint** (conforming to type I(i) of IS:158) in as many number of coats (not less than four coats in any case) as required to give a paint DFT of not less than 150 microns including the cost of all labour, materials, equipment, surface preparation, primer and finish painting, protecting, cleaning etc. complete as per drawings and specifications.	Sqm	500	500	500.0	1500	0.00063493
51	Providing and painting, at all levels, inside surface of chimney shell, inside and outside surfaces of minishells, underside of roof slab and other concrete components/surfaces of the chimney as indicated in the drawings and wherever as directed by the Engineer, with **epoxy phenolic coating system having total 220 microns DFT** including the cost of all labour, materials, equipment, surface preparation, primer and finish painting, protecting, cleaning etc. complete as per drawings and specifications.	Sqm	500	500	500.0	1500	0.00044952
55	Providing and painting, at all levels, the external surfaces of chimney shell and wherever as directed by the Engineer, with **aliphatic acrylate system having total 170 microns DFT** including the cost of all labours, material and & equipment,surface preparation, primer and finish painting, and consisting of : i) Two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 100 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free. ii)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 24 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, protecting, cleaning etc. complete as per drawings and specification.	Sqm	500	500	500.0	1500	0.00073069
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	10	10	10.0	30	0.00002027
57	Providing and painting, at all levels, the external surfaces of chimney shell and wherever as directed by the Engineer, with **epoxy phenolic coating having total 220 microns DFT in alternate bands of 'signal red' and 'bright white' colours** including the cost of all labours, material and & equipment surface preparation, primer and finish painting, protecting, cleaning etc. complete as per drawings and specification. 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 Employer.	Sqm	10000	10000	10000.0	30000	0.00899037
58	Providing and painting, at all levels, the inside surface of chimney shell above roof, horizontal surface of sheel at top, underside of concrete roof slab, external surface of minishell above roof and wherever as directed by the Engineer, with **epoxy phenolic coating having total 220 microns DFT** including the cost of all labours, material and & equipment surface preparation, primer and finish painting, protecting, cleaning etc. complete as per drawings and specification. 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 Employer.	Sqm	400	400	400.0	1200	0.00035961
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	200	200	200.0	600	0.00346551
60	Providing, fitting& **fixing, outlet and overflow, cast iron roof drain heads (with gratin**gs) 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	8	8.0	24	0.00032081
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	32	32.0	96	0.00039348
b	150 mm nominal bore **medium class galvanised mild steel pipes**.	Rm	300	300	300.0	900	0.00319351

JOB: CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

TENDER NO PSER:SCT:NKP-C2005:20

SCHEDULE - 3 : SERVICE

ITEM SL NO.	Description of Item	Unit	Quantity (Unit 1)	Quantity (Unit 2)	Quantity (Unit 3)	Total Quantity	Weightage
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	472	472	472.0	1416	0.00115098
63	Providing and installing an **electrically operated 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 65 sqare 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	1	1	3	0.00191225
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	1	1	3	0.00008084
65	Supply, fabricating and fixing of **cleanout door** of size 650X825 mm. The door should be solid steel construction with inner plate 8mm and outer plate 6mm with suitable infill of stiffners, & filled with insulation mateterial and all other fittings, fixtures, fasteners including the cost of painting etc complete as per drawings and specification. The door should be hinged type and providing with locking device in addition to swivel studs with wing nuts on remaining 3 edges. The should be openable both from inside & outside and removable insulation to be provided around door opening. The door shall be provided with a minimum two coats of acid & alkali resistant paint confirming to IS158 type-I to give a DFT of 75microns. The outside surface shall be provided with minimum 2 coats of Zinc redoxide primer and two coats of synthetic enamil paint.	Each	1	1	1	3	0.00007486
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	1	1.0	3	0.0001337
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	1	1.0	3	0.00093102
69	Designing, supplying, fabricating and installing after approval by the Engineer, **non-metalic expansion joints** to seal gaps between chimney components and to meet the service requirements of wet stack and as given in the specifications alongwith the cost of all components of the expansion joint, insulation, galvanised bolts, nuts, washers, anchor fasteners and retaining bars, packing materials and reinforcements at the connecting ends and flanges, lapping etc. including cost of all labour and equipment, user hand books (giving details of installation, dismantling and maintenance procedures for the expansion joints) etc. complete as per drawings and specifications for:						
a	Expansion joint **between ducts and liners**.	Sqm	50	50	50.0	150	0.00381797
b	Expansion joint **between duct and chimney shell**.	Sqm	50	50	50.0	150	0.00381797
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	1	1	1.0	3	0.00014843
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	1	1	1.0	3	0.0000536
72	Erecting after Supply as per Sl No. **S72** of SCH-4 SUPPLY, of **Elevator** from ground upto top of chimney with landing at various platform level complete as per spec. and drawings.	Lumpsum	1	1	1.0	3	0.00483929
73	Fabricating and erecting FRP Pipes (Material as per Sl No. S73 of SCH-4 SUPPLY) 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	488	488	488.0	1464	0.00014559
PART 1B (E1 TO E29)	**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	1	1	3	0.00004004
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	1	1	3	0.00004004
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	2	2	6	0.0000218
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	2	2	6	0.0000218
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	1	1	3	0.0000109
E6	Aviation obstruction lights (mounted on door panel openable from interior) :						
	a. High intensity flashing white light Type-A as per ICAO standard 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 photocell. shall be provided with all accessories, photocell, timer etc.	no.	16	16	16	48	0.00013739

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SCHEDULE - 3 : SERVICE

ITEM SL NO.	Description of Item	Unit	Quantity (Unit 1)	Quantity (Unit 2)	Quantity (Unit 3)	Total Quantity	Weightage
	b. Temporary obstruction light located at diametrically opposite points at the top of chimney during period of construction with four fixture each .	no.	4	4	4	12	0.00022474
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	1	1	3	0.00000934
E8	Flood light type 120W(approx) LED luminaire with fitting (integrated /retrofitted LED lamp) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W.	no.	6	6	6	18	0.00023311
E9	Well glass type 30W(approx) LED luminaire with fitting (integrated /retrofitted LED lamp) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W.	no.	64	64	64	192	0.00066046
E10	Well glass type 70W(approx) LED luminaire with fitting (integrated /retrofitted LED lamp) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W.	no.	35	35	35	105	0.00025581
E11	Well glass type 50W(approx) LED luminaire with fitting (integrated /retrofitted LED lamp) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W.	no.	20	20	20	60	0.00016993
E12	63Amp welding switch socket with plug & other Mounting accessories	no.	9	9	9	27	0.00003644

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JOB: CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

TENDER NO PSER:SCT:NKP-C2005:20

SCHEDULE - 3 : SERVICE

ITEM SL NO.	Description of Item	Unit	Quantity (Unit 1)	Quantity (Unit 2)	Quantity (Unit 3)	Total Quantity	Weightage
E13	3 pin, 1 ph, 240V, 20Amp. Industrial Power sockets complete with plug Switches etc.	no.	9	9	9	27	0.00001702
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 x95mm^2 Al for connection between ACDB/ELDB/ welding sockets	Mtrs.	1500	1500	1500	4500	0.00063403
b	3½ Cx35mm^2 Al for Lighting panel incoming supply	Mtrs.	1000	1000	1000	3000	0.00026696
c	4C x16mm^2 Al for connection between ALP/ADB/Aviation Lights	Mtrs.	250	250	250	750	0.00006118
d	4C x 2.5mm^2 Cu Control cable for Aviation lighting system	Mtrs.	500	500	500	1500	0.00009875
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 mm^2	Mtrs.	2000	2000	2000	6000	0.00016506
b	4.0 mm^2	Mtrs.	5000	5000	5000	15000	0.00053139
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	2000	2000	6000	0.00100542
E17	PVC coated Flexible steel conduit 25mm dia with accessories	Mtrs.	100	100	100	300	0.00000889
E18	Lightning protection Air terminal : Lead coated copper material of 20 mm dia & 3 metre long.	no.	6	6	6	18	0.00013036
E19	50x6 Lead Coated GI Strip for coronal band on flue and top platform	Mtrs.	100	100	100	300	0.00005537
E20	Electrical equipment earthing materials including down conductors 50x6 GI Strip	Mtrs.	700	700	700	2100	0.00034196
E21	Electrical equipment earthing materials including down conductors 25x3 GI Strip	Mtrs.	700	700	700	2100	0.00011392
E22	8 SWG GI wire for equipment earthing	Mtrs.	2000	2000	2000	6000	0.00004449
E23	Test links for 50x6 down conductors enclosed in 200mm X 200mm X 100mm GI box of 16SWG sheet steel..	no.	6	6	6	18	0.00006513
E24	40mm dia MS rod for earthing of down conductor (BHEL will provide Earthing Rod free of cost)	Mtrs.	200	200	200	600	0.00021713
E25	Earthpit with earthing electrode including brick chamber with cover, accessories etc. complete in all respect..	no.	6	6	6	18	0.0000996
E26	Telephone socket with junction box etc. complete.	no.	6	6	6	18	0.00003341
E27	Telephone handsets complete.	no.	6	6	6	18	0.00003226
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	300	300	900	0.00011563
	b) 2 pairs	Mtrs.	100	100	100	300	0.00000924
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	600 mm wide	Mtrs.	200	200	200	600	0.00022247
b	300 mm wide	Mtrs.	200	200	200	600	0.00014238
c	150 mm wide	Mtrs.	400	400	400	1200	0.00026696
	Miscellaneous Works						
M1	**BORE WELL**						
M1.1	Boring/drilling bore well of required dia for casing/strainer pipe, by suitable method prescribed in IS:2800 (Part I), including collecting samples from different strata, preparing and submitting strata chart/bore log, including hire & running charges of all equipments, tools, plants & machineries required for the job, all equipments, tools, plants & machinaries required for the job, all complete as per direction of Engineer-in-charge, Upto 90 metre depth below ground level. All types of soil						

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JOB: CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

TENDER NO PSER:SCT:NKP-C2005:20

SCHEDULE - 3 : SERVICE

ITEM SL NO.	Description of Item	Unit	Quantity (Unit 1)	Quantity (Unit 2)	Quantity (Unit 3)	Total Quantity	Weightage
	300 mm dia	metre	450			450	0.00025032
M1.2	Boring/drilling bore well of required dia for casing/strainer pipe, by suitable method prescribed in IS:2800 (Part I), including collecting samples from different strata, preparing and submitting strata chart/bore log, including hire & running charges of all equipments, tools, plants & machineries required for the job, all equipments, tools, plants & machinaries required for the job, all complete as per direction of Engineer-in-charge, beyond 90 metre & upto 150 metre depth below ground level. All types of soil						
	300 mm dia	metre	300			300	0.00019469
M1.3	Labour for boring through any type of soil for sinking tubewell of required dia. With top enlargement by rig boring system (either by reverse circulation or by direct rotary method) including hire charges and labour for Rig Machine tools and plants, staging force pumping set, and making arrangement for water required for boring etc. complete and lowering of casing pipes , strainers blind pipes etc. complete for 300 mm dia . Depth of boring to be decided at the time of execution.						
	Beyond 150 (Hundred Fifty) From Ground Level (In case good water strata is not available upto 150 M Depth.)	metre	875			875	0.00077055
M1.4	Supplying assembling lowering and fixing in vertical position in bore well, upvc midium bell casing of required dia confirming to IS 12818 including required higher and labour charges fitting and nessesary etc all complete for all depths as per direction of engineer incharge						
	200 mm dia Nominal bore GI pipe	metre	550			550	0.00063666
M1.5	Providing and fixing to filter / submersible pump and lowering to proper levels 40 mm G.I. pipe for tube well including cleaning and priming the tube well	Mtrs.	1500			1500	0.0007068
M1.6	Supply, installation, commissioning of 5 HP KSB make or equivalent submersible pump motor set having capacity of discharging minimum 4 LPS of clear water at a total head as per site requirement or maximum 300 mtr depth . Pump shall be connected with 40 mm dia GI column pipes of length as per site requirement as directed by BHEL . Supply , assembling, lowering and fixing in vertical position in bore well including required fixing and labour charges etc. of 40 mm column pipe shall be paid in separet item. Depths of lowering of pump will be as per direction of Engineer- in-charge.	SET	5			5	0.00027573
M1.7	Supplying , delivery and installation of Shakti 3-phase DOL Submersible Pump Starter (with Auto Swich-3 positon selection, with SPP), Overload Relay Range 6.0(A) - 9.0(A) of make BCH or equivalent to be installed for bore well.	SET	5			5	0.00016544
M1.8	Supplying & laying 10 Sq. m 1.1 Kv grade 3.5 core PVC armoured ALUMINIUM cable on wall by means of saddles from ICTPN switch to busbars to MCCB, NCCB to starter including all end termination and interconnections etc. complete.	Mtrs.	1500			1500	0.00024816
M1.9	Providing and fixing M.S. clamp of required dia to the top of casing/housing pipe of tubewell as IS:2800 (part I), including necesarry bolts & nuts of required size complete.						
	200 mm clamp	Nos.	5			5	0.00000918
M2	Deployment of Tools & Plants like Poclain, dumper etc. at nearby Coal Mines (around 10-15 km distance), liaising with concerned authority / owner, loading of the coal rejected boulders, transporting to the work place at North Karanpura site including incidental charges, if any, laying the boulders at designated location(s) as per instruction of BHEL engineer, deployment of dozer/poclain for spreading the boulders in required thickness, breaking the boulders in small sizes to fill up the interstitial voids and compacting with 8-10 Ton capacity roller so as to provide even finished surface. (Rate to be quoted excluding taxes. GST, as applicable will be paid extra on submission of requsite documents)	cum	5000			5000	0.00344291
	TOTAL						**0.84516118**

JOB: CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

TENDER NO PSER:SCT:NKP-C2005:20

SCHEDULE - 4 : SUPPLY

ITEM SL NO.	Description of Item	Unit	Quantity (Unit 1)	Quantity (Unit 2)	Quantity (Unit 3)	Total Quantity	Weightage
S25	Supplying **high strength structural bolts** (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. up to and inclusive of 39 mm diameter and upto 300 mm long 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	50	50	50	150	0.00262789
S26F	Supplying C276 strips, plates, gutters / vanes / pipes, bends, fittings and any other appurtenances as required 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 for payment shall be done for net weight of C276 strip only after erection (weld thickness not to be considered). (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	1800	1800	1800	5400	0.01311017
S30AA	Supplying 2mm thick titanium sheet (Grade 2 as per ASME B265) to be wrapped over chimney mini-shell (as described in item no. 30AAA and insulation over it) external surface 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).	MT	2.00	2.00	2.00	6	0.00953033
S30AAA	Supplying solid titanium (grade 2 as per ASME SB265) plate of minimum 10mm thk required for fabrication and erection of Mini Shell 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. 30AAA of SCHEDULE-3 admitted in final bill).	MT	12.00	12.00	12.00	36	0.05718195
S33	Supplying, Fabricated Ready to Install, **spare expansion compensators** alongwith bolster including the cost of all labour, material and equipment, accessories, transporting, proper packaging (for several years of storage), and delivery to site store complete in all respects as per drawings and specification. (Final measurement of total qty of this item shall be shall be restricted to total quantity of Item no. 33 of SCHEDULE-3 admitted in final bill).	Sqm	30	30	30	90	0.00284324
S72	Design, engineering and supply after approval by Engineer for an **Elevator** from ground upto top of chimney with landing at various platform level complete as per spec. and drawings.	Lumpsum	1	1	1	3	0.02277028
S73	Supplying 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 moulding, testing, guarantee / warranty etc. complete as per drawings, specification, manufacturer's recommendations and relevant codes. (Final measurement of total qty of this item shall be shall be restricted to total quantity of Item no. 73 of SCHEDULE-3 admitted in final bill).	Kg	488	488	488	1464	0.00058238
	ELECTRICAL WORKS (Design, Engineering and Supply of following items as per specification)						0
SE1	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	1	1	3	0.00191397
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	1	1	3	0.00193653
SE3	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	2	2	6	0.0005503
SE4	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	2	2	6	0.00064496
SE5	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	1	1	3	0.00043393
SE6	Aviation obstruction lights (mounted on door panel openable from interior) :						
	a. High intensity flashing white light Type-A as per ICAO standard 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 photocell. shall be provided with all accessories, photocell, timer etc.	no.	16	16	16	48	0.02333214
	b. Temporary obstruction light located at diametrically opposite points at the top of chimney during period of construction with four fixture each .	no.	4	4	4	12	0.0005244

VOLUME-III
PRICE SCHEDULE, REV-00

JOB: CONSTRUCTION OF 3 NOS. 150 METER HIGH REINFORCED CONCRETE SINGLE STEEL FLUE CHIMNEY WITH BOROSILICATE GLASS BLOCK LINING SYSTEM ON MS FLUE CAN AND OTHER INCIDENTALS COMPLETE INCLUDING RAFT FOUNDATION FOR FGD SYSTEM OF 3 X 660 MW NORTH KARANPURA STPP, JHARKHAND.

TENDER NO PSER:SCT:NKP-C2005:20

SCHEDULE - 4 : SUPPLY

ITEM SL NO.	Description of Item	Unit	Quantity (Unit 1)	Quantity (Unit 2)	Quantity (Unit 3)	Total Quantity	Weightage
SE7	Aviation Distribution Board (ADB) with one 32A SFU (TPN) incomer and 8 nos. SP 20A MCB. Construction is same as Lighting Panel.	no.	1	1	1	3	0.00010591
SE8	Flood light type 120W(approx) LED luminaire with fitting (integrated /retrofitted LED lamp) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W.	no.	6	6	6	18	0.00026219
SE9	Well glass type 30W(approx) LED luminaire with fitting (integrated /retrofitted LED lamp) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W.	no.	64	64	64	192	0.00109326
SE10	Well glass type 70W(approx) LED luminaire with fitting (integrated /retrofitted LED lamp) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W.	no.	35	35	35	105	0.001015
SE11	Well glass type 50W(approx) LED luminaire with fitting (integrated /retrofitted LED lamp) having an integral driver.The luminaire efficacy shall not be less than 80 Lm/W.	no.	20	20	20	60	0.00055418
SE12	63 Amp welding switch socket with plug & other Mounting accessories	no.	9	9	9	27	0.00046995
SE13	3 pin, 1 ph, 240V, 20Amp. Industrial Power sockets complete with plug Switches etc.	no.	9	9	9	27	0.00009933
SE14	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 x 95mm^2 Al for connection between ACDB/ELDB/ welding sockets	Mtrs.	1500	1500	1500	4500	0.00316532
b	3½ C x 35mm^2 Al for Lighting panel incoming supply	Mtrs.	1000	1000	1000	3000	0.00104656
c	4C x 16mm^2 Al for connection between ALP/ADB/Aviation Lights	Mtrs.	250	250	250	750	0.00040523
d	4C x 2.5mm^2 Cu Control cable for Aviation lighting system	Mtrs.	500	500	500	1500	0.00023041
SE15	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 mm^2	Mtrs.	2000	2000	2000	6000	0.00038513
b	4.0 mm^2	Mtrs.	5000	5000	5000	15000	0.00123992
SE16	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	2000	2000	6000	0.00234599
SE17	PVC coated Flexible steel conduit 25mm dia with accessories	Mtrs.	100	100	100	300	0.00002074
SE18	Lightning protection Air terminal : Lead coated copper material of 20 mm dia & 3 metre long.	no.	6	6	6	18	0.00030418
SE19	50x6 Lead Coated GI Strip for coronal band on flue and top platform	Mtrs.	100	100	100	300	0.00012919
SE20	Electrical equipment earthing materials including down conductors 50x6 GI Strip	Mtrs.	700	700	700	2100	0.00079792
SE21	Electrical equipment earthing materials including down conductors 25x3 GI Strip	Mtrs.	700	700	700	2100	0.00026581
SE22	8 SWG GI wire for equipment earthing	Mtrs.	2000	2000	2000	6000	0.00011426
SE23	Test links for 50x6 down conductors enclosed in 200mm X 200mm X 100mm GI box of 16 SWG sheet steel.	no.	6	6	6	18	0.00015197
SE25	Earthpit with earthing electrode including brick chamber with cover, accessories etc. complete in all respect.	no.	6	6	6	18	0.00023239
SE26	Telephone socket with junction box etc. complete	no.	6	6	6	18	0.00007796
SE27	Telephone handsets complete	no.	6	6	6	18	0.00007527
SE28	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	300	300	900	0.0002698
	b) 2 pairs	Mtrs.	100	100	100	300	0.00002155
SE29	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	600 mm wide	Mtrs.	200	200	200	600	0.00062365
b	300 mm wide	Mtrs.	200	200	200	600	0.00049505
c	150 mm wide	Mtrs.	400	400	400	1200	0.00085823
	TOTAL						**0.15483882**