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

Ref: PSER:SITE:KLN-C2019:19 Date: 28-11-2019

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 hard copy mode, 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:SITE:KLN-C2019:19	
ii	Broad Scope of job	*Package#10E:CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.*	
iii	DETAILS OF TENDER DOCUMENT		
a	Volume-IA	*General conditions of contract (Supply)*	*Not Applicable.*
b	Volume-IB	*General conditions of contract (Service)*	***Applicable.***
c	Volume-IC	*Special conditions of contract (Supply)*	*Not Applicable.*
d	Volume-ID	*Special conditions of contract (Service)*	***Applicable.***
e	Volume-IE	*Forms and Procedures etc.*	***Applicable.***
f	Volume-IF	*Technical Conditions of Contract (TCC) (CML, TS, DRG, FQP)*	***Applicable.***
g	Volume-III	*Price Schedule (Absolute value) – Rev-00*	***Applicable.***
iv	ISSUE OF TENDER DOCUMENTS	*1. Sale from BHEL PSER MAITREE SITE office:* *Start: 28-11-2019* *Close: 05-12-2019* *2. From BHEL website (www.bhel.com & CPP Portal)* *Tender documents can be downloaded from above website till due date of submission.*	***Applicable.***
v	DUE DATE & TIME OF OFFER SUBMISSION	*Date: 05-12-2019, Time: 15-00 Hrs. BANGLADESH STANDARD TIME (BST)* ***The bidder may respond by submitting their offer through hard copy mode. Offers are invited in two-parts only.***	*Applicable.*
vi	OPENING OF TENDER	*1 hours after the latest due date and time of Offer submission* *Notes:* *(1) In case the due date of opening of tender becomes a non-working day, tenders shall be opened on next working day at the same time.* *(2) Bidder may depute representative to witness the opening of tender.*	*Applicable.*

vii	EMD AMOUNT	*INR 31,07,504/- (or equivalent amount in USD/BDT/Other Foreign Currency as per currency matrix).*	*Applicable.*
viii	COST OF TENDER	*INR 10,000/- (or equivalent amount in USD/BDT/Other Foreign Currency as per currency matrix).*	*Applicable.*
ix	LAST DATE FOR SEEKING CLARIFICATION	*Date:02-12-2019* *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 and not in the newspapers. 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 signed and stamped (digitally signed & stamped in case of e mode of bidding) 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/Khulna, issuing the Tender, along with techno-commercial offer. Bidder may also choose to deposit the Tender document cost by cash at the Cash Office, on any working day; and in such case copy of Cash receipt is to be enclosed with the Techno Commercial offer. Sale of tender Documents shall not take place on National Holidays, holidays declared by Central or State Governments and BHEL PSER, at KOLKATA/ Khulna, Sundays and second/ last Saturdays.

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 at following address as detailed below:

- ADDRESS FOR TENDER/OFFER SUBMISSION: GENERAL MANAGER & CONSTRUCTION MANAGER- BHEL, 2X660 MW MAITREE SUPER THERMAL POWER PROJECT, PO-KALEKKHARBER, UNION-RAJNAGAR, UPAJILA-RAMPAL, DIST: BAGERHAT-9343, BANGLADESH.

- PART-I consisting of 'PART-I A (Techno Commercial Bid)' & 'PART-I B (EMD/COST of TENDER)' in two separate sealed and superscribed envelopes (ENVELOPE-I & ENVELOPE-II)

- PART-II (Price Bid) – in sealed and superscribed envelope (ENVELOPE-III)
  One set of tender documents shall be retained by the bidder for their reference

- Two additional copies of Techno-commercial bid, along with original shall be submitted.

The contents for ENVELOPES and the superscription for each sealed cover/Envelope are as given below. FOR HARD COPY SUBMISSION (All pages to be signed and stamped)

Sl no	Description	Remarks
	Part-I A	
	ENVELOPE – I superscribed as : PART-I (TECHNO COMMERCIAL BID) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION:	
	CONTAINING THE FOLLOWING:-	
i.	Covering letter/Offer forwarding letter of Tenderer.	
ii.	Duly filled-in `No Deviation Certificate' as per prescribed format to be placed after document under sl no (i) above. 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 placed after document under sl no (i) above. 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 indexed properly 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.	
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	
vii.	Notice inviting Tender (NIT)	
viii.	Volume – I F : Technical Conditions of Contract (TCC)	
ix.	Volume – I D : Special Conditions of Contract (SCC)-Service	

x.	Volume - I B : General Conditions of Contract (GCC)-Service	
xi.	Volume – I E : Forms & Procedures etc.	
xii.	Volume – III- (UNPRICED – without disclosing rates/price, but mentioning only 'QUOTED' or 'UNQUOTED' against each item.	
xiii.	Any other details preferred by bidder with proper indexing.	

	PART-I B	
	ENVELOPE – II superscribed as: PART-I (EMD &/or COST of TENDER) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF 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 consisting of the following shall be enclosed	
	ENVELOPE-III superscribed as: PART-II- (PRICE BID) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION:	
	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)	

	OUTER COVER	
	ENVELOPE-IV (MAIN ENVELOPE / OUTER ENVELOPE) superscribed as: TECHNO-COMMERCIAL BID, PRICE BID & EMD TENDER NO: NAME OF WORK: PROJECT: DUE DATE OF SUBMISSION:	
	CONTAINING THE FOLLOWING:	
i	o Envelopes I o Envelopes II o Envelopes III	

SPECIAL NOTE:

A) Your offer & documents submitted along with offer shall be 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 of offer.
C) All documents/ annexures submitted with the offer shall be properly annexed and placed in respective places of the offer as per enclosure list mentioned in the covering letter (or attached in the respective sections in case of submission of offer through BHEL's e-procurement site). BHEL shall not be responsible for any missing documents.

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

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

8.0 Assessment of Capacity of Bidders:

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

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

Total number of Packages in hand = Load (P)

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

II. PERFORMANCE: Here 'Monthly Performance' of the bidder for all the packages (under execution/ executed during the 'Period of Assessment' in all Power Sector Regions of BHEL) SIMILAR to the packages covered under the tendered scope, excepting packages not commenced shall be taken into consideration. The 'Period of Assessment' shall be 6 months preceding and including the cut off month. The cut off month for reckoning 'Period of Assessment' shall be the 3rd Month preceding the month corresponding to 'latest date of bid submission', in the following manner:
(Note: For example, if 'latest date of bid submission' is in Jan 2017, then the 'performance' shall be assessed for a 6 months' period up to and inclusive of Oct 2016 (i.e. from May 2016 to Oct 2016), for all the unit wise identified packages (refer Table I))

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

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

a) P_1, P_2, P_3, P_4, P_5 , …. P_N etc. be the packages (under execution/ executed during the 'Period of Assessment' in all Regions of BHEL) SIMILAR to the packages covered under the tendered

scope, excepting packages not commenced. Total number of similar packages for all Regions = P_T (i.e. $P_T = P_1 + P_2 + P_3 + P_4 + \ldots P_N$)

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

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

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

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

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

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

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

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

Sl. No.	Item Description	Details for all Regions							Total
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
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 ≤ 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, 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.

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) in hard bid 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-E – Guidelines/ rules for Bank Guarantee submission by Foreign vendor.

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

33.0 For sale & import transactions, Foreign Bidders are required to submit the following documents before raising first bill for payment –

a) Tax Residency Certificate.
b) Form 10F as attached to be signed by the vendor (To avail the benefit of DTAA).
c) A declaration from vendor stating he does not have a Business Connection or Permanent Establishment in India (if applicable).

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 Monitor (IEMs) on the present panel has been appointed by BHEL with the approval of CVC to oversee implementation of IP in BHEL.

Sl No.	IEM	Address	Phone & 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	ANISH KUMAR
Dept	SCT Dept, BHEL PSER, Kolkata
Address	DJ-9/1, Sector – II, Salt Lake, Kolkata – 700091
Phone	033- 23398235
Email	k.anish@bhel.in
FAX	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 The contractor shall, at all stages of work deploy skilled/ semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute/ Industrial Training Institute/ National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed/ certified by State/ Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled/ semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in-Charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 100 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding."

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

39.0 Order of Precedence

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

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

for BHARAT HEAVY ELECTRICALS LTD

DGM (ERN / MAITREE SITE)

Agency	Contact details	
	Name	JAMINDAR DOLEY
BHEL, PSER, MAITREE SITE, BANGLADESH	Address	General Manager & Construction Manager, 2x660 MW Maitree Super Thermal Power Project, PO-Kalekkharber, Union-Rajnagar, Upajila-Rampal, Dist: Bagerhat-9343, Bangladesh
	Phone no	9435725010, 00881730584536, 9491399723, 008801730719867
	FAX no	-
	E-mail	jamindar.doley@bhel.in , k.anish@bhel.in , uds@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-E – Guidelines/ rules for Bank Guarantee submission by Foreign vendor.
10. Annexure– CPP-GST/I.
11. Integrity Pact Agreement Format (Separate).
12. Form 10F (Separate).
13. Currency Matrix (Separate)
14. Other Tender documents as per this NIT.

ANNEXURE - 1

PRE QUALIFICATION CRITERIA

JOB	Package#10E:CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.
TENDER NO	PSER:SITE:KLN-C2019:19.

SL NO	CRITERIA
1.0	**FINANCIAL CRITERIA**
1.0 (a)	BIDDER SHOULD HAVE AVERAGE MINIMUM ANNUAL FINANCIAL TURNOVER OF **USD 0.65 MILLION OR EQUIVALENT AMOUNT*** DURING THE LAST 3 (THREE) YEARS, ENDING ON 31-03-2019 OR CORRESPONDING FINANCIAL YEAR FOLLOWED BY THE BIDDER AND HAVING POSITIVE NET WORTH AS ON LATEST AUDITED ACCOUNTS AS SUBMITTED FOR PARA 1(C).
(b)	BIDDER MUST HAVE EARNED PROFIT IN ANY ONE OF THE LAST THREE FINANCIAL YEARS ENDING ON 31-03-2019 OR CORRESPONDING FINANCIAL YEAR FOLLOWED BY THE BIDDER. AUDITED BALANCE SHEET AND PROFIT & LOSS ACCOUNT OF THE COMPANY FOR LAST 3 (THREE) FINANCIAL YEARS, ENDING ON 31-03-2019 OR CORRESPONDING FINANCIAL YEAR FOLLOWED BY THE BIDDER NEED TO BE SUBMITTED IN SUPPORT OF ABOVE.
(c)	IN CASE AUDITED BALANCE SHEET AND PROFIT AND LOSS ACCOUNT HAS NOT BEEN SUBMITTED FOR ALL THREE YEARS INDICATED ABOVE THEN THE APPLICABLE FINANCIAL AUDITED STATEMENTS SUBMITTED BY THE BIDDERS AGAINST THE REQUISITE THREE YEARS WILL BE AVERAGED FOR THREE YEARS.
(d)	IF FINANCIAL STATEMENTS ARE NOT REQUIRED TO BE AUDITED STATUTORILY, THEN INSTEAD OF AUDITED FINANCIAL STATEMENTS, FINANCIAL STATEMENTS ARE REQUIRED TO BE CERTIFIED BY CHARTERED ACCOUNTANT.
2.0	**TECHNICAL CRITERIA**
2.1	BIDDER SHOULD HAVE EXECUTED PILING OR CIVIL OR STRUCTURE OR 'CIVIL AND STRUCTURES' OR CHIMNEY OR COOLING TOWER WORKS DURING 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: RELEVANT DOCUMENT IN SUPPORT OF ABOVE SHALL BE SUBMITTED.
A	1 (SINGLE) WORK OF VALUE NOT LESS THAN **USD 1.73 MILLION OR EQUIVALENT AMOUNT***
	OR
B	2 (TWO) WORKS OF VALUE NOT LESS THAN **USD 1.08 MILLION OR EQUIVALENT AMOUNT*** EACH
	OR
C	3 (THREE) WORKS OF VALUE NOT LESS THAN **USD 0.87 MILLION OR EQUIVALENT AMOUNT*** EACH.
2.2	BIDDER SHOULD HAVE 'EXECUTED' THE FOLLOWING JOB DURING LAST 7 (SEVEN) YEARS, ENDING ON THE LATEST DUE DATE OF SUBMISSION OF OFFER. RELEVANT DOCUMENT IN SUPPORT OF ABOVE SHALL BE SUBMITTED.
2.2.1	AT LEAST **3870** CUM OF REINFORCED CEMENT CONCRETE COMPLETED WITHIN A PERIOD OF TWELVE CONSECUTIVE MONTHS IN ONE RUNNING/COMPLETED CONTRACT. **OR** AT LEAST **5810** CUM OF REINFORCED CEMENT CONCRETE COMPLETED WITHIN A PERIOD OF TWELVE CONSECUTIVE MONTHS IN CUMULATIVE OF TWO CONCURRENTLY RUNNING/COMPLETED CONTRACTS.
3.0	**GENERAL**
A	CONSORTIUM/JV BIDDING IS NOT ALLOWED.

B	IN CASE THE JOB IS UNDER EXECUTION/ ONGOING JOB, THE VALUE OF EXECUTED PORTION OF THE JOB SHALL AT LEAST CORRESPOND TO THE RESPECTIVE VALUES SPECIFIED ABOVE EVEN IF THE CONTRACT HAS NOT BEEN COMPLETED OR CLOSED.
C	THE VENDOR SHOULD HAVE ACHIEVED THE CRITERIA SPECIFIED IN THE PRE-QUALIFICATION CRITERIA, EVEN IF THE CONTRACT HAS NOT BEEN COMPLETED OR CLOSED.
D	BIDDER SHALL SUBMIT ABOVE PRE-QUALIFICATION CRITERIA FORMAT, DULY FILLED-IN, SPECIFYING RESPECTIVE ANNEXURE NUMBER AGAINST EACH CRITERIA AND FURNISH RELEVANT DOCUMENT IN THE RESPECTIVE ANNEXURES IN THEIR OFFER
E	AFTER SATISFACTORY FULFILLMENT OF ALL ABOVE CRITERIA, OFFER SHALL BE CONSIDERED FOR FURTHER EVALUATION & PARTICIPATION AS PER NIT & ALL OTHER TERMS OF TENDER, ALONG WITH ACCEPTANCE/ APPROVAL OF BIDDER BY CUSTOMER.
F	BIDDER HAS TO SUBMIT THE FOLLOWING DOCUMENTS ALONG WITH THE TECHNICAL BID: - i) FILLED UP SUB VENDOR QUESTIONNAIRE (ENCLOSED AS ANNEXURE “A”) ii) FILLED UP BHEL EVALUATION REPORT (ENCLOSED AS ANNEXURE “B”) iii) FILLED UP EXIM BANK UNDERTAKING AS PER ANNEXURE “C” iv) SOFT COPY OF THE FOLLOWING DOCUMENTS a) ORGANIZATION CHART OF PROPOSED WORKS b) ORGANIZATION CHART OF QA/QC DEPTT. (IF ANY) c) REFERENCE LIST d) ISO CERTIFICATE (IF ANY) e) QUALITY & HSE MANUAL (IF ANY) f) FINANCIAL DETAILS g) COMPANY BROCHURE h) ANY OTHER DOCUMENTS(IF ANY)
G	**EXISTING VENDOR/CONTRACTOR OF 10B** (CIVIL, STRUCTURAL & ARCHITECTURAL WORKS (EXCEPT PILE, PILECAP, PEDESTAL AND ASSOCIATED WORKS) FOR AUXILLARY BUILDINGS FOR 2X660 MW MAITREE RAMPAL PROJECT, BANGLADESH. **SHALL NOT BE CONSIDERED FOR PACKAGE 10E.**
H	EXISTING CONTRACTOR/SUPPLIER WILL INCLUDE: - 1) IN CASE EXISTING CONTRACTOR/SUPPLIER IS THE SOLE PROPRIETORSHIP FIRM, ANY SOLE PROPRIETORSHIP FIRM OWNED BY SAME SOLE PROPRIETOR. 2) IN CASE EXISTING CONTRACTOR/SUPPLIER IS THE PARTNERSHIP FIRM, ANY FIRM COMPRISING OF SAME PARTNERS/SOME OF THE SAME PARTNERS(BUT NOT INCLUDING ANY NEW PARTNER) OR SOLE PROPRIETORSHIP FIRM OWNED BY ANY PARTNER(S) AS A SOLE PROPRIETOR.
I	* EQUIVALENT AMOUNT MEANS THAT IT IS CONVERTED AT RATES AS ON THE DATE OF TENDER FLOATING (BANGLADESH BANK RATES - SELLING RATE).

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 specified in the Common QR should be in the last 7 years ending on the 'latest date of Bid Submission' of Tender irrespective of date of the start of work.
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,
General Manager & Construction Manager, 2x660 MW Maitree Super Thermal Power Project, PO-Kalekkharber, Union-Rajnagar, Upajila-Rampal, Dist: Bagerhat-9343, Bangladesh

Sub	No Deviation Certificate.	
Job	Package#10E:CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.	
Ref	1.0	Tender no PSER:SITE:KLN-C2019:19.
	2.0	BHEL's NIT, vide reference no PSER:SITE:KLN-C2019:19 Date: 28-11-2019.
	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	Package#10E:CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.
TENDER NO	PSER:SITE:KLN-C2019:19.

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	Undertaking regarding Bankruptcy Code Proceedings (IBC) by NCLT or under Liquidation / BIFR		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.

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

Annexure - A

Amendment to GCC/SCC

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

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

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

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

A = 80% of BHEL estimate

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

OR

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

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

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

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

The EMD may be accepted only in the following forms:

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

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

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

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

In addition to above, the EMD amount in excess of Rs. 2 Lakh may also be accepted in the form of Bank Guarantee from scheduled bank. The Bank Guarantee in such cases shall be valid for 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.

(b) 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.

(c) 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.

(d) 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.

(e) 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."

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

2.17 PRICE VARIATION COMPENSATION

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

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

SL NO	CATEGORY	BASE INDEX	PERCENTAGECOMPONENT('K')				
			CIVIL PACKAGES (See Note A/B/C)			MECHANICAL PACKAGES	Electrical, C&I Material Management/Handling and other labour oriented packages
			A	B	C		
i)	LABOUR (ALL CATEGORIES)	'MONTHLY ALL-INDIA AVERAGE CONSUMER PRICE INDEX NUMBERS FOR INDUSTRIAL WORKERS' published by Labour Bureau, Ministry of Labour and Employment, Government of India. (Website: labourbureau.nic.in)	40	25	30	65	80
ii)	HIGH SPEED DIESEL OIL	Name of Commodity: HSD 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 Cl or Civil+Mechanical or Mechanicai+Eiectrical and/or Cl}, the COMPONENT ('K') for various categories shall be as per respective packages as above.

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

2.17.3 #

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

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

Where

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(g) 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."

(h) 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.

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

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

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

Risk & Cost Amount against Balance Work:

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

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

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

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

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

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

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

i). Let the time period from scheduled date of start of work till termination of contract excluding the period of Hold (if any) not attributable to contractor = T1
ii) Let the value of executed work till the time of termination of contract= X
iii) Let the Total Executable Value of work for which inputs/fronts were made available to contractor and were

planned for execution till termination of contract = Y

iv) Delay in executed work attributable to contractor i.e. T2=[1-(X/Y)] x T1

v) LD shall be calculated in line with LD clause (clause 2.7.9) of the Contract for the delay attributable to contractor taking "X" as Contract Value and "T2" as period of delay attributable to contractor.

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

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

Following sequence shall be applicable for recoveries from contractor:

a) Dues available in the form of Bills payable to contractor, SD, BGs against the same contract.

b) Demand notice for deposit of balance recovery amount shall be sent to contractor, if funds are insufficient to effect complete recovery against dues indicated in (a) above.

c) If contractor fails to deposit the balance amount to be recovered within the period as prescribed in demand notice, following action shall be taken for balance recovery:

i) Dues payable to contractor against other contracts in the same Region shall be considered for recovery.

ii) If recovery cannot be made out of dues payable to the contractor as above, balance amount to be recovered, shall be informed to other Regions/Units for making recovery from the Unpaid Bills/Running Bills/SD/BGs/Final Bills of contractor.

iii) In-case recoveries are not possible with any of the above available options, Legal action shall be initiated for recovery against contractor.

(j) 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"

(k) 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."

(l) 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"

(m) 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 –E

Guidelines/ rules for Bank Guarantee submission by Foreign vendor

As per tender provision Bank Guarantees shall be furnished by the contractor from scheduled Banks/ Public Financial Institutions in line with the following guidelines/rules for acceptance of the BG:

I. *In case of Bank Guarantees submitted by the 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, 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)(List of BHEL's Consortium Bank is given below). It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor.*

b.2) *In case, Foreign Vendors intend to provide BG from Overseas Branch of our Consortium Bank, 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).*

b.4) *The BG should clearly specify that the demand or other document can be presented in electronic form.*

II. *Currency of BG shall be the currency indicated in the Letter of Intent (LOI).*

List of Consortium Banks					
	Nationalised Bank		Nationalised Bank		Foreign bank
1	Allahabad bank	13	State Bank of Hyderabad	21	CITI Bank N.A
2	Andhra bank	14	Syndicate Bank	22	Deutsche Bank AG
3	Bank of Baroda	15	State Bank of Travancore	23	The Hongkong and Shanghai Banking Corporation Limited
4	Canara Bank	16	UCO Bank	24	Standard Chartered Bank
5	Corporation bank	17	Union Bank of India	25	J P Morgan
6	Central bank	18	United Bank of India		Private bank
7	Indian Bank	19	Vijaya Bank	26	Axis Bank
8	Indian Oversea Bank			27	The Federal Bank Limited
9	Oriental bank of Commerce		Public Sector Banks	28	HDFC
10	Punjab National Bank	20	IDBI	29	Kotak Mahindra Bank
11	Punjab & Sindh Bank			30	ICICI
12	State Bank of India			31	Indusind Bank
				32	Yes Bank

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 IPC/ PC 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 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.

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 Bidder(s)/ Contractor(s) undertake(s) to obtain from all subcontractors a commitment consistent with this Integrity Pact and report Compliance to the Principal. This commitment shall be taken only from those sub-contractors whose contract value is more than 20 % of Bidder's/ Contractor's contract value with the Principal. The Bidder(s)/ Contractor(s) shall continue to remain responsible for any default by his Sub-contractor(s).

6.2 The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors.

6.3 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 /Sub-contractors

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.

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 As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or take corrective action, or heal the situation, or to take other relevant action. The Monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.

8.6 The Monitor will submit a written report to the CMD, BHEL within 8 to 10 weeks from the date of reference or intimation to him by the Principal and, should the occasion arise, submit proposals for correcting problematic situations.

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

8.8 If the Monitor has reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant IPC / PC 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.

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

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

Section 9 – Pact Duration

9.1 This Pact begins and shall be binding on and from the submission of bid(s) by bidder(s). It expires for the Contractor 12 months after the last payment under the respective contract and for all other Bidders 6 months after the contract has been awarded.

9.2 If any claim is made / lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified as 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)_____

_____

ANNEXURE A

FICHTNER

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BHEL EVALUATION REPORT FOR SUB-VENDOR NO.

(Information marked with asterisk (*) is mandatory)

(APPLICABLE FOR SERVICE/ WORK CONTRACTS)

PACKAGE & PROJECT * :

EQUIPMENT / ITEM* :

CATEGORY (A, DR, N, acc. Vol I-B)* :

JUSTIFICATION (wrt EPC Contract)*:

GENERAL INFORMATION

1. **PROPOSED SUB-SUPPLIER'S NAME**

   WORKSHOP ADDRESS*

2. **CONTACT PERSON* :**

   TELEPHONE (LAND LINE/MOB.) :

   FAX :

   E-MAIL* :

3. **BRIEF SPEC. OF EQUIPMENT * ITEM / MODEL / TYPE / RANGE / CAPACITY:**

4. **REFERENCE LIST (LIST OF PROJECTS THE EPC HAS PERFORMED TOGETHER WITH THE PROPOSED SUB-SUPPLIER FOR THE PROPOSED SERVICES/ WORKS)***

CUSTOMER/ LOCATION WITH ADDRESS AND CONTACT PERSON	Proposed Works / Services	DATE OF COMPLETION	NO. OF YRS. IN OPERATION	PERFORMANCE FEEDBACK

5. **COMPLIANCE WITH RESPECT TO TECHNICAL SPECIFICATION**

   BHEL CONFIRMS THAT THE PROPOSED SUB SUPPLIER IS IN COMPLIANCE WITH RESPECT TO CONTRACT TECHNICAL SPECIFICATION AND HAS UNDERGONE SUCCESSFUL INTERNAL APPROVAL PROCESS FOR THE PROPOSED SERVICE / WORK CONTRACT INCLUDING PROVENNESS REQUIREMENT.

6. **CONCLUSION**

   BHEL CONFIRMS THAT SUB-SUPPLIER FULFILLS ALL REQUIREMENTS AS REQUESTED BY MFS AND IS DEEMED AS CAPABLE FOR ENVISAGED TASK.

Name Designation Signature Date

ANNEXURE B

SUB-VENDOR QUESTIONNAIRE

FICHTNER

(Information marked with asterisk (*) is mandatory)

(APPLICABLE FOR SERVICE/ WORK CONTRACTS)

Name of the proposed SERVICES/ WORKS *

1. **Name of Proposed Sub-Vendor ***: _____

Website *: _____

2. **Address of Regd. Office ***: **Details of contact person ***:
Name_____
Mobile no._____
Desig._____
E-mail:

- **Country of Head Office ***
- **Field of activities ***

3. **Address of Works*** **Details of contact person:**
Name_____
Mobile no._____
Desig._____
E-mail:

4. **Branch / Liaison office in Dhaka*** **Details of contact person:**
Name_____
Mobile no._____
Desig._____
E-mail:

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5. **Annual Turnover * & Profit in past three years *:**

#	Annual Turnover in Mn USD	Profit After tax in Mn USD
2015-2016		
2014-2015		
2013-2014		

6. Present & Peak Manpower Handled Status*:

Division Status	Permanent Manpower			Peak Manpower		Remarks
	Graduate		Diploma	Number	Project	
	Technical	Non-Technical				

a) Enclose organization chart of the proposed works (Y / N)

b) Enclose Organization chart of QA / QC Deptt. (Y / N)

c) Enclose List of Qualified Welders with process etc. (Y / N)

d) Enclose List of Qualified NDT personnel with area (Y / N)

7. Approval/ Certificates by National/ International standards/ accredited agency applicable for the proposed services/ works

8. Furnish Experience list of the proposed services/ works *

9. Enclose End User's operational feedback certificate for the proposed services/ works *.

10. Enclose list of equipment & machinery specific to the proposed services/ works*.

This should include name of equipment, capacity, year of manufacturing & nos. etc.:

11. Enclose list of Site Infrastructure & Services Available *

11. Quality management*

11.1 General

11.1.1 Work Instruction for different processes available. (Y / N)
if yes, furnish list.

11.1.2 Records generated during inspection maintained & available for review? (Y / N)

11.1.3 Statistical quality control techniques used? (Y/N)
If yes please furnish details.

11.1.4 ISO certificate for the works available? (Y/ N)
If yes, enclose copy of the certificate.

11.1.5 Quality & HSE Manual for the works available (Y / N)
If yes, enclose copy of the manual.

11.2 Corrective action

11.2.1 Specifically confirm whether System for identifying & disposition of Non Conformity in the process / product is available (Y / N)

11.2.2 Specifically confirm whether System for Customer complains & their satisfactory disposal is available. (Y / N)

11.3 Documentation Control

11.3.1 Procedure available for documentation control (Y / N)

11.4 Control of Inspection, measuring & testing equipment.

11.4.1 Procedure for calibration of testing & measuring instrument available. (Y / N)

12. Certification of sub-vendor *

I CERTIFY THAT THE INFORMATION SUPPLIED HEREIN (INCLUDING ALL PAGES ATTACHED) IS CORRECT.

SEAL

M/S.

Name

SIGNATURE

DESIGNATION

MOBILE NO

EMAIL

PLACE

DATE

13. Certification by Main Supplier *:

ABOVE INFORMATION HAVE BEEN VERIFIED AND FOUND IN ORDER TO COMPLY WITH TECHNICAL SPECIFICATION AS PER EPC-CONTRACT.

SEAL

M/S.

Name

SIGNATURE

DESIGNATION

MOBILE NO

EMAIL

PLACE

DATE

NOTE:

1. COLUMN SHALL NOT BE LEFT UNFILLED. IN CASE OF NOT APPLICABLE / NOT AVAILABLE, THE SAME SHALL BE INDICTED IN THE PROVIDED SPACE.
2. IN CASE PROVIDED SPACE IS NOT ADEQUATE, INFORMATION SHALL BE PROVIDED AS AN ATTACHMENT.
3. PRODUCT CATALOGUE FOR THE PROPOSED EQUIPMENT / ITEM / PROCESS, IF AVAILABLE, SHALL BE ENCLOSED

ANNEXURE C

UNDERTAKING
(To be submitted in the company's letter head)

THIS UNDERTAKING ("Undertaking") executed at **(Location)** on this **(Date)** by:

1. (**Company Name**), registered office at _____,

IN FAVOUR OF

2. **Bharat Heavy Electricals Limited**, a company incorporated under the company Act, 1956 of India having its registered office at BHEL House, Siri Fort, New Delhi-110049 and Power Sector Eastern Region Office at DJ-9/1, Sector-II, Saltlake City, Kolkata-700091, India.

1. UNDERTAKING

1.1 We hereby confirm that we are not a black listed company/organization by EXIM Bank of India as on the latest due date of bid submission.

1.2 During scrutiny if it is found otherwise w.r.t. undertaking furnished above, BHEL shall have right to cancel our bid for further evaluation.

Signed & Delivered on behalf of

(Company Name):
Official Representative:-
Designation:-
Date:-

FORM NO. 10F

[See sub-rule (1) of rule 21AB]

Information to be provided under sub-section (5) of section 90 or sub-section (5) of section 90A of the Income-tax Act, 1961

I_____ *son/daughter of Shri. _____in the capacity of _____ (designation) do provide the following information, relevant to the previous year_____ *in my case/in the case of_____ for the purposes of sub-section (5) of * section 90/section 90A:-

Sl.No.	***Nature of information***	***Details#***
(*i*)	Status (individual; company, firm etc.) of the assessee	
(*ii*)	Permanent Account Number (PAN) of the assessee if allotted	
(*iii*)	Nationality (in the case of an individual) or Country or specified territory of incorporation or registration (in the case of others)	
(*iv*)	Assessee's tax identification number in the country or specified territory of residence and if there is no such number, then, a unique number on the basis of which the person is identified by the Government of the country or the specified territory of which the assessee claims to be a resident	
(*v*)	Period for which the residential status as mentioned in the certificate referred to in sub-section (4) of section 90 or sub-section (4) of section 90A is applicable	
(*vi*)	Address of the assessee in the country or territory outside India during the period for which the certificate, mentioned in (v) above, is applicable	

2. I have obtained a certificate referred to in sub-section (4) of section 90 of sub-section (4) of section 90A from the Government of_____(name of country or specified territory outside India).

Signature: _____

Name: _____

Address: _____

Permanent Account Number: _____

Verification

I_____ do hereby declare that to the best of my knowledge and belief what is stated above is correct complete and is truly stated.

Verified today the _____ day of_____

_____

Signature of the person providing the information

Place: _____

Notes:

1. *Delete whichever is not applicable.

2. #Write N.A. if the relevant information forms part of the certificate referred to in sub-section (4) of section 90 or sub-section (4) of section 90A.

Currency Matrix for Erection contract being executed in Bangladesh - in USD (Rev. 01 (11-04-2018)

Sl no	Nature	Mode	Currency	Place of Deposit/ Return	Exchange Rate On	Rate Published by	Payable
1	Cost of tender	DD/NEFT/RTGS	Indian Rupees (INR)	India			In INR
		DD/ Telegraphic Transfer	United States Dollars(USD)	India	Tender floating	SBI Card Rate	INR/USD [SBI Card Rate -- Bank TT Buying Rate]
		DD/ Telegraphic Transfer	Bangladesh Taka (BDT)	India/ Bangladesh	Tender floating	Bangladesh Bank	INR/BDT [Bangladesh Bank -- Bank Selling Rate]
		DD/ Telegraphic Transfer	Other Foreign Currency	India	Tender floating	SBI Card Rate	INR/ Other Foreign Currency [SBI Card Rate --Bank TT Buying Rate]
2	Financial Evaluation of Pre Qualification Criterion		Indian Rupees (INR)	India	Tender floating	SBI Card Rate	INR/USD [SBI Card Rate -- Bank TT Selling Rate]
			United States Dollars(USD)	India			In USD
			Bangladesh Taka (BDT)	India	Tender floating	Bangladesh Bank	BDT / USD [Bangladesh Bank - Bank Selling Rate]
			Other Foreign Currency	India	Tender floating	SBI Card Rate	Other Foreign Currency / INR [SBI Card Rate - Bank TT Buying Rate] --- INR / USD [SBI Card Rate - Bank TT Selling Rate]
3	EMD by Bidder [Upto INR 20 Lakhs--- Compulsory] [More than INR 20 Lakhs --- Optional]	DD/NEFT/RTGS	Indian Rupees (INR)	India			In INR
		DD/ Telegraphic Transfer	United States Dollars(USD)	India	Tender floating	SBI Card Rate	INR/USD [SBI Card Rate -- Bank TT Buying Rate]
		DD/ Telegraphic Transfer	Bangladesh Taka (BDT)	India/ Bangladesh	Tender floating	Bangladesh Bank	INR/BDT [Bangladesh Bank -- Bank Selling Rate]
		DD/ Telegraphic Transfer	Other Foreign Currency	India	Tender floating	SBI Card Rate	INR/ Other Foreign Currency [SBI Card Rate --Bank TT Buying Rate]
4	EMD by Bidder [More than INR 20 Lakhs - Optional]	Bank Guarantee from Scheduled Bank in India.	Indian Rupees (INR)	India			In INR
		Bank Guarantee from Scheduled Bank in India. In case of Bank Guarantee by Foreign Bank, the bank Gurantee should be counter Guranteeed / Confirmed by any Scheduled Bank in India	United States Dollars(USD)	India	Tender floating	SBI Card Rate	INR/USD [SBI Card Rate -- Bank TT Buying Rate]
			Bangladesh Taka (BDT)	India	Tender floating	Bangladesh Bank	INR/BDT [Bangladesh Bank Card Rate --Bank Selling Rate]
			Other Foreign Currency	India	Tender floating	SBI Card Rate	INR/ Other Foreign Currency [SBI Card Rate --Bank TT Buying Rate]
5	Offer by Bidder		**USD Compulsorily (If inadvertently the same is quoted in any other currency , it will be converted to USD at TT Buying rate of SBI as on latest date of Part-I Bid opening). In case of bank holiday , forex rate of previous SBI Working day.**				
6	Reverse Auction		**United States Dollars(USD)**				

Sl no	Nature	Mode	Currency	Place of Deposit/ Return	Exchange Rate On	Rate Published by	Payable
7	Price Bid Evaluation		**USD Compulsorily (If inadvertently the same is quoted in any other currency , it will be converted to USD at TT Buying rate of SBI as on latest date of Part-I Bid opening). In case of bank holiday , forex rate of previous SBI Working day.**				
8	Order by BHEL		**United States Dollars(USD) / Evaluated USD**				
9	Return of EMD to unsucessful Bidder [Net of Bank Charges]	DD/NEFT/RTGS	Indian Rupees (INR)	India			At the Actual amount received in INR
		DD/ Telegraphic Transfer	United States Dollars(USD)	India			At the Actual amount received in USD
		DD/ Telegraphic Transfer	Bangladesh Taka (BDT)	India			At the Actual amount received in BDT
		DD/ Telegraphic Transfer	Other Foreign Currency	India			At the Actual amount received in Other Foreign Currency
10	Conversion of EMD to SD for successful Bidder	Book Adjustment in BHEL	Indian Rupees (INR)	India	Tender floating	SBI Card Rate	INR/USD [SBI Card Rate -- Bank TT Selling Rate]
			United States Dollars(USD)	India			At Actual USD
			Bangladesh Taka (BDT)	India	Tender floating	Bangladesh Bank	BDT / USD [Bangladesh Bank - Bank Selling Rate]
			Other Foreign Currency	India	Tender floating	SBI Card Rate	Other Foreign Currency / INR [SBI Card Rate - Bank TT Buying Rate] --- INR / USD [SBI Card Rate - Bank TT Selling Rate]
11	Billing	By Sub-contractor (Hord Copy)	United States Dollars(USD)	Bangladesh			In USD
12	Payment against contract execution[Currency of the Contract USD]	Cheque/ EFT / SWIFT	United States Dollars(USD)	Bangladesh			In USD
			Bangladesh Taka (BDT) -- (At the discretion of BHEL only if payment in USD is not possible)	Bangladesh	Date of Payment	Buying Rate of Banker of BHEL	USD / BDT [BHEL's Bangladesh Banker's Buying Rate]
13	Balance SD	As per Tender (Deposit before start of work / Recovery from RA Bills)	United States Dollars(USD)-- (After adjusting 100% EMD converted to SD)	Bangladesh for Recovery from RA Bill /India in case of BG			In USD
14	Performance Bank Guarantee (where applicable)	Bank Guarantee from Scheduled Bank in India. Bank Guarantee from Scheduled Bank in India. In case of Bank Guarantee by Foreign Bank, the bank Gurantee should be counter Guranteeed / Confirmed by any Scheduled Bank in India	United States Dollars(USD)	India			In USD

TENDER NO: PSER:SITE:KLN-C2019:19

VOLUME -IB

GENERAL CONDITIONS OF CONTRACT

(SERVICE)

FOR

Package#10E: CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.

BHARAT HEAVY ELECTRICALS LIMITED

(A GOVT. OF INDIA UNDERTAKING)

General Manager & Construction Manager, 2x660 MW Maitree Super Thermal Power Project, PO-Kalekkharber, Union-Rajnagar, Upajila-Rampal, Dist: Bagerhat-9343, Bangladesh

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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:SITE:KLN-C2019:19

VOLUME -ID

SPECIAL CONDITIONS OF CONTRACT

FOR

Package#10E: CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.

BHARAT HEAVY ELECTRICALS LIMITED

(A GOVT. OF INDIA UNDERTAKING)

General Manager & Construction Manager, 2x660 MW Maitree Super Thermal Power Project, PO-Kalekkharber, Union-Rajnagar, Upajila-Rampal, Dist: Bagerhat-9343, Bangladesh

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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.

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

भारत हेवी इलेक्ट्रिकल्स लिमिटेड

(भारत सरकार का उपक्रम)

BHARAT HEAVY ELECTRICALS LIMITED

(A Govt. of India Undertaking)

HEALTH, SAFETY AND ENVIRONMENT PLAN FOR SUB-CONTRACTORS FOR 2X660MW MAITREE SUPER THERMAL POWER PROJECT

DOCUMENT NO; HSEP:14-MAITREE: VENDOR DATE:05.05.16

Pradip Ghosh

Digitally signed by Pradip Ghosh
DN: cn=Pradip Ghosh, o=BHEL, ou=HSE-PSER, email=pradipg@bhelpser.co.in, c=IN
Date: 2017.05.06 13:31:44 +05'30'

HSE DEPARTMENT
Plot No. 9/1, Block-DJ,Sector-II, Salt Lake, Kolkata – 700 091
Phone no. 033-23398049, Web : www.jantermanter.com

SPECIAL NOTES

- **This document supersedes section-IX of SCC or any such HSE related document in the tender**

- This document is a living document and subject to changes as many times as desired by BHEL and customer, BIFCL and project consultant Fichtner GmbH. Any cost implication shall be absorbed by the contractor.
- This project is a highly eco-sensitive project. There will be regular assessment of impact of the site activities on ecology. The contractors shall be obligated to take corrective actions, if any, as advised by BHEL/ Customer/ any Statutory body.
- The contractor shall ensure that only persons with required competence and sound health are engaged at the site. No deviation shall be allowed. The person and the contractor shall be in possession of relevant documents in support of competence and health condition for producing before BHEL for verification, whenever demanded.
- It may take minimum 2 days for finishing health check-up and induction training before a gate-pass/ ID is issued. In a day, maximum 30 persons can be given induction training. Mobilization shall be planned accordingly
- Method statement and Job Safety Analysis shall be carried out for all hazardous jobs and critical lifts
- As the site is located in an area which is prone to adverse weather condition, the contractors shall have infrastructure for fast evacuation of people
- Contractor for Boiler-1, Chimney-1 and Cooling Tower-1 shall provide one double-mounted siren at a height covering a dia of about 2KM for alerting site workers in case of emergency.
- The following basic instruments shall be available with contractors HSE team if their job involves:
  - Height work: Binoculars
  - Confined space work: Oxy-meter
  - Night work: Lux meter, Torch light
  - Checking of ELCBs: ELCB tester
  - Checking of earthing: Megger

  Apart from these, DB meter, Alcohol Breath analyzer, and other HSE promotional items shall be made available by the contractors as and when demanded by BHEL.

- Well-equipped sick room shall be set up and ambulance shall be made available by specific contractors as provided for in the work order of certain packages. However, the operational expenses can be shared by those contractors who will avail services of these facilities.

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1.0 PURPOSE

1.1 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.

1.2 This document shall be followed by BHEL's subcontractors at all installation and servicing sites. In case customer specific documents are to be implemented, this document will be followed in conjunction with customer specific documents.

1.3 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 or EHSS contract requirements must be followed of which the most stringent shall apply

1.4 In case the customer has any specific requirement, the same is to be fulfilled.

1.5 We will promote and maintain a safe, healthy and environmentally compliant workplace for all employees, contractors, visitors and any others that may be affected by construction activities, and strive for a "GOAL of ZERO REPORTABLE INCIDENTS" on the project.

2.0 SCOPE

The document is applicable for installation and commissioning of 2x660MW SETS as per the relevant contractual obligations, and provides the minimum HSE requirements to be followed at the project site and labour colony. As an item of note, this HSE Plan is considered a living document and will be revised as/if necessary to ensure that contractual and regulatory compliance requirements are met during the performance of work on the project

3.0 OBJECTIVES

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

- Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
- Ensure protection of environment of the work site.
- Comply at all times with the relevant statutory and contractual HSE requirements.
- Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.
- Provide all personnel with adequate information, instruction, training and supervision.
- 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.
- Ensure that all work planning takes into account all persons that may be affected by the work.
- Ensure fitness testing of all T&Ps/Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent authority.
- Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
- Ensure continual improvements in HSE performance
- Ensure conservation of resources and reduction of wastage.

- 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 and preventive action.

3.1 Goals and Targets -

- To achieve “Zero Fatal Incident at Site”
- 100% compliance of all legal/statutory requirements related to EHS.
- 100% Health, Safety and Environmental Induction training attendance for all employees and sub-contractors.
- 100% High Risk activities to be carried out only after approved Method Satement, HIRA/JSA and Permit to Work are implemented.
- 100% PPEs compliance in high & medium risk activities.
- 100% incident reporting, recording and reviewing for corrective & preventive actions.
- A monthly review shall be scheduled and conducted to assess HSE program compliance and to close any recognized gaps to improve safety management and incident prevention.

4.0 BHEL POWER SECTORHEALTH, SAFETY & ENVIRONMENT POLICY

Power Sector HSE Policy

We, at BHEL Power Sector, reaffirm our belief that the Health and Safety of our stakeholders and conservation of Environment is of utmost importance and takes precedence in all our business decisions. In pursuit of this belief and commitment, we strive to:

- ✓ **Ensure total compliance with applicable legislation, regulations and other requirements concerning Occupational Health, Safety and Environment.**
- ✓ **Ensure continual improvement in the Occupational Health, Safety and Environment Management System performance.**
- ✓ **Enhance Occupational Health, Safety and Environment awareness amongst employees, customers and suppliers by proactive communication and training.**
- ✓ **Review periodically and improve Occupational Health, Safety and Environment Management System to ensure its continuing suitability, adequacy and effectiveness in a continuously changing business environment.**
- ✓ **Develop a culture of safety through active leadership and provide appropriate training at all levels to enable employees to fulfill their Health, Safety and Environmental obligations.**
- ✓ **Incorporate appropriate Occupational Health, Safety and Environmental criteria into business decisions for selection of plant, technology and services as well as appointment of key personnel.**
- ✓ **Ensure availability at all times of appropriate resources to fully implement the Occupational Health, Safety and Environmental policy of the company.**

This policy will be communicated to all employees and made available to interested parties.

Sd/-

Director (Power)

5.0 TERMS AND DEFINITIONS

5.1 DEFINITIONS

5.1.1 INCIDENT

Work- related event(s) in which an injury or ill health (regardless of severity) or fatality occurred, or could have occurred.

5.1.2 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".

5.1.3 MAN-HOUR 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 labours. 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.

5.1.4 FIRST AID CASES

First Aid includes:

- Visit to a physician or a licensed health care professional solely for observation or counselling
- 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)
- 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};
- Administering tetanus immunizations (other immunizations, such as Hepatitis B vaccine or rabies vaccine, are considered medical treatment);
- Cleaning, flushing or soaking wounds on the surface of the skin;
- Using wound coverings such as bandages, Band-Aids TM, gauze pads, etc.;or using butterfly bandages or Steri-StripsTM (other wound closing devices such as sutures, staples, etc., are considered medical treatment);
- Using hot or cold therapy;
- 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);
- Using temporary immobilization devices while transporting an accident victim (e.g., splints, slings, neck collars, back boards, etc.).
- Drilling of a fingernail or toenail to relieve pressure, or draining fluid from a blister;
- Using eye patches;
- Removing foreign bodies from the eye using only irrigation or a cotton swab;
- Removing splinters or foreign material from areas other than the eye by irrigation, tweezers, cotton swabs or other simple means;
- Using finger guards;

- Using massages (physical therapy or chiropractic treatment are considered medical treatment for recordkeeping purposes); or
- Drinking fluids for relief of heat stress.

No other treatments are considered first aid.

5.1.5 **INJURY OTHER THAN FIRST-AID: (As per Chapter VII, Rule 69 of Bangladesh Labour Rules, 2015)**

Notice to be given of any accident. When any accident occurs in an establishment causing loss of life or bodily injury, or an accidental explosion, ignition, outbreak of fire or irruption of water or fumes occurs, the employer shall give notice of the occurrence to the Inspector within following 3 (three) working days [:]
Provided that the factory authority shall, immediately after the occurrence of such incident, inform the matter to the Government, Fire Service, Directorate of Inspection of Factories and Establishments, Police Station, and if required, the nearby hospital or government-private medical service establishment, through telephone, mobile phone, SMS or fax, in order to take immediate necessary action to minimize potential damages or bring the situation under control.]

Fatal incident and Serious Incident:
If the victim dies in the incident, it will be treated as a fatal incident.
In this case the injured person is likely to be disable for more than 20 days to perform his duty, it will be treated as Serious Incident. In these cases, the intimation will be made as described above.

Minor Incident: (As per Chapter VII , Rule 70 of Bangladesh Labour Rules, 2015)
Where an accident mentioned above causes bodily injury resulting the compulsory absence from work of the person injured for a period exceeding 48 (forty-eight) hours, but not exceeding 20days. The management will inform the concerned statutory authority within 7 days in form-27 under rule 69/1/(A), (B) and (C) of Bangladesh Labour Rules, 2015.

6.0 HSE ORGANISATION

Number of HSE officers:

The subcontractor must deploy one HSE officer for every 500 workers or part thereof in each package. If there are more than one HSE officer, one shall be designated as head/HSE. No Of HSE stewards shall be one for every 100 workers deployed

Deployment: The subcontractor should deploy sufficient HSE officers and HSE-steward/supervisor, as per requirement given above, since initial stage and add more in proportion to the added strength in work force. Any delay in deployment of HSE Officer will attract a penalty of BNR.40,000/- per man month for the delayed period.

6.1 QUALIFICATION FOR HSE PERSONNEL

Sl.no	Designation	Minimum Qualification	Experience
1	Safety officer (Construction Agency)	Degree or Diploma in Engineering with diploma in Industrial Safety with construction safety as one of the subjects. If Degree/Diploma in safety is from India, it must be recognized by AICTE/SCTE&VT. NEBOSH IGC /IOSH diploma also acceptable	Minimum two years for degree holder and five years for diploma holder in the field of Construction of power plant/ major industries

6.2 RESPONSIBILITIES

6.2.1 **SITE IN -CHARGE OF SUBCONTRACTOR**

- Shall engage qualified safety officer(s) as per clause 6.1
- Shall adhere to the rules and regulations mentioned in this code, practice very strictly in his area of work in consultation with his concerned engineer and the safety coordinator.
- Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
- Shall not engage any employee below 18 years.
- 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.
- Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent authorities.
- Shall ensure that provisions stipulated in contract Labour Regulation Act 1970, Chapter V C.9, canteen, rest rooms/washing facilities to contracted employees at site.
- Shall adhere to the instructions laid down in Operation Control Procedures (OCPs) available with the site management.
- Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
- Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /HSE officer of BHEL.
- Shall ensure that Horseplay is strictly forbidden.
- Shall ensure that adequate illumination is arranged during night work.
- Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
- Shall ensure display of adequate signage/posters on HSE.
- Shall ensure that mobile phone is not used by workers while working.
- Shall ensure conductance of HSE audit, mock drill, medical camps, induction training and training on HSE at site.
- Shall ensure full co-operation during HQ/External /Customer HSE audits.
- Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- Shall ensure good housekeeping.
- Shall ensure adequate valid fire extinguishers are provided at the work site.
- Shall ensure availability of sufficient number of toilets /restrooms and adequate drinking water at work site and labour colony.
- Shall ensure adequate emergency preparedness.
- Shall be member of site HSE committee and attend all meetings of the committee

6.2.2 **HEALTH, SAFETY AND ENVIRONMENT OFFICER OF SUBCONTRACTOR**

- Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
- Facilitate inclusion of safety elements into Work Method Statement.
- Highlight the requirements of safety through Tool-box / other meetings.
- Help concerned HOS to prepare Job Specific instructions for critical jobs.
- Conduct investigation of all incident/dangerous occurrences & recommend appropriate safety measures.
- Advice & co-ordinate for implementation of HSE permit systems, OCPs & MPs.
- Convene HSE meeting & minute the proceeding for circulation & follow-up action.
- Plan procurement of PPE & Safety devices and inspect their healthiness.
- Report to PS Region/HQ on all matters pertaining to status of safety and promotional program at site level.
- Facilitate administration of First Aid
- Facilitate screening of workmen and safety induction.
- Conduct fire Drill and facilitate emergency preparedness
- Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
- Apprise PS– Region on safety related problems.
- Notify site personnel non-conformance to safety norms observed during site visits / site inspections.
- 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.
- To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.
- Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
- Shall work as interface between various agencies such customer, package-in-charges, subcontractors on HSE matters

7.0 PLANNING BY SUBCONTRACTOR

7.1 MOBILISATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR

- As a 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 complies with legislative and owner requirement. A documented daily prior to use inspection checklist shall be completed by the end user and periodic inspection shall be arranged by in-house competent authority for acceptance as applicable. All Tools & Plants shall be certified by a third party COMPETENT person before these are put to use as per Rule 60, 75 and schedule 3 of Bangladesh Labor Rules. As far as possible, this certification shall be made available to site HSE function by the contractor before entry into the site. The certification shall be renewed annually, otherwise, the item shall be withdrawn from the work area. The fitness of T&Ps shall be monitored by site HSE quarterly and alert/ reminder issued to the concerned agency and BHEL package in-charge.

- The machinery and equipment to be embraced for this purpose shall include but not limited to the following:

    - Mobile cranes.

- Side Booms.
- Grinding machine.
- Drilling machine.
- Air compressors.
- Welding machine.
- Generator sets.
- Dump Trucks.
- Excavators.
- Dozers
- Grit Blasting Equipment.
- Hand and power tools.

- Subcontractor 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 subcontractor 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.

7.2 MOBILISATION OF MANPOWER BY SUBCONTRACTOR

- 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-contractors to fulfill contractual as well as legislative requirement.
- Examination of medical fitness shall be conducted through qualified medical professional for all workers to be deployed (pre-employment). Post-employment medical check-up shall be done for persons engaged in hazardous jobs at a regular interval as per legislations.
- 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.
- Appropriate accommodation to be arranged for all workmen in hygienic condition.

7.3 PROVISION OF PPEs

- Personnel Protective Equipment (PPEs), in adequate numbers, will be made available at site & their regular use by all concerned will be ensured. PPE details shall be maintained as per Form-23
- The following matrix recommends usage of minimum PPEs against the respective job.

Sl. No	Type of work	PPEs
1	Concrete and asphalt mixing	Nose mask, hand glove, apron and gum boot
2	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
3	Stone/ concrete breakers	Ear muffs, safety goggles, hand gloves
4	Electrical Work	Rubber hand glove, Electrical Resistance shoes,Apron
5	Insulation Work	Respiratory mask, Hand gloves, safety goggles
6	Work at height	Double lanyard full body harness, Fall arrestor (specific cases)
7	Grit/Sand blasting	Blast suit, blast helmet, respirator, leather gloves

8	Painting	Plastic gloves, Respirators (particularly for spray painting)
9	Radiography	As per BARC guidelines

The PPEs and other related safety equipments shall conform to the relevant indian or equivalent Europeon or American standards as below:

BS EN 397-2012	Industrial Safety Helmets.
BS EN 60903:2003	Insulating material gloves for electrical purposes.
BS EN 374-3: 2003	Protective Gloves- Chemical Penetration
BS EN 388:2003	Protective Gloves- Mechanical Risks
BS EN 407: 2004	Protective Gloves- heat and fire
BS EN 420:2003	Gloves- general requirement
BS EN-20345	Industrial safety footwear
BS EN 166:2002	Eye protectors.
BS EN 352-1 & 2:2002	Ear Muff & Ear Plug
BS EN 175:1997	Eye & Face protection during welding
BS EN 361:2002	Fall Arrest Full Body Harness
BS EN 360:2002	Retractable type fall arresters
BS EN 795:2012	Lifeline System
BS EN 358;1999	Work Resistant Harness
BS EN 813:2008	Seat harness
BS EN 1498+ others	Rescue Harness+ other items of a rescue kit
BS EN 353:2002	Detachable fall arrester
BS EN 149: 2001	Filtering Half masks tp protect against particles
BS EN 471:2003	High Visibility Clothing

The list is not exhaustive. The safety officer may demand additional PPEs based on specific requirement.

- 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
- . The visitors shall also use Reflective Vests, Helmet and any other PPEs as deemed appropriate for the area of work.

Colour scheme for Helmets:

1. Workmen: Yellow
2. Safety staff: Green or white with green band
3. Electrician: Red
4. Others including visitors: White

- All the PPEs shall be checked for its quality before issue and the same shall be periodically checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be repaired/ replaced.
- The issuing agency shall maintain register for issue and receipt of PPEs.
- The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.
- The body harnesses shall be serial numbered.

  In case, contractor fails to provide PPEs in time, BHEL/Customer may provide the same and the cost as deemed appropriate by BHEL/Customer shall be debited

7.4 ARRANGEMENT OF INFRASTRUCTURE

7.4.1 DRINKING WATER

- Adequate drinking water shall be provided and maintained at suitable places at different elevations.
- Chilled water shall be made available from 1st April to 30th Sep of the year
- Container should be labeled as " Drinking Water"
- Cleaning of the storage tank shall be ensured at least once in 1 month indicating date of cleaning and next due date. 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.
- Employees should use their own cup for collecting water-no cup shall be shared
- Potability of water should be tested as per standard at least once in every quarter as per Rule 50(5) of Bangladesh Labour Rules, 2015.
- Apart from above, those who are engaged in work producing significant heat , shall be served saline water or Sarbat at the rate of 2litres perday
- Storage of drinking water shall be min 6M away from any toilet and washroom

7.4.2 WASHING FACILITIES (As per Chapter VIII, Rule 86 of Bangladesh Labour Rules, 2015)

- In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
- 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.
- 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.
- If water used for washing is not potable, it shall be marked "Do Not Drink" in English and Bangla

7.4.3 LATRINES AND URINALS (As per Chapter V, Rule 51, Schedule II of Bangladesh Labour Rules, 2015)

- Latrines and urinals shall be provided in every work place based on strength of workmen at the rate of one toilet seat and one urinal for every 50 female workmen and that for every 60 male workmen
- Urinals shall also be provided at different elevations.
- They shall be adequately illuminated and shall be maintained in a clean and hygienic condition at all times, by appointing designated person.
- Separate facilities shall be provided for the use of male and female worker if any.
- Hand-wash facility shall be provided

7.4.4 **PROVISION OF SHELTER DURING REST**

Proper Shed & Shelter shall be provided for rest during break::

7.4.5 **MEDICAL FACILITIES (Sharing with other sub-contractors at site is permitted)**

7.4.5.1 **Sick Room (As per rule 77) (As stipulated in the contract)**

- A Sick room shall be ensured/identified at site with basic facilities as per subrule 77(5) for handling medical emergencies. The sick room can be run independently or jointly developed on proportionate sharing basis with permission from BHEL. It shall be equipped with one rigid stretcher, one foldable stretcher, one rescue basket stretcher, a wheel chair, at least 2 beds with separator and all basic facilities that a doctor needs for basic health check-up and quick referral including those listed in sub-rule 77(5) of Bangladesh Labour Rules,2015
- A qualified medical professional, not less than a Degree in Medical Science (Allopathy) as recognized in Bangladesh , shall be deployed at the sick room along with sufficient support staff
- Medical waste shall be disposed as per prevailing legislation
- Ambulance, **as stipulated in the contract**, shall be made available at the site along with a trained driver and shall be equipped with at least an Oxygen cylinder along with dispensation system, first-aid box, a portable ABC type fire extinguisher.

7.4.5.2 **FIRST AIDER**

- Must have a competence certificate in First-aid issued by Bangladesh Red Cross Society/ Bangladesh St Johns Ambulance/ any other agency which is recognised by the Govt of Bangladesh
- Ensure availability of one Qualified First-aider throughout the working hours for every 150 workmen engaged as per clause 89 of Bangladesh Labour Law
- Every injury shall be treated, recorded and reported.
- Refresher course on first aid shall be conducted as necessary.
- List of Qualified first aiders and their contact numbers should be displayed at conspicuous places.

7.4.5.3 **FIRST AID BOX (as per rule 76(2) of Bangladesh Labour Rules.2015))**

- The subcontractor shall provide necessary first aid facilities. At every work place first aid facilities shall be provided and maintained.

- The first aid box shall be kept by first aider who shall always be readily available during the working hours of the work place. His name and contact no to be displayed on the box.
- 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 first aid box shall be distinctly marked with a Green Cross on white background.

- Details of contents of first aid box is given in Annexure No. 01
- Monthly inspection of First Aid Box shall be carried out by the owner as per format no. HSEP:14-F01
- The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

7.4.5.4 **HEALTH CHECK UP**

The persons engaged at the site shall undergo mandatory health checkup from a qualified doctor as per the **format no. HSEP:13-F03 and Health Record 31-A** before induction. The persons engaged in the following works shall undergo health checkup at least once in a year:

a. Height workers
b. Drivers/crane operators/riggers
c. Confined space workers
d. Shot/sand blaster
e. Welding and Gas cutting personnel

7.4.6 **PROVISION OF CANTEEN FACILITY**

- Canteen facilities shall be provided for the workmen of the project inside the project site.
- Proper cleaning and hygienic condition shall be maintained.
- Proper care should be taken to prevent biological contamination.
- Adequate drinking water should be available at canteen.
- Fire extinguisher shall be provided inside canteen.
- Regular health check-up and medication to the canteen workers shall be ensured.

7.4.7 **PROVISION OF ACCOMODATION/LABOUR COLONY**

- The subcontractor shall arrange for the accommodation of workmen at nearby houses or by making a labour colony.
- Regular housekeeping of the labour colony shall be ensured.
- Proper sanitation and hygienic conditions shall be maintained and inspected once in a month.
- Adequate number of toilet facilities with water for workers as per norms to be provided. There must be separate toilet for women workers. Drinking water and electricity to be provided at the labour colony.
- Potable water shall be tested once in six months as per IS10500.
- MSDS of LPG shall be put up prominently. This shall be included in the induction training as well.
- The labour colony shall be appropriately secure so that only authorized persons have access to it.
- First aid facility shall be provided in the labour camp under the administration of trained first aiders.
- Common kitchen facilities to be ensured and cooking inside the room to be avoided. The canteen should be maintained in hygienic condition.
- No. of occupants in room rooms to be as per the standards practice.
- Awareness training shall be organized for the workers regarding fire safety, safe use of LPG, Health & Hygiene, and electrical safety etc. on monthly basis.
- Adequate drainage and approach roads to be done.
- Perimeter fencing, security and main gate entrance shall be established and maintained.
- Monthly inspection to be done to ensure the compliance and for opportunity of improvement.
- Workers shall not be transported in open vehicles i.e. trailers, truck beds etc within project boundaries which includes the labor colony.

7.4.8 **PROVISION OF EMERGENCY VEHICLE (in addition to Ambulance)**

Generally one vehicle (4 wheeler) is identified by each major package holder (sub-agency). Minor package holders are permitted to have a tie-up with major package holder

7.4.9 **PEST CONTROL**

Regular pest control should be carried out at all offices, mainly laboratories, canteen, labour colony and stores

7.4.10 GENERAL DISCIPLINE:

Workmen under influence of liquor or drug or any other intoxication shall not be permitted to work and sent out of the work area. Workmen shall not be permitted to smoke in work area. None shall be permitted to carry any arms or firearms. The workmen shall report to work on time and follow supervisor's instruction. Use of cell phone particularly in hazardous jobs shall be discouraged like height work, crane operation etc. Horseplay, willful violation of rules shall be dealt with suitable disciplinary action including suspension and termination. They shall be subjected to physical frisking or alcohol/drug test at random by security and security shall be authorized to take appropriate disciplinary action against any delinquent employee like throwing out of the gate for the day and so on. If any such employee returns to work, he shall be put through induction training once again.

7.4.11 **SCRAPYARD**

- In consultation with customer, scrap yard shall be developed to store metal scrap, wooden scrap, waste, hazardous waste.
- Scrap/Waste shall be segregated as Bio-degradable and non-bio-degradable and stored separately.

7.4.12 **ILLUMINATION (to be reviewed)**

- Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II) or as per Bangladesh standard. Some recommended values are given below:

S. No.	Location	Illumination (Lux)
A.	**Construction Area**	
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 rough measurements etc.	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

- Lamp (hand held) shall not be powered by mains supply but either by 24V or dry cells.
- Lamps shall be protected by suitable guards where necessary to prevent danger, in case of breakage of lamp.
- Emergency lighting provision for night work shall be made to minimise danger in case of main supply failure.

If the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions issued by the authorized BHEL official, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor

8.0 HSE TRAINING& AWARENESS (Trainer, venue and infrastructure shall be decided by site HSE team headed by BHEL site HSE head). Cost shall be borne by respective contractor alone or on sharing basis on case-to-case basis.

8.1 HSE INDUCTION TRAINING

All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL /subcontractor before being assigned to work.
In-house induction training subjects shall include but not limited to:

- Briefing of the Project details.
- Safety objectives and targets.
- Site HSE rules.
- Site HSE hazards and aspects.
- First aid facility.
- Emergency Contact No.
- Incident reporting.
- Fire prevention and emergency response.
- Rules to be followed in the labour colony (if applicable)
- 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.)
- They must arrive fully dressed in safety wear & gear to attend the induction.
- Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.
- On completing attending 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.

8.2 HSE TOOLBOX TALK

- HSE tool Box talk shall be conducted by frontline foreman/supervisor of subcontractor to specific work groups prior to the start of work. The agenda shall consist of the followings:
    - Details of the job being intended for immediate execution.
    - The relevant hazards and risks involved in executing the job and their control and mitigating measures.
    - Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
    - Recent non-compliances observed.
    - Appreciation of good work done by any person.
    - Any doubt clearing session at the end.
- Record of Tool box talk shall be maintained as per format no. HSEP:14-F04

- Tool box talk to be conducted at least once a week for the specific work.

8.2.1 **PRE JOB BRIEFING**

- A separate documented daily pre job briefing must be conducted at the actual job/work site location with the supervisor and work crew, to cover working environment/conditions, safe work practices for the activities to be carried out, required PPE and review of the work package, JSA and permit requirements. Each crew member and the supervisor will sign-off on the pre job briefing form, and form will be submitted to the HSE department at the end of each shift

8.3 **TRAINING ON HEIGHT WORK**

Training on height work (3m and above from ground) shall be imparted to all workers working at height by in-house/external faculty at least twice in a year. Fall protection training must involve as much hands-on activity with the equipment as possible. The training shall include following topics:

- Fall hazards associated with the elevated work.
- Elements of the fall protection systems utilized
- Requirement for 100% tie-off when working at or above 6' or 2m.
- Body Harnesses of at least a five-point configuration shall be used in all fall arrest systems. The harness Dee-ring shall have a minimum tensile strength of 5,000 pounds (22.2 kN).
- Fall protection equipment used. Use of PPEs – Harness proper fit, storage and compulsory tie-off of body harness to a firm support/life-line or anchorage point).
- Anchorage selection used for attachment of personal fall arrest systems shall be capable of supporting at least 5,000 pounds (22.2 kN) per employee attached, determined by a competent person.
- Use of fall arrester (shock abosbing lanyard), retractable fall arrester, life line, safety nets etc.
- Safe climbing through monkey ladders.
- Maintenance and Inspection of PPEs.(Daily/periodical)-color coding
- Medical fitness requirements.
- Mock drill on rescue at height.
- Dos & Don'ts during height work.For the workers & staff passed through the vertigo test, an additional sticker for height pass to be issued. This is applicable for those who are supposed to work or inspecting in BTG area, etc.

8.4 **HSE TRAINING DURING PROJECT EXECUTION**

- Other HSE training shall be arranged by BHEL/sub-contractor as per the need of the project execution and recommendation of HSE committee of site.
- The topics of the HSE training shall be as follows but not limited to:

  - Hazards identification and risk analysis (HIRA)
  - Work Permit System
  - Incident investigation and reporting
  - Fire fighting
  - First aid
  - T & Ps fitness and operation
  - Electrical safety
  - Welding, NDE & Radiological safety
  - Storage, preservation & material handling.

- A matrix shall be maintained to keep an up-to-date record of attendance of training sessions carried out.
- Skill labour (like fitter, electrician, rigger, scaffolder, carpenter etc.) will pass through the trade test (written and practical) conducted at site by the respective engineer & EHS officer. A pass sticker of qualified person to be marked on their ID Card/Gate Pass.

8.4.1 HSE Induction for Visitors: No visitors are allowed to visit the construction site without safety induction, mandatory PPEs, and designated escort.

8.4.2 Safety Induction for all (Staff/engineers/sub-Contractors officials/supervisors): It is compulsory to provide safety induction and briefing about the site HSE management systems, requirements and individual's roles & responsibility to carry out the activities is safe manner, before deploying them.

8.5 HSE PROMOTION-SIGNAGE, POSTERS, COMPETITION, AWARDS ETC

8.5.1 **Display of HSE posters and banners**

- Site shall arrange appropriate posters, banners, slogans in local/Hindi/English languages at work place

8.5.2 **Display of HSE signage as per Safety signages will be as per BS 5378 *safety signs & Colors* and BS 5499 graphical symbols & signs)**

- Appropriate HSE signage shall be displayed at the work area to aware workmen and passersby about the work going on and do's and don'ts to be followed

8.5.3 **Competition on HSE and award**

- Site will arrange different competition (slogan, poster, essay etc.) on HSE time to time (Safety day, BHEL day, World Environment Day etc.) and winners will be suitably awarded. Monthly Safety Day shall be celebrated every month preferably on a fixed date or day at the site jointly by all the contractors as a promotional measure on cost sharing basis

9.0 HSE COMMUNICATION

9.1 INCIDENT INVESTIGATION, REPORTING AND RECORDS:

Every incident including near-misses or injury of any kind and at any level of severity shall be immediately reported by the contractor's workmen in their work area to the safety officer/ HSE coordinator, site engineer or RCM. The site HSE co-ordinator shall be the nodal person for this purpose.

For any reportable injury to any employee or to the contractor's workmen, the safety officer/ HSE-coordinator shall report the incident in incident/ incident report, to CUSTOMER

In the case of serious injury requiring hospitalization or fatality, communication shall be made to customer through telecom immediately with submission of incident report within 24 hrs and detail investigation report may be forwarded in INCIDENT INVESTIGATION REPORT FORMAT within seven days.

Investigations into all reportable incidents shall be conducted using accepted Root Cause Analysis (RCA) methodology cause and effect, 5 why's, etc, to determine the Physical, Human and Latent Root Causes for these type accident/incidents. However, it is recommended to conduct preliminary investigations into all other incidents as a proactive measure.

Every contractor shall maintain record of incidents / incidents at site, and shall be available for inspection by representatives of statutory agencies / officials visiting site from BHEL/customer The Safety Officer/ HSE coordinator shall maintain these records.

26.1 Incident Investigation Procedure:

The purpose of the investigation procedure is to find out root cause of accidents / incidents & not to find out faults, so as to avoid recurrences, in future and share lessons learned.

RCM shall constitute a committee of at-least 2 site engineers within 24 hours of such incidents. The investigation shall aim at finding out the basic unsafe acts / conditions that have caused the incidents. Immediately after all appropriate emergency measures, first aid and damage containment measures have been taken, every effort shall be made by the committee to:

- Preserve physical evidence
- Take photographs
- Take statement from incident victim(s) and eyewitnesses and anyone who may have knowledge of possible cause(s) of incidents

The committee shall also recommend corrective measures to prevent recurrence of similar incidents

25.2 Initial Incident Response:

In the event of an accident/incident, the supervisor and employees at the work site must:

- Stop work and make the work area safe (mitigate or remove the exposure to the hazard)
- Provide first aid and activate "Emergency Medical Services" and other emergency services, e.g. fire or police, as required,
- Ensure the injured worker is transported to "Emergency Medical Services" for medical attention if necessary,
- Secure the site to ensure the protection of employees and the public and to aid with the investigation,
- Report the incident immediately to the local Site In-Charge.

26.3 **Incident Investigation Report:**

The investigation committee on completion of the all investigations shall prepare and submit the report to the RCM. The report shall also include corrective measures with assigned responsibility to be taken at site to prevent similar incidents in future. The RCM shall forward the copy of the investigation report to BHEL

9.2 HSE EVENT REPORTING

- Important HSE events like HSE training, Medical camp etc. organized at site shall be reported to BHEL site management in detail with photographs for publication in different in-house magazines
- Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported as mentioned above.

10.0 OPERATIONAL CONTROL

All applicable OCPs (Operational control procedures) will be followed by subcontractor 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 subcontractor will follow this as well, within quoted rate. These OCPs (applicable ones) will be made available to subcontractor 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 subcontractor, if they so desire.

LIST OF OCPs

Safe handling of chemicals	Safety in use of cranes	Hydraulic test
Electrical safety	Storage and handling of gas cylinders	Spray insulation
Energy conservation	Manual arc welding	Trial run of rotary equipment
Safe welding and gas cutting operation	Safe use of helmets	Stress relieving
Fire safety	Good house keeping	Material preservation
Safety in use of hand tools	Working at height	Cable laying/tray work
First aid	Safe excavation	Transformer charging
Food safety at canteen	Safe filling of hydrogen in cylinder	Electrical maintenance
Illumination	Vehicle maintenance	Safe handling of battery system
Handling and erection of heavy metals	Safe radiography	Computer operation
Safe acid cleaning	Waste disposal	Storage in open yard
Safe alkali boil out	Working at night	For sanitary maintenance
Safe oil flushing	Blasting	Batching
Steam blowing	DG set	Piling rig operation
Safe working in confined area	Handling & storage of mineral wool	Gas distribution test
Safe operation of passenger lift, material hoists & cages	Drilling, reaming and grinding(machining)	Cleaning of hot well / de-aerator
Electro-resistance heating	Compressor operation	O&M of control of AC plant & system
Air compressor	Passivation	Safe Loading of Unit
Safe EDTA Cleaning	Safe Chemical cleaning of Pre boiler system	Safe Boiler Light up
Safe Rolling and Synchronization		

10.1 HSE ACTIVITIES

While planning for any activity the following documents shall be referred for infrastructural requirements to establish control measures: Only specific portion of the following documents may be shared as reference at discretion of BHEL.

1) HSE Procedure for Register of OHS Hazards and Risks
2) HSE Procedure for Register of Environmental Aspects and Impacts
3) HSE Procedure for Register of Regulations
4) Operational Control Procedures
5) HSE Procedure for Emergency Preparedness and Response Plan
6) Contract documents

10.2 WORK PERMIT SYSTEM

- The following activities shall come under Work Permit System
- a The following activities shall come under Work Permit System
  a. Height working
  b. Hot work in general and at height including handling of hazardous substance viz, Acetylene, Oxygen and LPG
  c. Confined space

d. Radiography
e. Hazardous Energy Control (lockout/tagout)
f. Excavation and Trenching
g. Heavy lifting exceeding 50Metric Tonne
h. Handling of Hazardous Substances- Diesel, Caustic Soda, Citric Acid/EDTA, Thinner, Battery Acid, Oil-based paint, Lubricants, Transformer oil.
Refer Annexure 05 for Work permit formats.

- Permit applicant shall apply for general work permit and other permits as referenced above of particular work activity at particular location before starting of the work with Method Statement and HIRA/Job Hazard Analysis.
- Permit signatory shall check that all the control measures necessary for the activity are in place and issue the permit to the permit holder.
- Permit holder shall implement and maintain all control measures during the period of permit .He will close the permit after completion of the work. The closed permit shall be archived in HSE Department of site.

10.3 SAFETY DURING WORK EXECUTION

Respective OCPS are to be followed and adherence to the same would be contractually binding

10.3.1 Power supply & upkeep of installation -

- Only persons licensed to Govt of State shall maintain and operate power installations.
- All distribution boxes shall be locked and the key controlled by site management of concerned contractor.
- Electrical appliance shall have proper earthing and for appliances equal to & more than 415V shall have two separate earthing (as per IS-3043-1987)
- All electrical supply shall be provided through ELCB of 30mA sensitivity.
- The working condition and sensitivity of ELCB shall be checked periodically.
- All fuses and fuse wires shall be of standard size and rating.
- All power supplies through cables shall be underground or overhead with height > 3mtrs.

The following guidelines are to be considered the absolute minimum requirements to be supplemented by requirements of all applicable codes and standards for such work; 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.

- 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).

- Must be visually checked before each use and periodically while in use to assure their original integrity is maintained. Cords with cuts, breaks, deep abrasions, etc. shall be taken out of service immediately. Repairs to extension cords shall only be performed by qualified/ licensed electricians.

- Must not be allowed to lie in wet or potentially wet areas.

- 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. 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. Such precautions may include halting the operation if appropriate. 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.

- Any and all underground lines that are discovered or become severed must be considered energized on both sides, and be treated accordingly.
- In general, equipment or machinery being moved or transported must maintain minimum clearances of 25 ft to all power lines.
- 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
- 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.
- 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.
- Splices in electrical cords are not permitted. Reparirs must be made at the socket connection and retain the same mechanical and dielectric condition of the original connection.
- Damaged or defective electric tools, equipment and extension cords, etc must not be used and shall be tagged out of servive, removed from the work area and taken back to stores.
- Only licensed electricians are authorized to repair and work on electrical equipment. Tampering with electric tools or equipment by others could result in termination.
- 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.
- Energized wiring in junction boxes, circuit breaker panels and similar places must be covered and locked at all times.
- Areas with live high voltage wires or terminals must be barricaded against entry and warning signs posted Danger – High Voltage and Authorized Personnel Only.
- Personnel should never work on energized equipment, deenergizing (lockout/tagout) the equipment is always the first requirement.
- The lockout and tagout procedure will be used when testing or working on, or around, energized installation.
- Working around energized equipment should never be done alone. A second electrician must always be available for assistance.
- If lockout/tagout 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/aprins, faceshields, and other protective equipment like insulated tools, blankets, mats, etc. must be used.
- 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.
- 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.

10.3.2 **Qualified and Unqualified Workers (Electrical Works):**

Basic electrical safety knowledge is a major concern. It is critical that only qualified workers be allowed to perform this work. Therefore only those persons that are both qualified and authorized may install, fabricate, repair, test, calibrate or modify electrical or electronic wiring, devices, parts, systems or equipment.

Qualified Person:
One who is trained and wiremen licensed to Govt as per Rule 58(9) of Bangladesh Labor Rules and familiar with the construction, operation and safety hazards of the equipment upon which they are permitted to work.

- 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.
- 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:
    - Qualified persons must be capable of working safely on energized circuits;
    - Must be familiar with the proper use of special precautionary techniques and procdures bases on equipment and exposure; and
    - Must be familiar with required personal protective equipment, insulating and shielding materials, and insulated tools.
- 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.
- 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 no their limitation and stop work if not qualified on what equipment they were to work on.
- 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.

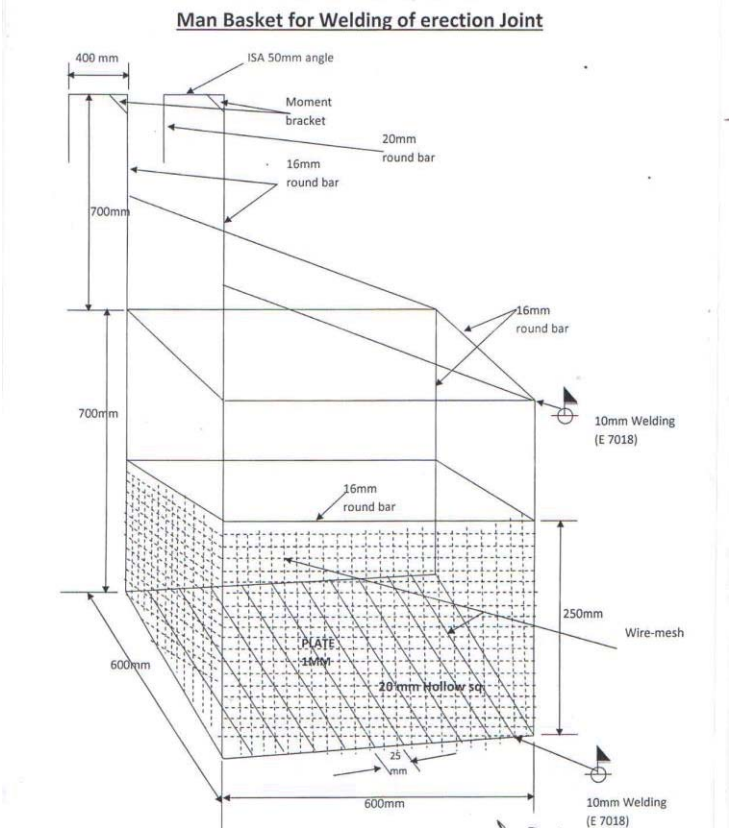
11.0 Lifting Operations:

All the cranes and lifting tools & tackles shall be inspected on daily basis and as well as formal monthly by expert and as per the law third party for annual certification. These shall be tested and certificates of fitness shall be obtained from 3rd party govt approved competent agency before deploying at site and later periodically (As per Rule 60 and 75, Schedule 3 of Bangladesh Labour Rules). 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 operators cabin of all the lifting equipment. The record shall be maintained in Form-24

The manufacturer's instruction for maintenance shall also be followed. All safety measures shall be followed. All tools tackles, lifting appliances; material-handling equipment etc used by the contractor shall be of safe design and construction. The operators, slingers and signalers shall be qualified as per IS 13367 (part-1):2003 "Safe use of cranes- code of practices". There shall be a person responsible for co-ordination

11.1 Personnel Lifts (Man-Basket): (To be treated as a T&P item)

A Personnel Man-Basket permit shall be completed prior to lifiting any people, along with a rigging plan. Man-basket shall be used where access through ladders or scaffolding is not feasible. 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. 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%. It shall have a door with double latches and shall open inside. Anchor points shall be identified within the man-basket. The man-basket shall be thoroughly inspected and load tested and a trial run perfomed without personnel before being put to job. It shall be treated as a lifting tool and shall undergo same certification cycle and inspection as other lifting equipments. An additional sling of required lifting capcity shall be fixed the the man-basket main lifting point and attached to the the crane above the ball or block.While lifting man-basket, the crane shall maintain a uniform speed of lift without any swing. 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. 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.



11.2 CRANES AND HOISTING EQUIPMENTS:

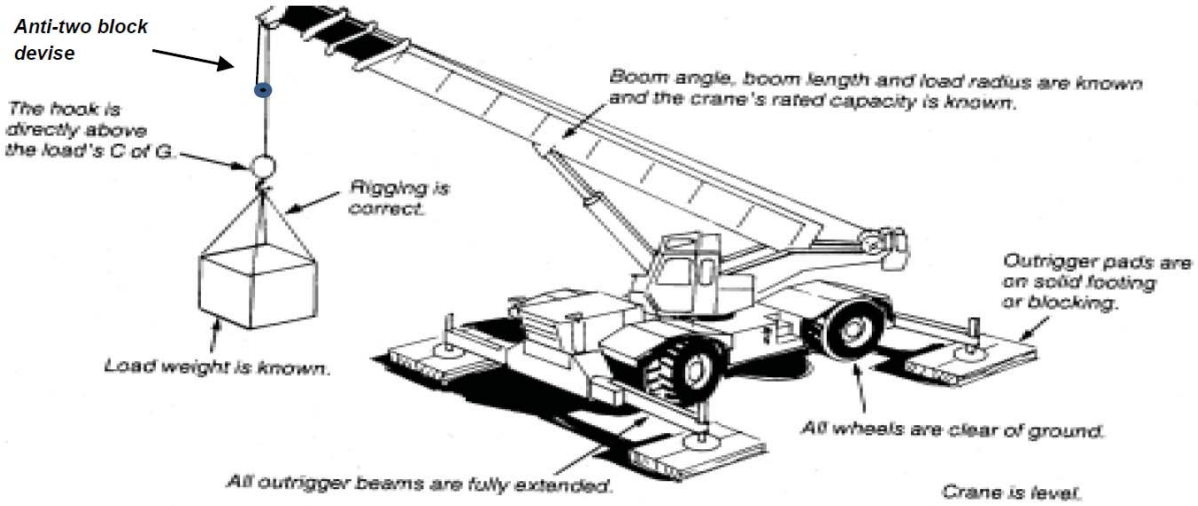
This procedure provides the guidelines to ensure proper rigging and lifting activities are accomplished safely and in accordance with applicable specifications, codes, and regulations.

- 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.
- Cranes shall have an Anti Two-block safety device installed
- All mobile cranes shall have overload and backup alarms
- Load angle indicators and limit switch

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).

- No part of the lifting equipment or its load shall be within the distance as specified in the Indian Electricity Act from an energised power line
- 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.
- Make certain that the rigging personnel, material, and equipment have the necessary capabilities for the job and are in safe condition.

- 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.
- Mats/Pads must be used on all lifting equipment, equipped with out riggers.
- Pick and carry must have the load secured to the rig in front.
- Proper crane setup:



11..2.1 Safe Rigging Practices:

- Review the planned operation and requirements with the operator and rigging crew.
- Ensure a pre-lift meeting is conducted with crane operator, tagline operator, signal personnel, and Safety Manager.
- 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.
- Clear the lift area of all unnecessary personnel.

11.2.2 The following are rules for safe rigging:

- Use loops, thimbles and corner pads to prevent damage to slings when used around corners or on cutting edges.
- 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.
- Slings must not be pulled from between or under loads with load resting on the sling.
- Keep all rope away from flame cutting or welding operations.
- Never use rope as sling material.
- Never wrap a wire rope completely around a hook.
- Do not bend wire rope near any attached fitting.

- 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.
- When using 3 and 4 legged sling configurations, any two legs must be capable of supporting the entire load.
- 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.
- 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.
- Properly rig all loads to prevent dislodgment of any part.
- Use guide ropes or tag lines to prevent the rotation or uncontrolled motion of the load when necessary.
- 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.
- 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.
- 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.
- Multiple part lines must not be twisted around each other.
- The hook must be brought over the center of gravity of load before the lift is started.
- 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.
- Keep hands away from pinch points as the slack is being taken up.
- Leather gloves are recommended when handling wire rope.
- Avoid impact loading caused by sudden jerking when lifting or lowering. Lift the load gradually until the slack is eliminated.
- Never ride on a load that is suspended.
- Avoid allowing the load to be carried over the heads of any personnel.
- 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.
- Never leave a load suspended unless emergency evacuation is required.
- Never make temporary repairs to sling.
- The capacity of a sling is determined by its angle, construction, type of hitch and size.
- Never lift loads with one leg of a multi-leg sling until the unused legs are made secure.
- Never point load a hook unless it is especially designed and rated for such use.
- Make certain that the load is broken free before lifting and that all legs are taking the load.
- When using two or more slings on a load make certain all slings are made from the same materials.
- Lower the loads on to adequate blocking to prevent damage to the slings.
- Materials and equipment being hoisted must be loaded and secured to prevent any movement which could create a hazard in transit.
- The weight of the hook, load block and any material handling devices must be included when determining crane capacity.
- Operator must have clear sight of loads being picked up or put down by crane. Tag lines will be used to control the loads. Loads must not be touched by hand while placing/ moving.

11.2.3 Synthetic Slings
The following are rules for safe use of synthetic slings:

- Synthetic slings must be marked to show the rated capacity for each type of hitch and type of web material.
- 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.

11.2.3.1 Synthetic web slings must be removed from service and destroyed if any of the following conditions are present:

- Acid or caustic burns
- Melting or charring of any part of the sling surface
- Snags, punctures tears or cuts
- Broken stitches
- Distortion of fittings
- Synthetic web slings of polyester or nylon must not be used at or come in contact with temperatures in excess of 82°C
- Polypropylene web slings must not be used at or come in contact with temperatures in excess of 93°C
- Insulated hooks must be tested yearly to insure insulation integrity to at least manufacturer's specifications.

11.2.4 Wire Rope Slings must be removed from service and destroyed if any of the following conditions are present:

- 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.
- Wear or scraping of one-third the original diameter of outside wires.
- Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure such as:
- Evidence of heat damage.
- End attachments that are cracked, deformed worn.
- Corrosion of the rope or end attachments.

11.2.5 Metal mesh slings must be immediately removed from service if any of the following conditions are present:

- A broken weld or broken brazed joint along the sling edge.
- Reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion.
- Lack of flexibility due to distortion or corrosion.
- Synthetic web slings must be removed from service and destroyed if any of the following conditions are present:
- Acid or caustic burns
- Melting or charring of any part of the sling service
- Snags, punctures, tears or cuts
- Broken stitches
- Distortion of fittings

11.2.6 Requirements of Plate Clamps:

- The rated load of the plate clamp must be marked on the main structure.
- Care must be taken to make certain the load is correctly distributed for the plate clamp being used.
- Do not allow load or plate clamp to come into contact with any obstruction.
- The plate clamp must not be used for side pulls or sliding the load.
- When lifting stainless steel or special alloys, ensure plate clamp is designed for use on the specific metal.

11.2.7 Crane operators must follow the followings:

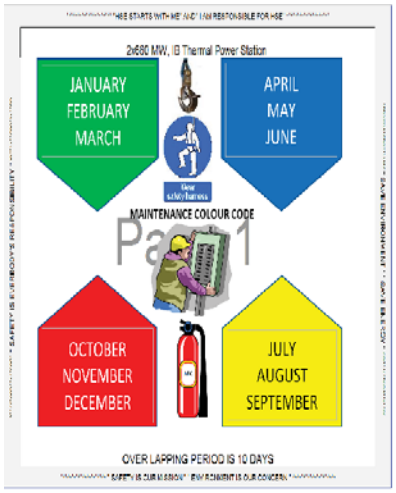
- Pass an annual Operator's Physical examination
- Carry a valid experience certificate from the previous employers

11.2.8 Colour 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

- The cycle of colors shall be Quarterly. The color code tape / Sticker shall be clearly visible to designate the period for which the inspections and tests were conducted.
- Following the initial inspection the equipment must be color-coded quarterly as per color-coding instructions that will be issued by the CONTRACTOR.
- Fire extinguisher with the current month color-coding inspection sticker must be provided and secured in the platform.
- All slings shall be regularly inspected in accordance with the requirement of the project for frequent and periodic inspections and removed from the job site if they fail to meet the minimum requirements of the project.
- The CONTRACTOR'S SFO 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.
- 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.



12.0 **Fire prevention, protection & preparedness -**

The Fire Prevention, Protection and Prepardness Program is an integral part of the overall HSE Program. Effort and consideration must be given to safety, life and potential for delays in construction schedules and plant startup, as well as protection of property on a given project.

The purpose of which is to prevent -

- Inception of fire
- Loss of life or personal injury
- Loss of Property
- Interruption of operations

Site-in-charge / Safety Officer will make periodical review of the site Fire Protection, Prevention Preparedness Programme, Site conditions and available fire protection equipment. It is very imperative that the Sub-contractors along with BHEL to establish good contact with Local fire station for availability of Fire tender in case of emergencies, in additionan to their own fire equipment.

Fire Protection, Prevention and Prepardness Inspections - The Contractor /Sub-Contractor will be required to make frequent fire prevention inspections of his work site and operating facilities. Deficiencies will be corrected at once.

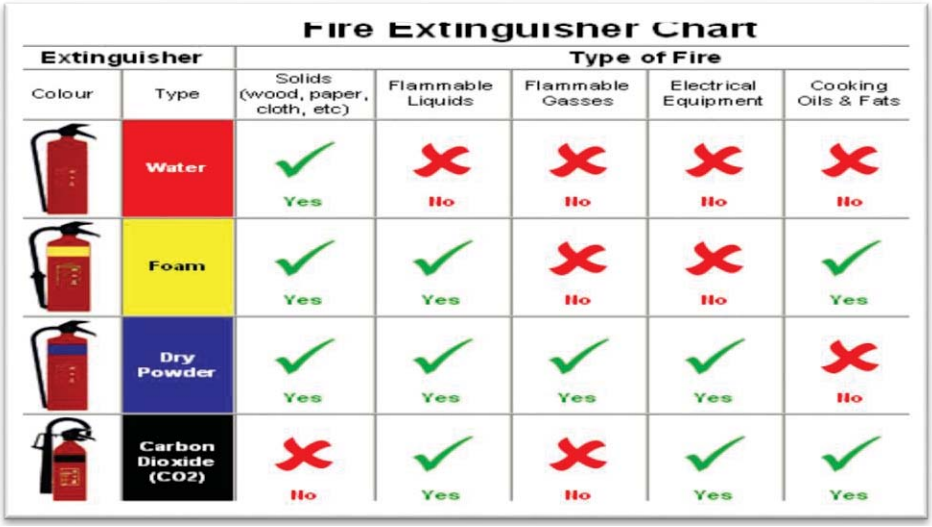
- Area where Hot work activities are carried out (Gas cutting / Welding/ any other spark producing work) above a working spot, a GI / fire-resistant non-asbestos sheet or suitable material shall be placed to prevent the fall of hot sparks. A bucket of water shall be kept nearby while doing hot work

- Hot work shall be preferably carried out in a designated area with a standing Hot Work Permit, to be renewed monthly. The designated area shall have fire extinguishers.

- Any hot work outside designated area shall require a Hot Work permit and fire watch.

No flammable material shall be stored within 35 feet from any fire load.

- Necessary fire extinguishers shall be kept at accessible area as per the chart below:
- The record of Fire safety training and Fire drill shall be maintained in Form-22 and 22(A)



- Emergency telephone number to be displayed at all conspicuous places.

General flammable material storage requirements:

- All flammable material shall be stored in deigned areas and/or in flammable storage cabinets, as necessary.
- Fire extinguishers shall be located near by and have unobstructed access.

13.0 RADIOGRAPHY: Wherever the process requires examination by radiography,

- BHEL /contractor shall use approved radiography contractors for the work on site.
- Site radiography shall be carried out after advance notification to the HSE officer and client personnel. All radiography on the site shall be subject to receipt of client/BHEL work permit and shall normally be performed outside of normal working hours. No ionising radiation sources shall be left unsupervised whilst on site.
- A minimum of 2 qualified persons from the radiography contractor are required for each activity involving ionising radiation. Adequate warning signs shall be posted on barriers and the work area shall be marked off at a safe distance with tape or hard barricades prior to starting radiography by concerned job sub-contractor.
- All personal executing radiography operations shall carry calibrated radiation monitoring devices at all times.
- The storage of radioactive sources on the site is prohibited, they shall be present only for the time required to complete the work. Whilst not in use, radiation sources and their container shall be secured in a safe location with adequate warning signs displayed as per AERB guidelines.

14.0 Confined Space Entry:

A confined space must have an opening of minimum dimension of 40.65cm X 30.65cm if shape is rectangular or oval and dia of 40.65cm if shape is round.

A hazard assessment must be completed prior to any entry into a confined space. The hazard assessment must identify the sequence of work to be performed in the confined space, the specific hazards known or anticipated, and the control measures to be implemented to eliminate or reduce each of the hazards to an acceptable level. No entry must be permitted until the hazard assessment has been reviewed and discussed by all persons engaged in the activity. Personnel who enter confined spaces must be trained per role e.g. entrant (worker), confined space supervior & attendant, and must be informed of known or potential hazards associated with the confined spaces to be entered. Number of persons entering shall be kept at minimum. All confined spaces must be inventoried at site and kept on file. Confined spaces must be posted at the entrance with similar type wording “DANAGER - Do Not Enter – Confined Space - Permit Required”.



Once a hazard assessment is completed the Contractors/Subcontractors requirements are:

- All confined space activities must be reviewed with the Contractor’s Safety Manager prior to commencement of the work. Confined space permits are required as part of the entry process.
- Prior to entering the confined space, the area must be completely controlled to prevent the entry of any unauthorized individual, hazardous substances, or materials, which would threaten the safety of the entrants and the stability of the space. All energy sources, including stored or residual energy, must be isolated and/or blanked, and locked out.
- All shall be given a pep-talk by the concerned supervisor giving details of the jobs to be performed, hazards and risks associated and mitigation measures. The persons shall be provided with all necessary PPEs including respiratory masks, if necessary.
- The confined space must be monitored prior to one entering the identified area. Then periodic atmospheric testing must take place throughout the entry, especially after breaks or work interruptions during the entry. Continuous monitoring is preferable, and may be necessary in certain situations. Monitoring results must be documented on the entry permit with the initials of the individual conducting the testing.
- Contractors/Subcontractors must complete a Confined Space Permit before permitting workers to enter the space. This document must be reviewed and approved via a signature by the entry supervisor. The content of the completed permit must be reviewed with the entrants before entering the space and posted at the confined space enertance.
- A proper and accessible means of exit and exit shall be ensured before entry.
- The space shall be illuminated with 24V lamps only
- All gas cylinders/welding machines shall be preferably kept outside the confined space. Even cutting torches/ electrode holders shall be kept outside, when not in use, if possible.
- All electrical equipments shall be connected to ELCB
- The confined space must have an attendant monitoring the activities within the space. This individual must be in constant communication with work crew inside the space. The attendant must know who is inside the space, that must

be documented. The attendant must not have any other responsibilities than monitoring the space. He/she may not enter the space to perform rescue unless relieved of the duties as an attendant.

- Adequate ventilation must be provided to establish and maintain a stable atmospheric environment. Air circulation shall be ensured. Fumes/dusts generated inside shall be extracted. Ventilation systems must be designed for use in confined spaces.
- Any space 5' or more in depth must have a mechanical retrieval system. This system must be designed for the retrieval of human, and must not be used for equipment purposes. Workers inside the space must wear full body harnesses, and must be connected to the retrieval system.
- Rescue procedures must be established prior to any entry. The local fire department must be contracted prior to entry if they will be the primary source of rescue.
- All individuals involved in the confined space activities must be trained, including hands-on experience with the safety equipment involved. Documentation of the required training must be available prior to the start of any confined space work activities.
- The confined space shall be cleared off all cables, machines, cylinders, materials at the end of the day's work as far as possible.

Once the confined space work has been completed, the entry permit must be cancelled. A copy of the cancelled permit must be given to the HSE Manager

15.0 Welding and Gas Cutting Operations

- 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 taken 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.

- Appropriate fire-fighting equipment is to be available in close proximity of any welding and gas cutting operations at all times.

- 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.

- Proper ventilation is required for any welding or torch operations performed in a confined space.

- 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.

- 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.

- 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.

- 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.

- Arc welding power supply cable shall be of proper rating and material, e.g. copper.
- 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.
- 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.
- Valve caps shall be in place when cylinders are not in use. Valve caps shall never be used for lifting the cylinder vertically.
- 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.
- Cylinders being transported by a powered vehicle shall be secured in an upright position. Gas cylinders are not allowed to be used in man-basket when occupied.
- Cylinders containing oxygen or fuel gasses shall not be taken into confined spaces.
- Oxygen cylinders shall be stored a minimum of (6) meters from fuel gas cylinders or shall have an approved firewall between them.
- Torches shall only be lit by approved strikers; never with matches, cigarette lighters, or hot work.
- 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 even MS Sheet. If such can not be provided, the passage of falling sparks or molten slag shall be barricaded till ground floor and any cable/ tubes/ any other objects interfering in the passage shall either be removed or covered with Fire-resistant sheet or M S Sheet.

16.0 COMPRESSED GAS :

- 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.
- Compressed gas cylinders shall be secured in an upright position with chain or other appropriate means.
- All cylinders shall be kept at a safe distance from welding or cutting operations or shielded from safe.
- All cylinders shall be placed where they cannot become part of the electrical circuit.
- Oxygen and acetylene shall not be stored together.
- Oxygen and fuel gas regulators, hoses and associated equipment shall not be altered and shall be in proper working order while in use.
- 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.

17.0 **WORK AT HEIGHT:** All work at height above 3meter 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 and subsequently BHEL shall follow the checklist religiously by physically verifying the condition of the work area before recommending for approval.

Whenever a fall hazard or other exposure exists for working at heights more than 3m, 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). A personnel fall protection system must include:

- The only permissible personal fall arrest system is an industry approved safety harness. Employees can use positioning belts with two-D ring attachment points as long as they are used in conjunction with a safety harness. Safety harnesses must be secured to an overhead object of substantial capacity capable of supporting five thousand pounds. In order to accomplish this and ensure 100% protection, the worker may need to use two lanyards. The primary lanyard is never unhooked until the secondary lanyard is secure.

- 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. 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. 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.

Minimum Requirements:

Prior to the start of work at elevation, the HSE Manager involved with the work must meet with 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 Manager.

The procedures for the safety response to identified fall hazards developed and resuce plans by must be reviewed with all individuals exposed to the hazards.

The HSE Manager must establish an inspection process of fall protection systems. Some equipment requires documented inspections by its manufacture on a regular schedule. This 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.

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.

Aerial lifting devices, excluding scissors lifts require the use of full body harnesses and lanyards in any elevated position.

All lifelines in general are to be made of min 8mm dia steel rope and tied to columns with 3 clamps at each end. Wherever columns are not available to tie the lifelines, the vertical posts are to be provided after carrying out drop-

load test initially.

18.0 SCAFFOLDS: (As per IS 3696 or any international standard)

The safe and efficient erection, use, dismantling, and storage of scaffolds, ladders and elevated work platforms are considered important objectives in maintaining a safe work environment. This procedure provides the guidelines for erection, use, dismantlement, and storage of scaffolding and elevated work platforms.

There is no such thing as a temporary scaffold. All scaffolds must be erected and maintained to conformed standard. The Scaffold Tagging defines satisfactory, incomplete or defective scaffolds.

Management must ensure or have each worker who performs work while on a scaffold trained by a person qualified in the subject matter to recognize the hazards associated with the type of scaffold being used and to understand the procedures to control or minimize those hazards.

All employees must be competent for the type of scaffolding work they are undertaking and should have received appropriate training relevant to the system they are working on.

- All scaffolds shall be erected / dismantled by scaffolding crew under direct supervision of **competent scaffolding supervisors.**

- 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. Bambo scaffolding is not permitted for use on site.

- Guard rails and toe boards shall be installed on all open sides and ends of platforms more than (2) meters above ground or floor

Scaffold planks must be at least 5 cm x 25 cm (2” x 10”) full thickness lumber scaffold grade or better.

- Scaffold planks shall not span distances greater than 2.5 meters (8 feet).

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.

- All scaffolding must be a minimum of two planks wide. No one may work from a single plank.

- Scaffold planks must be inspected before use. Planks that have been damaged must be removed from the site.
- Access ladders must be provided for each scaffold. Climbing the end frames is prohibited unless the design incorporates an approved ladder.
- Adequate mudsills or other rigid footing capable of withstanding the maximum intended load must be provided.
- 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.
- Do not overload scaffolds. Material should be brought up as needed. Scaffolding must not be loaded in

excess of its rated capacity.

- Barrels, boxes, kegs, blocks or similar unstable object must never be used as work platforms or to support scaffold.
- 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.
- Employees exposed to overhead hazards while working on a scaffold will be protected by 5 cm (2") thick planks.
- 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.
- The platform should have permanent hand rail and mid rail with Toe board without fail.

- 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.

- 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. 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.

Suspension Scaffold

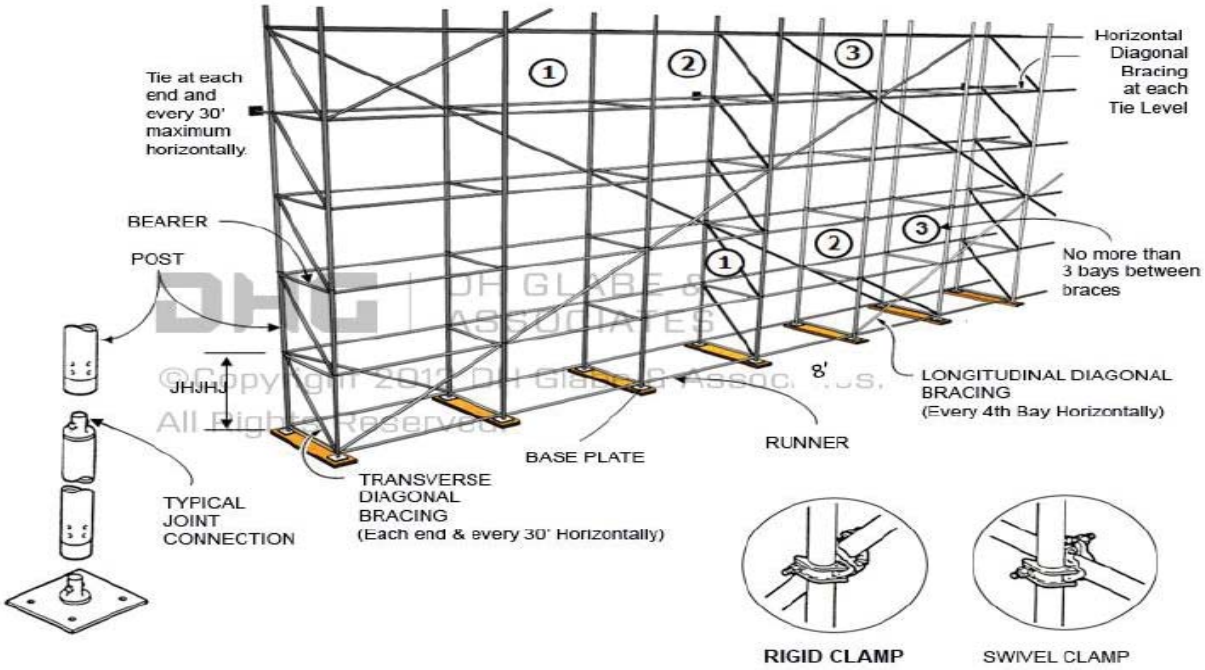
- Suspended scaffolds are platforms suspended by ropes, or other non-rigid means, from an overhead structure.
- Requirements for use are to be preapproved by HSE Head, under a specific Permit to Work.

Rolling Scaffolds

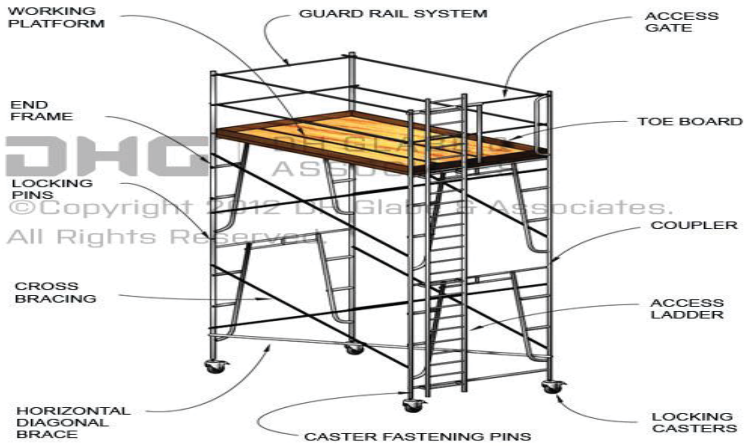
- The height of rolling scaffolds shall not exceed three times the minimum base dimension.
- The minimum base dimension of rolling scaffold will be 1.25 meters (4 feet).
- Adequate help must be provided when moving a rolling scaffold.
- Secure or remove all loose materials, equipment and tools before moving a rolling scaffold.
- 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.

Typical Scaffold Designs

Tube & Coupler Scaffold –



Rolling Scaffold –



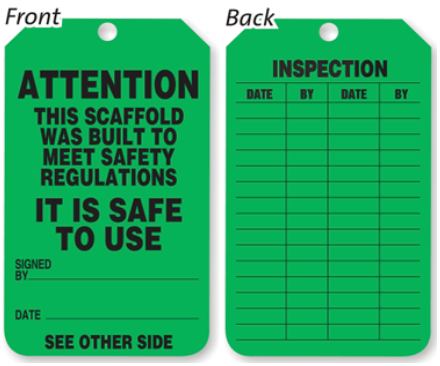
Scaffold Tagging:

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 errection.

Examples of scaffold tags:





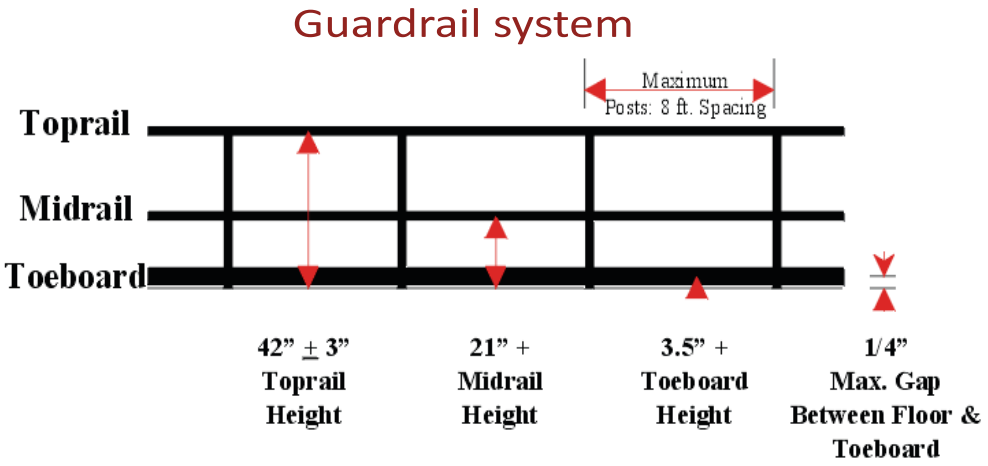
18.1SAFE USE OF LADDERS.

- ❖ Fall protection is required when working on a ladder above 2 meters and when climbing above nearby guardrails.
- ❖ Ladders must be inspected prior to use and by a competent person quarterly, with documentation.
- ❖ Use portable ladders for height up to 4 M only
- ❖ Provide fixed ladders for height above 4 M
- ❖ Place the ladder at an angle of 75 degrees (approx) from the horizontal (1:4)
- ❖ Extend ladder at least 1 M above the top landing
- ❖ Secure top and bottom of the ladder firmly to prevent displacement- anti skid lining at the bottom
- ❖ Ensure that the width of the ladder is not less than 300 mm and distance between rungs is not more than 300 mm
- ❖ 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
- ❖ 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, loose or rough soil
- ❖ Do not use ladders of conducting material near power lines, and only use ladders near powerline or other energize system with exposed parts if they are confirmed locked-out and de-energized.

- ❖ Stand no higher than the fourth rung from the top for carrying out any job standing on a ladder.
- ❖ Never reach out from a ladder to perform work where your belt buckle protrude past the ladder rung.
- ❖ Always face the ladder while climbing up or down
- ❖ 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.
- ❖ Avoid climbing up or down a ladder while carrying anything in hands. Lift tools, equipment and materials with a rope.
- ❖ Work from portable and extension ladders near guarrail where fall expouse exisit 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.

18.2 Precautions against the fall of materials and persons and collapse of structures

- ❖ 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.
- ❖ Guardrails (including scaffolding) erected over/adjacent working areas must have the guardrails screened (opening < 0.5), to prevent material from falling outsite the platform/decking.
- ❖ Guardrails must be able to withstand a 200 pound force exerted in any one direction.
- ❖ 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.
- ❖ All openings through which workers are liable to fall should be kept effectively covered or fenced and indicated in the most appropriate manner.
- ❖ As far as practicable, guard-rails and toe-boards in accordance with Indian laws and regulations as depicted below:



- 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.

  The monkey ladders shall have sufficient fall arrestors. Adequate lifelines of 8mm steel wire rope shall be provided across the work area.

  The HSE officer shall recommend appropriate PPEs after analysing hazards and risks involved.

18.3 **Safety Nets:**

- All safety net systems shall meet the requirements of Indian Standard (IS: 5175)
- Safety net mesh openings shall have a maximum size of 6 inches x 6 inches and be secured at each crossing to prevent elongation of the opening. All nets must meet IS: 5175 standard.
- Safety nets must be installed with sufficient clearance to prevent contact with the surface or structures under them
- Safety nets shall be installed as close as possible to the working level but in no case more than 25 feet below the working level.
- The safety nets shall extend out at least 8 ft. from the side of the open edge.
- Material, equipment and other items that fall into the net are to be promptly removed.
- Safety nets are to be inspected before use and then daily for wear or damage caused by falling materials.
- Safety net installation shall be inspected by a competent person.
- Safety nets must be installed below the working decks of the super structure for protection from falls of personnel and material.
- Safety nets and safety net installations must be drop-tested at the jobsite:
  - After initial installation and before being used.
  - Whenever relocated.
  - After major repair.
  - At 6-month intervals if left in one place.
- The drop test consists of a 400 pound bag of sand 28-32 inches in diameter dropped into the net from the highest surface at which employees are exposed to fall hazards, but not from less than than 42 inches above that level.
- When the employer can demonstrate that it is unreasonable to perform the drop-test described above, the employer or a designated competent person shall certify that the net and net installation have sufficient clearance and impact absorption by preparing a certification record prior to the net being used as a fall protection system. The certification must include:
  - Identification of the net and net installation.
  - Date that it was determined that the net and net installation were in compliance.
  - Signature of the person making the determination and certification.

19.0 SAFETY IN JETTY CONSTRUCTION:

A jetty is to be constructed close to the power plant site over a river. The construction activity involves deployment of cranes and other lifting appliances – a few may be mounted on vessels.
Prior to taking up job at the identified space, a HIRA shall be prepared and corrective measures shall be prepared by an expert group. This shall be shared with the subcontractor/gang to be deployed for the job through meeting/TBM as well as proper documentations.

- The safety rules as described in clause 12.0 shall be followed for all safety appliances. However, the operators shall be certified specifically for operating the lifting appliances mounted on the vessels by the owner of the vessels or the lifting supervisor of the agency.
- The lifting appliances on vessels shall be fixed and securely anchored
- Lifting appliances/ mobile plant shall be kept away from dangerous locations such as openings, edges close to water.
- The operation zone shall be clearly demarcated and properly fenced off.

19.1 SAFE USE OF LIFE JACKETS AND BUOYANCY AIDS:

- Lifejackets/buoyancy aids should be provided to and worn by workers with risk of falling into water.
- Lifejackets/buoyancy aids should conform to BS EN ISO 12402-1, 2, 3 or 4, or other equivalent international standards according to working conditions
- Lifejackets should be thoroughly checked by the user before each use.







Efficient state: Green

Maintenance Record

- A lifebuoy with sufficient lifeline (not less than 30 meters) shall be provided and the locations of the lifebuoys shall be at less than 50 metre intervals along the edges of places where work is being carried out overside or in exposed position on vessels where there is a reasonably foreseeable risk of falling or being washed overboard. To avoid any delays to rescue operations, lifebuoys shall be tightly tied to the posts.



- The lifejacket/ buoyancy aid shall preferably be provided w or a self-activating light (for night work) in order to aid locating the wearer and facilitating rescue.
- The lifejackets /buoyancy aids shall be inspected and checked periodically by a competent person.



- The life jackets/ buoyancy aids shall be properly maintained in a good serviceable condition according to the manufacturer's instructions.
- All inflatable life jackets shall be serviced by an authorized person/agent at least once a year.

19.2 WORKING AT HEIGHT

- Suitable guard-rails and toe-boards shall be installed at edges. Openings shall be properly covered where persons are liable to fall from height, to land surfaces or into water.
- Suitable working platforms, with suitable guard-rails and toe-boards, shall be provided for work at height. Safe means of access and egress shall be provided for the working platform.
- Safety harnesses with continuous and effective anchorage system shall be provided when it is impracticable to provide a suitable working platform, access and egress and safe place of work.
- Access and egress shall be sufficiently illuminated and free from any obstructions, openings, projections in order to avoid any slip, trip and fall.

20.0 NIGHT SHIFT OPERATION:

Night shift operation shall be avoided to the extent possible, so shall be any complicated or heavy job. However, prior administrative approval shall be obtained from BHEL for such operation. The following shall be ensured:

i. Adequate illumination along access, work area and egress

ii. Supervision
iii. Issue of strict instruction to workmen not to stray away from the work area and earmarked approach
iv. Non-deployment of women workforce
v. Non-deployment of fatigued workforce
vi. Vacating the area immediately on completion of the job
vii. informing first-aid facility and ambulance in advance

21.0 CONTROL OF MOVEMENTS AND USE OF HAZARDOUS SUBSTANCES AND CHEMICALS:

- The hazardous substances and chemicals shall be stored in a cool, well ventilated, dry and covered space with restricted entry only
- The loading, unloading, issue and use of these materials shall be strictly in accordance with the Material Safety Data Sheet (MSDS) and under strict supervision. Every supply shall accompany a MSDS as per standard purchase order clause.
- The site HSE team shall maintain MSDS of all these items and the same shall be shared with the stores or the user as and when required.
- Each container shall be labeled.
- The stores shall check the expiry date of perishable chemicals while receiving and store in such a fashion so as to follow First-in-first-out queue.
- There shall be enough space for movement of material and people in the stores.
- Containment shall be provided so as to arrest spillage from spreading.
- There shall be sufficient fire extinguishers and sand buckets in the stores and at point of use. In case of any spillage, dry sand shall be put on the spill and soaked sand shall be disposed as per the procedure for hazardous waste.
- There shall be provision of water preferably flowing one and a face shower at stores and point of use
- The persons handling these items shall strictly wear appropriate PPEs like leather gloves, apron, shield etc

22.0 CHEMICAL CLEANING: The chemicals have to be handled as instructed in MSDS. Only authorized person(s) shall be engaged for this job under strict supervision. The waste chemicals shall be drained out to a suitable storage provision and disposed off as per the relevant procedure. The area shall be barricaded while carrying out cleaning operation so as to prevent any unauthorized entry. Once the operation is completed, the surplus material along with the containers shall be returned to stores or scrap yard, as the case may be. The users shall use all appropriate PPEs and shall have water and sand for handling any incidental spillage or splash etc. The area shall be left completely clean before removing barricades.

22.1 PAINTING

Requirements provide a detailed procedure to be implemented by all concerned employees and sub-contractors involved in painting activities.

Significant Environmental Hazards:

- Chemical hazard due to inhalation of lead fumes (lead containing paint)
- Chemical hazard due to inhalation of VOC's from paining operations
- VOC's from painting and coating operation
- Disposal of paints and coats drums

Control Procedure for Painting:

- Chemical products used in painting and coating operation shall have proper MSDS sheet in place. Whenever any doubt arise with respect to handling and safety point of view it should be accessed to all concerned.
- Toxic substances and hazards relate the toxic chemicals shall be indentified.
- Proper PPE shall be used including plastic gloves appropriate overall etc.,
- Arrangement for cleaning of spillage shall be ensured

- In case of nauseating feeling by any one immediate action shall be taken
- Only trained workers shall be allowed and proper training should be imparted to the works.
- Exposure limits of the toxic substances shall be checked before starting the work and nobody shall be allowed to carry the work beyond the permissible limit.
- Ventilation or exhaust facility shall be provided at place where painting and coating operations are carried out.
- Overalls shall be supplied by the contractors/subcontractors to the workmen and adequate facilities shall be provided to enable the painters to wash at the cessation of work.
- Smoking, open flames or sources of ignition shall not be allowed in places where paints and other flammable substances are stored.
- A caution board in national /regional language “smoking strictly prohibited” shall be displayed in the vicinity.
- Suitable fire extinguishers/sand buckets shall be kept available at places where flammable paints are stored, handled or used.
- In case of indoor painting or painting in confined spaces, exhaust ventilating shall be provided. If adequate ventilation is not provided a proper respirator shall be provided and used by persons who are trainined and fit tested.
- The VOC’s from painting and coating operations shall not exceed the permissible level of CPCB/ SPCB norms. The paints and coats must be selected as per the guidelines.
- Workers shall thoroughly wash their hands and feet before leaving the work.

23.0 SAFETY IN THE USE OF HAND TOOLS AND POWER-OPERATED TOOLS

23.1 General provisions

i. All hands and power tools and similar equipment, shall be maintained in safe condition.
ii. When power operated tools are designed to accommodate guards, they shall be equipped
iii. with such guards, when in use;
iv. Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains and other reciprocating, rotating or moving parts of the equipment shall be similarly guarded;
v. 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, vapours, or gases shall be provided with the particular personal protective equipment necessary to protect them from the hazards;
vi. 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.
vii. 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.

23.2 Hand Tools

i. The contractor shall not issue or permit the use of unsafe hand tools;
ii. Wrenches including adjustable pipe end and socket wrenches shall not be used when saws are sprung to the point that slippage occurs;
iii. Impact tools such as drift pins, wedges and chisels shall be kept free of mushroomed heads;
iv. The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight on the tools.

23.3 Power operated tools

i. Electric power operated tools shall be either of the approved double-insulated type or shall be grounded;
ii. The use of electric cords for hoisting or lowering loads shall not be permitted;

iii. Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming incidentally disconnected;
iv. Safety clips or retainers shall be securely installed or maintained on pneumatic impact (percussion) tools to prevent attachments from being incidentally expelled;
v. 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;
vi. 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;
vii. The manufacturer's safe operating for hoses, pipes, valves, filters and other fittings shall not be exceeded;
viii. Only personnel who has been trained in the operation of the particular tool shall be allowed to operate power-actuated tools;
ix. 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;
x. 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;
xi. 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;
xii. Loaded tools shall not be left unattended;
xiii. 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;
xiv. Driving into materials that can be easily penetrated shall be avoided unless backed by a
xv. substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side;
xvi. No fastener shall be driven into a palled area caused by an unsatisfactory fastening;
xvii. Only non-sparking tools shall be used in an explosive or flammable atmosphere;
xviii. All tools shall be used with the correct shield, guard or attachment as recommended by thee manufacturer.

23.4 Abrasive wheels and tools

i. All grinding machines shall be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation;
ii. Grinding machines shall be equipped with suitable safety guards;
iii. 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;
iv. 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;
v. Cup type wheels used for external grinding shall be protected by either revolving cup guard or a band type guard;
vi. 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;
vii. Portable abrasive wheel used for internal grinding shall be provided with suitable safety flanges;
viii. When safety flanges are required, they shall be used only with wheels designed to fit the
ix. 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;

x. All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that they are free from cracks or defects;

xi. 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;

xii. All employees using abrasive wheels shall be protected by suitable eye protection equipment.

23.5 Woodworking tools

i. All fixed power driven woodworking tools shall be provided with a disconnect switch that can either be locked or tagged in the **off-position**;

ii. 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 retensioned for a different speed, the marking shall be corrected to show the new speed;

iii. 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;

iv. 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.

23.6 Defective tools to be tagged out for maintenance, as ***DEFECTIVE, DO NOT USE***, and sent to tool/store room for repair or to be discarded.

24.0 START UP, COMMISSIONING AND TESTING:

There are various activities involved prior to commissioning- the major ones are -Hydraulic Test, Steam Blowing, Charging of transformers, Boiler Light Up, Rolling and Synchronisation and Full loading of unit.

These activities shall be personally supervised by the site executive along with the commissioning engineer. The readiness of upstream and downstream system shall be ensured before taking up. These shall be handled strictly by the authorised 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. Entry of persons to the area of activity shall be suitably restricted and the emergency functions like Ambulance, first aid centre and Fire station shall be intimated about the plan well in advance. Tag-in/ Tag-out shall be in place while charging transformer and whenever necessary. Electricians with valid wiremen license only shall be permitted to work on power lines.
The area and the passage shall be adequately illuminated.

25.0 **DEMOLITION WORK**

Before any demolition work is commenced and also during the process of the work the following shall be ensured:

- All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- 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.
- 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.

26.0 **EXCAVATION**

Wherever there is 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. All safety precautions shall be taken for foundation and other excavation marks as per IS-3764. Any excavation above 2m shall be considered as hazardous job.

27.0 ENVIRONMENTAL CONTROL

Environment protection has always been given prime importance by BHEL. Environmental damage is a major concern of the principal contractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life. Chlorofluorocarbons such as carbon tetrachloride and trichloroethylene shall not be used. Waste disposal shall be done in accordance with the guidelines laid down in the project specification.

Any chemical including solvents and paints, required for construction shall be stored in designated bonded areas around the site as per MSDS.

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. BHEL shall use appropriate MSDS for clean-up technique

All contractors shall be responsible for the cleanliness of their own areas and must not pollute the ground, air and water.

BHEL shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the contractor anticipates the generation of excessive noise levels from his operations the contractor shall inform to Construction manager of BHEL accordingly so that reasonable &practicable precautions can be taken to protect other persons who may be affected.

27.1 **Water Supply and Wastewater Discharge Requirement**

- Source of water is provided by client from the existing system.
- Wastage of water to be controlled by monitoring the required water for construction & domestic use and actual consumed.
- No contaminated water to be discharged in the storm water drain confirming the standard parameters before discharge. Proper approval to be taken if applicable as per Bangladesh Environmental Standards

27.2 **Storm water runoff Management**

- Expansion of existing plant, no existing drainage systems will be disturbed and damaged.
- No construction waste water to be discharged in the existing storm water drain or newly construction storm water drains.

27.3 **Noise Mitigation**

High noise is harmful to the human health and it can cause impairment if exposed for long duration at regular intervals, and also cause disruption in nearby communities.

- Noise monitoring shall be carried out in all construction locations periodically.
- Use of silent DG is allowed at site during construction.
- Low noise generation equipment's to be preferred
- Acoustic enclosure to be used in case noise level is high for particular equipment or system.
- Work areas where noise levels exceed the 85db shall be posted as hearing protection required.
- Use of PPEs / ear plug/ear muff for personnel entering into high noise area.
- Activities generation High noise will be planned in day shift.

Noise Level Chart (As per Bangladesh Environmental Standards)

Parameter	Night Noise level dBA	Daytime Noise Level dBA
At 1-meter from each piece of equipment	85	85
At Property boundary	70	70

27.4 **Air pollution Control**

- Water sprinkling on road for suppression of fugitive dust to be done regularly.
- Startup and comminsioning activities to be planned for compliance with contract, regulatory and permit requirements..(As per Bangladesh Environmental Standards)
- Required monitoring to be done in the respective work location as applicable.

27.5 **Land and Water Resource Protection**

- Only prior approved land by CUSTOMERL to be used during construction work.
- Contract clauses to be followed
- All hazardous substances will be stored with proper containment facilities to avoid any release into the water system, causing land/water contamination.

28.0 HOUSEKEEPING

- 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 subcontractor. Such cleanings has to be done by subcontractor within quoted rate, on daily basis by an identified group. 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 contractor's bill. Such decisions of BHEL shall be binding on the subcontractor
- Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis:
  - ❖ All surplus earth and debris are removed/disposed off from the working areas to identified locations.
  - ❖ Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
  - ❖ 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 location.
  - ❖ Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
  - ❖ Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
  - ❖ Labour 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.
  - ❖ Fabricated steel structures, pipes & piping materials shall be stacked properly.
  - ❖ 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.
  - ❖ Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas
  - ❖ The paint and thinner and other chemical containers (filled, partly used and empty) shall be carefully stored, used and tracked. All empty containers shall be removed after getting punctured/lid removed and deformed to the scrap yard. The partial used one shall either be returned to store or carefully kept at a corner much away from any hot work or source of fire.

29.0 WASTE MANAGEMENT

There are operations on construction projects that may create hazardous waste, which would require handling, storage, transferring, and transporting. Therefore, hazardous waste guidelines apply for Hazardous Waste Planning:

29.1 Minimum Requirements:

- Contractors must designate a Material Manager who is responsible for checking delivered materials as potential hazardous waste and informing the Contractor's Safety Manager.
- Contractors who create, may be expected to create or could accidentally create a material that could be classified to be hazardous waste must provide Disposal number (or equivalent) and other pertinent information on file.
- All hazardous waste or waste which could be considered hazardous waste, as determined by the methodology and definitions from environmental regulators must be stored and collected in special areas and properly disposed of by the Contractor.
- No waste haulers, disposers, recyclers, or scavengers will be allowed on the site without the permission of the owner. It will be the responsibility of the Contractor to provide copies of all licenses, permits, and authorizations to the.
- No waste may be removed from the site by any person without the authorization of the Contractor. No waste may be brought onto the site and disposed of using the Contractor's systems or facilities.
- Burning of waste, if not used for generating energy, shall be generally prohibited

29.2 General Requirements

- For non-hazardous waste disposal. Receptacles e.g., dumpsters, etc. must be placed around the site for collection of waste materials. No material is to be abandoned on the site.
- Dumpsters will be inspected frequently, and any potentially hazardous material or waste will be removed from the dumpster and placed in the appropriate storage area at the expense of the responsible Contractor.

29.3 Definitions

- Solid Waste - Any garbage, refuse, sludge, or any other waste material which is not an "excluded waste."
  - The following solid wastes are not hazardous wastes unless otherwise designated as such by local authorities:
  - Fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels
  - Drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas, or geothermal energy.

- Other Waste Material - Any solid, liquid, semi-solid, or contained gaseous material, resulting from industrial, commercial, mining or agricultural operations which are discarded. This is usually an incidental by-product of the operation. Discarded material must be treated as follows:
  - Disposed of, and not used, reused, reclaimed, or recycled
  - Burned or incinerated, except where the material is being burned as a fuel for the purpose of recovering usable energy
  - Physically, chemically, or biologically treated (other than burned or incinerated) in lieu of or prior to being disposed of.

- Excluded Waste - Materials that are not solid wastes. The following materials are not solid wastes for the purpose of this part:
  - Domestic sewage ("Domestic sewage" means untreated sanitary wastes that pass through a sewer system.)
  - Any mixture of domestic sewage and other wastes that passes through a sewer system to a publicly-owned treatment works for treatment
  - Industrial wastewater discharges that are point source discharges.

29.4 Treatment - Any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste to neutralize such waste, to recover energy or material resources from the waste, or to render such waste non-hazardous.

29.5 Improper Disposal - The discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into the environment.

29.6 Temporary Storage - The holding of a hazardous waste for a period less than 90 days, at the end of which the hazardous waste is properly disposed of.

29.7 **BINS AT WORK PLACE**

- Sufficient rubbish bins shall be provided close to workplaces.
- Bins should be painted yellow and numbered.
- Sufficient nos. of drip trays shall be provided to collect oil and grease.
- Sufficient qty. of broomsticks with handle shall be provided.
- Adequate strength of employees should be deployed to ensure daily monitoring and service for waste management.

29.8 **STORAGE AND COLLECTION**

- Different types of rubbish/waste should be collected and stored separately.
- Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
- Rubbish should not be left or allowed to accumulate on construction and other work places.
- Do not burn construction rubbish near working site.

29.9 **SEGREGATION**

- Earmark the scrap area for different types of waste.
- Store wastes away from building.
- Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
- Clinical and first aid waste stored and incinerated separately.

29.10 **DISPOSAL**

- Sufficient containers and scrap disposal area should be allocated.
- All scrap bin and containers should be conveniently located.

- Provide self-closing containers for flammable/spontaneously combustible material.
- Keep drainage channels free from choking.
- Make schedule for collection and disposal of waste.

29.11 **WARNING AND SIGNS**

- Appropriate sign to be displayed at scrap storage area
- No toxic, corrosive or flammable substance to be discarded into public sewage system.
- Waste disposal shall be in accordance with best practice.
- Comply with all the requirements of Pollution Control Board (PCB) for storage and disposal of hazardous waste.

30.0 **WORK VEHICLES (Limited to contractual provision)**

Work vehicle shall be as safe stable efficient and roadworthy as private vehicles on public roads. Site management shall ensure that drivers are minimum 18 years of age, physically fit, suitably qualified and trained for the equipment they are operating. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

- A high level of stability.
- Equiped with backup alarms.
- A safe means of access/egress.
- Suitable and effective service and parking brakes.
- Windscreens with wipers and external mirrors giving optimum all round visibility.
- Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
- Provision of seat belts.
- Guards on dangerous parts.
- Driver protection - to prevent injury from overturning and from falling objects/materials.
- Driver protection from adverse weather.
- No vehicle shall be parked below HT/LT power lines.
- Valid Pollution Under Control certification for all vehicles

30.1 **TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES**

- 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.
- 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.
- All overhangs shall be made clearly visible and restricted to acceptable limits
- Load shall be checked before moving off and after traveling a suitable distance.
- 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.
- Warning signs shall be displayed during transportation of material.
  All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement

31.0 EMERGENCY PREPAREDNESS AND RESPONSE Preferably to be maintained jointly by all stake-holders in the project) (A separate document titled "Emergency Preparedness and Response Plan bearing document no HSEP:EPRP:MAITREE is to be read along with this plan) Emergency preparedness and response plan requirements are to protect worker life and health, and to safeguard property used and stored on the project. This plan

is prepared in anticipation of an emergency to prevent losses to any Incident. This plan describes how the organization identifies, respond to and review emergency situations.

This plan covers fire, medical and other environmental incidents. It aims at controlling the emergency and generally mitigating the adverse effects of a major Incident. This plan is applicable to all activities carried at all BHEL project sites. Determination of hazard potential and identification and assessment of hazards is the first part in emergency planning. This requires systematic study of the site / plant to identify emergencies that can occur.

31.1 Definition:

A major emergency can be defined as an Incident that has potential to cause serious injury of loss of life. It may cause extensive property damage and adversely affect the environment as a whole.

31.2 Emergency scenarios and General Guidelines:

Various scenarios that are anticipated to cause emergency at BGRESL site are discussed in brief along with guidelines.

- Personal injuries:
  In spite of putting best efforts some technical failure or human error may lead to personal injury at site. Guidelines are given below when personnel injuries happen:
  - Contact medical center over phone/cell/radio;
  - Contact security control room over phone/cell/radio;
  - Contact HR/Admin department over phone/cell/radio;
  - Tell your location nature of injury or near miss incident;
  - Inform site safety department;
  - Provide First Aid treatment if properly trained person is available, otherwise take the injured person to Medical center if pratical; or
  - Stay with the injured person until medical assistant arrives.

- In case of fire:
  - Shout “fire fire”;
  - Inform the persons nearby. Contact Fire Center and give your location and other details as warranted and act very calmly and swiftly. Then contact security and safety department once in a safe location;
  - Try to put out the fire by using available portable fire extinguisher if trained and fire is in incipient stage only, otherwise let firefighting personnel tend to it;
  - Do not make any attempt to collect your belonging;
  - Get out and away from the area immediately and walk do not run. Follow shortest escape route and assemble at assembly point; and
  - Under no circumstance put your precious life at risk.

- Mishaps involving failures of crane, structures, equipment and vehicular incidents, etc., can also lead to an Emergency situation on construction sites. Guidelines for actions to be taken in case of such situations are as:
  - Inform immediate authority and also inform security and safety departments.
  - Try to assist in rescue personnel involved only if safe to do so;
  - Cordon off the area to prevent entry of personnel in affected area;
  - Security shall ensure movement in affected area in coordination with Section/Site In-charge.

- Fire/Security service departments responding to affected area to contain and control the situation;
- All other personnel not involved in mitigation operation shall be directed to assembly point; and
- Contractor/ sub-contractor management shall ensure that their workmen are away from emergency site, not gathering around location of emergency.

- Toxic leakage from nearby live units can also lead to emergency situation at construction site. Guidelines for actions to be taken are as:
  - Inform immediate authority and also inform security and safety departments;
  - Evacuate all the personnel from the area immediately depending upon the wind direction to safetest assembly point;
  - Call for help from fire and medical by phone/Cell/radio;
  - Arrange transport for any victims to medical Centre; and
  - Do not panic, act swiftly, do not run and proceed as per advice of emergency services.

- Bomb threat, sabotage, riot etc., also may lead to emergency situation at construction site. Such situation shall be dealt by HR/Admin and security department with the advice of Site In-charge.
  - Notification to the owner and authorizes to follow immediately.

- Natural calamities like earthquake, cyclone, and flood like situation can also lead to emergency situation at construction site. Site In-charge will act with required diligent and directive received from Concerned State Government, Corporate office and Owner.

- High Angle rescue -
  - First arrival. The first arriving HSE Officer should assume command after arriving on the scene;
  - HSE Officer should secure a witness as soon as possible after arriving on scene. This will help in identifying the problem and locating the victim;
  - Locate the victim to determine nature of injuries if any and report to Medical for response as needed.
  - Administer first aid to the victim as necessary;
  - Resuce team to use proper rescue kit / equipment to reach the victim;
  - Personnel manbasket or arial lift may be used to reach the vitim if applicable;
  - Assess the hazards. HSE Officer to identify all potential hazards and assist rescuers.
  - The HSE Officer will be responsible for securing those hazards or making all members aware of those hazards.
  - HSE Officer shall be made aware of the specific emergency action plans once the emergency response team arrives.
  - The HSE Officer shall also be responsible for assuring that all safety procedures are adhered to.

31.3 Communication system

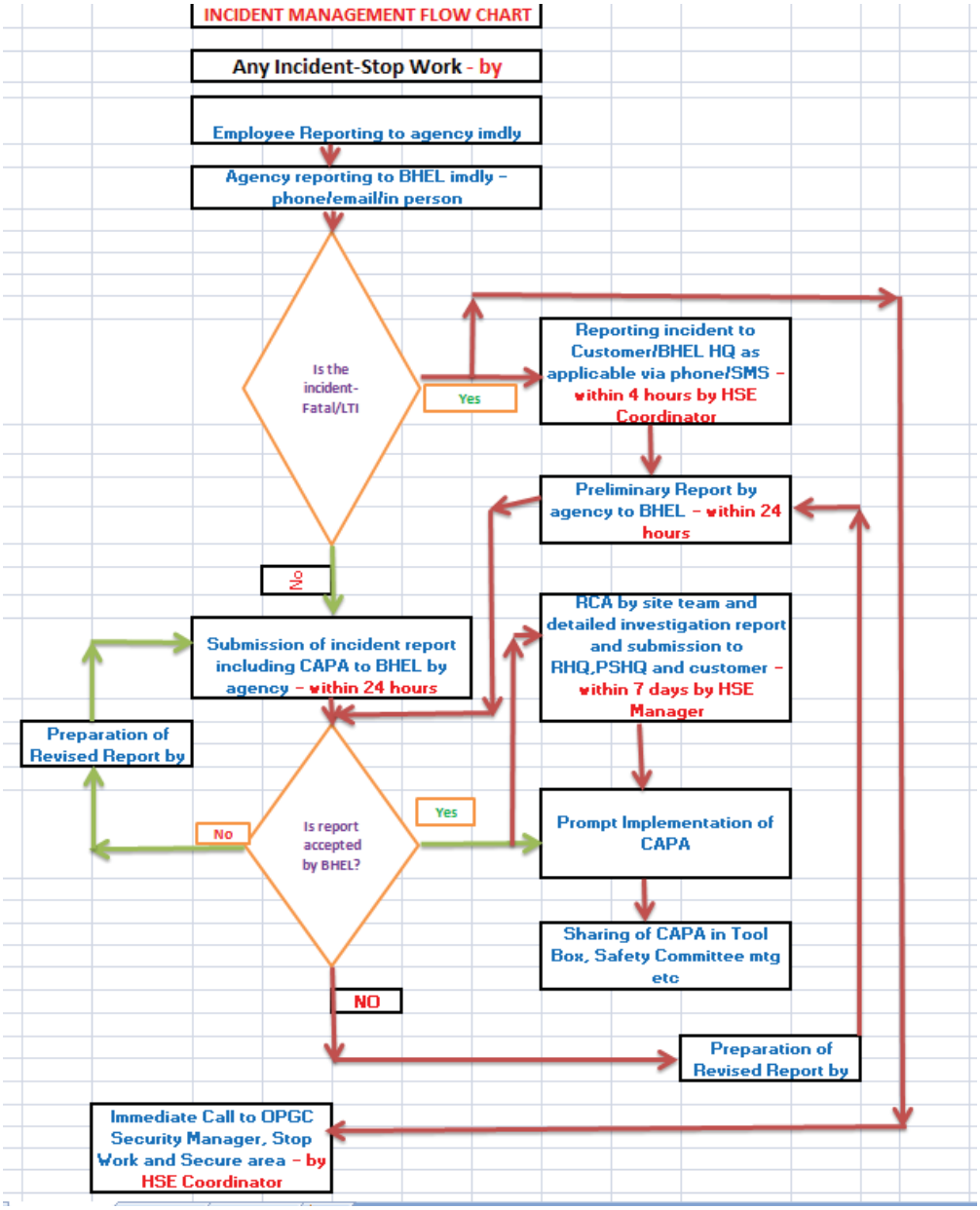
An important key to effective emergency response is an effective communication system. At BHEL, site telephone, mobile and radios will be used for communication during emergency.

- Whosoever is observing any emergency shall inform about emergency to:
  - HR/Admin department
  - HSE-Head /Officers /
  - Medical and Security department
  - Fire department,

- BHEL Site/Section In-charge

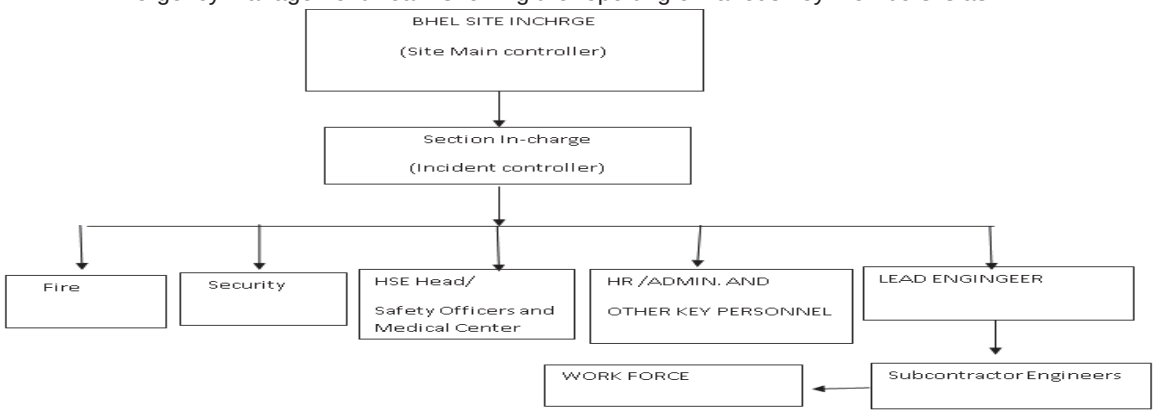
- BHEL Section In-charge will confirm the information with emergency services and also inform the Regional Manager as well as sub-contractors Site In-charge.

31.4 Communication matrix shall be as:



31.5 Emergency Organization -

An emergency organization establishment is based on nature of emergency at BHEL site. The matrix for the Emergency Management Team showing the reporting of various key members is as:



31.6 List of Key Personnel -

Sl. No.	Name	Designation	Telephone Number	Mobile number

31.7 Emergency Control Center -

For the coordination with emergency situations at BHEL site Site In-charge office shall operate as an Emergency Control Room. Site Main Controller (Site In-charge) will coordinate from this Emergency Control Room. Control Room shall be equipped with all necessary communication devises necessary to manage particular emergencys.

31.8 Emergency Drills -

The site HSE Manager and Emergency and Rescue Teams must participate in regular emergency drills of various types. The intervals between such drills must not exceed three months. The records of the drills must be prepared and kept on site for review by the Owner and site Management. The records must be reviewed during regularly scheduled project HSE Committee meetings.

- After each drill, a formal, documented debriefing must be conducted to discuss areas of improvement and an Action Plan developed with Responsible Person and Anticipated Completion Dates describing improvements to be implemented.

31.9 Roles & Responsibility -

Responsibility of Site In-charge (Site Main Controller):

- Immediately on receiving message regarding emergency will proceed to their cabin and fill their role as Main Controller and activate the Emergency Control Room and Emergency Management Team.
- Take strategic and technical decisions in line with the incident scenario to mitigate the cause of emergency.
- Provide leadership and guidance to the Emergency Management Team.
- As soon an emergency call is received they shall inform respective Section In-charge.
- Call for available resources Fire, Medical, Security as needed based on emergency situation.
- Stay in contact with Section In-charge for coordination efforts of resources and evacuation of personnel.
- Ensure head count is conducted and received.
- Notify Owner representative of situation and plan.

Responsibility of Section In-charge (Area Controller):

- If not at the location, once notified of an emergency will proceed to the area and act as an incident controller if safe or as appropriate based on the nature of emergency.
- Will be overall in-charge of the area situation in consultation with emergency responding offices and mobilized resources in coordination with Main Controller.
- Will assess the situation and take necessary action to control the emergency and give necessary instruction to site personnel as necessary and appropriate.
- Will evaluate if fire emergency and attempt to extinguish if safe and in incipient stage and assist injured as applicable.
- Shall instruct the sub-contractors and ensure that all non-essential employees are moved to safe assembly point and organize head count.
- Ensure safe exvacuation of site personnel to safe assembliy point in coordination with Main Controller.
- Shall keep in contact with Main Controller keep them informed about site situation and seek directives for mitigation of emergency.
- Communicate with shift Fire Officer of fire condition and rescue measures.
- Communicate with shift Security Officer assist in barricading the affected area.
- Communicte with shift Medical for transporting of causalities, if any.

Fire officer /shift Fire in charge:

- Respond to the emergency call with fire crew in first turn out. Report to Incident controller at site of emergency.
- Decide line of control action in consultation with Section In-charge/Incident Controller for firefighting and other control actions including evacuation of trapped personnel.
- Deploy auxiliary fire squad for assisting fire crew.
- Ensure safety of the crew members
- Keep in constant contact with Emergency Control Room and Team.

Security officer / In charge:

- Instruct and deploy security personnel at security posts/gates and around the affected area.
- Communicate with the auxiliary fire squad at emergency site immediately on receiving emergency call to ensure their mobilzation.
- Cordon off the affected area and guide traffic /emergency vehicles and manage crowd control by dispersing unnecessary persons from the area.
- Ensure vigilance at security posts /gates and be in contact with area manager and other members connected with firefighting or rescue operation.
- Mobilize for evacuation of personnel to safe locations/assemble point.

Medical Center:

- Upon receiving notification of an emergency, anticipate the casualties and prepare accordingly as per medical response plan. Inform Medical Staff and nearest Hospital in advance.
- Dispatch ambulance to incident site along with necessary staff.
- Provide medical treatment/first aid as necessary.

HR/Admin and HSE Teams:

- Coordinate with Main Controller and all other Emergency Management Team members and Government agencies as per requirement.
- Identify appropriate Assembly Points at project site, provide directions and marked areas clearly.
- Assist with arrangement of necessary PPE and use of.
- Support the Emergency Management Team as directed and/or necessary based on situation.

31.10 General Requirements:

- Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by Regional HQ
- Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its sub-contractors
- Assembly point shall be earmarked and access to the same from different location shall be shown in consultation with the owner
- Fire exit shall be identified and pathway shall be clear for emergency escape.
- Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
- Adequate number of first aid boxes shall be strategically placed at different work places to cater emergency need. Holder of the first aid box shall be identified on the box itself who will have the responsibility to maintain the same.
- First aid center shall be developed at site with trained medical personnel and ambulance
- Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
- Tie up with fire brigade shall be done in case customer is not having fire station.
- Tie up with hospital shall be done in case customer is not having hospital.
- Emergency Organization group shall be formed at site.
- Mock drill shall be conducted on different emergencies periodically (every three months) to find out gaps in emergency preparedness and taking necessary corrective action

31.11 **WEATHER SEVERITY PLAN**

A. OBJECTIVE AND SCOPE:

considering the over all monsoon and wind speed in the area the emergencies like cyclone and flood shall be considered from safety point of view during project work.

Warning/alerts issued by Bangladesh Meteorological department shall be acted upon by appropriate measures. These alerts are mostly conveyed to District Administration which in turn passes on to the owner of the project i.e. BIFPCL in this case. BIFPCL shall convey such alert to contractors. and coordinate appropriate response. Such alert is transmitted over Radio and TV channels also. However, contractors shall also remain alert to w3eather conditions and share with BHEL and fellow contractors any input received. Contractors shall actively participate in the Emergency Response activities

This safety plan provides procedure to be followed during emergency due to flood and cyclone for the period of entire project work with respect:

- To give clear guidance as to the actions that must be implemented.
- To inform employees what to do in an Emergency Scenario.
- To establish an emergency response and communications procedure.

B. RESPONSIBILITIES

RCM or his assignee shall coordinate with various departments in charge and supervisors, who will execute the alert procedures in their assigned areas. The coordination shall be in line with directives received from the Client/consultants.

C. CYCLONE

In the event of CYCLONE, alert warning is in three parts. The alert will be issued by BHEL Site Manager.

The actions required during cyclone/Rough Weather:

- Check and assist subcontractors in cleanup. Pick up all loose and unused material of respective supervisor's area
- Check tie-down arrangement is proper for all temporary structure, cranes and tall objects etc.
- Tie to secure all gas cylinders to avoid displacement and unsafe conditions which could be due to wind pressure.
- Secure portable electricity generating sets and other equipments, pumps, hoses etc.
- Make preparation for removal of water logging.
- Take review of work activity and make preparation for removal of equipments and material from all areas.
- Isolate/Turn off all electrical power from the main panel/switches. Secure and anchor panels properly.
- Recheck anchorage/tie of all temporary structures/sheds, tall objects, cranes, rigs, scaffolds etc to avoid toppling due to wind force.
- Cranes boom shall be either locked or lowered the booms as reasonably & practicably and rigs to safe position for the safety point of view.
- Group up all trash barrels, wooden pallets, forms; wooden decks etc. and anchor properly.
- Welding machines, air compressors, and such equipments are to be grouped together and secured to the stable objects. Welding leads, electrical cables, hoses are to be rolled up and secured properly.
- Set on site vehicles on high ground in the site area with brakes set firmly.
- Anchor all tanks, vessels, gas cylinders that may be moved by high wind and water.

- Evacuate job site.

D. **PERSONNEL EVACUATION**:

Personnel Evacuation will be required if predicted wind speed and storm surge heights are beyond acceptable limits as per the guidelines of BHEL management.

Special cyclone shelter shall be arranged in consultation with BHEL management. This shelter shall be equipped with first aid kit and emergency kit containing torch, sufficient batteries, jackets, emergency treatment manual. The map of escape routes and other site specific instructions of emergency situations shall be prominently displayed in the shelter.

Once the warning received from Client/Consultant, the emergency response team shall evacuate and transport all personnel involved in the project to the cyclone shelter.

Cyclone may 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”.

After the cyclone do not go outside until officially communicated about safe situation outside. Use recommended routs for returning. Do not panic or rush while returning.

Checking of gas leaks and wellbeing of electrical appliances is essential before leaving the site.

Listen to local radio for official warning and advice. The site manager shall also obtain updates from client/consultants/metrological departments and communicate to the personnel on project site.

E. MONSOON:

During monsoon following precautions needs to be considered.

- **Excavation:** Inspect all excavations and protect from collapsing or subsidence. Clear all excavated material.
- **Storm water drains:** Check all storm water drains ahead of monsoon for any blockage etc. Identify way for draining out water collected in the site. If required, temporary drains should be prepared for draining out accumulated water in site. The sufficient number of dewatering pumps should be available for the purpose and logged water shall be pumped to nearest drain by dewatering pumps.
- **Access Routes:** Identify access routes to the site in case of flood. Sand should be available to spread over slippery surface.
- **Electrical Supply:** Beforehand check earthing of electrical panels and electrical cables for joints, cracks, insulation failure etc. Keep additional stock of electrical cables and plug tops for replacement of damaged one or to energize dewatering pumps. Do not keep electrical cables/welding cables on the ground but route them above head level. Do not use welding / DB sheds as shelters. All electrical equipment shall be equipped with ELCBs/RCCBs.
- **Power Cable route demarking:** cable rout shall be demarked by either by temporary or permanent.
- **Scaffolding:** Check all scaffolds for stability after heavy rain/storm.

- **Work restrictions:** Do not perform any height work, electrical work and rigging activities during rain. Lower the crane boom to avoid striking of lightning.
- **Vehicular movement:** Instruct the vehicle operators about following safety precautions during monsoon in daily tool box meeting, Slippery surface and road conditions, Speed limit, Wind shield wiper, Fog light, break condition is proper, break light is in proper condition & functioning. Not to take vehicle in loose soil.
    - **Lightening protection:** Boiler structure shall be facilitated with thunder protecting equipment.
    - **Workmen shed construction:** workmen rest shed shall be constructed in robust way. RCC pillar shall be used instead of brick pillar. It shall be facilitated with lightning arrestor as per site resource. However if the rest room is nearby high mast light. Lighting arrestor may or may not be provided.
    - **Field Training Programme on Lightening/Thunder: Dos or Dos not.**

F. SAFETY PRECAUTIONS FOR SNAKE MENACE:

Preventive Measures –

③ Remove vegetations around the site

③ Pour Carbolic acid around site boundaries in regular intervals to keep away poisonous snakes. . In summer and rainy season, frequency will be once a month and in other seasons, it will be once a quarter. It may be noted that as the location of the project is on a sand bed, there is almost no wild growths. Hence, Snake menace may not of significant severity and scale.

Precautions to avoid snake bite –

③ Avoid stepping out in the dark, especially during monsoon without safety shoes and torch.

③ Before wearing shoes, check inside the shoes for any snake/insect hiding inside. Similarly before lifting any material with hand lying on ground for long time, look for snake/insect handling inside. Wear leather hand gloves. Always check inside gunny bags, cartons, boxes before putting your hand in side or lifting them.

③ Be aware of your surroundings at all time. Never sit or step over obstacles without looking carefully. Never go near bushes for natural calls.

③ Don't chase snakes as they become aggressive. Never try to hit a snake or try to catch it, where there is one, there are likely others.

③ Never handle a snake, even if you think it is dead.

Symptoms of Snake Bite –

③ A pair of punctured mark, severe pain, Redness & swelling around bitten area

③ Victim gets nausea, vomiting sensation, sweating, disturbed breathing and increased salivation.

Actions required in case of snake bite –

③ Reassure the victim

③ Immobilize the bitten body part without compression.

③ Get the patient to hospital as fast as safely possible

③ Tell the doctor any of the symptoms appearing on the way to the hospital.

Snakebite Emergency: DO's and DON'Ts

Do's:

③ Avoid yourself and victim from the risk of second bite.

③ Remove tight clothing, shoes, watch or ring near bitten area before swelling starts. Calm the victim. Tell victim that virtually all snakebites are successfully treated. Panic can increase the danger to the victim by inducing rapid heartbeat.

③ Clean / disinfect bite area thoroughly, apply hard direct pressure with gauze pad over bite area, soak gauze pad with Betadine if possible before application and strap pad tightly in place with adhesive tape

③ Wrap affected extremity with 2" – 3" elastic bandaging as tightly as one would for sprain, keep the affected extremity positioned at or as close to heart level as possible and immobilize affected extremity; use a splint if possible.

③ Get medical attention as soon as possible

③ Ensure the availability of anti venom serum in the hospital.

Don'ts:

③ Do not bleed the wound, cut or increase bite marks or put ice on the bite

③ Do not eat or drink anything and engage in strenuous physical activity

③ Do not apply oral suction to bite

③ Do not take alcoholic beverage or any self medication

③ Do not apply cold / hot packs or burn wound

③ Do not delay seeking medical attention

③ Do not remove dressings/elastic wrap until at hospital

G. EMERGENCY CONTACT LIST:

Following emergency contact numbers shall be available / displayed at site and updated regularly.

Emergency Contact Numbers

(Contact numbers to be filled by Site Management)

Client		
	Project Manager	
	Plant Safety Manager	
	OPGC Fire Services	
	Medical and Ambulance Services	
	ADMIN-OPGC	
	Security- OPGC	

BHEL		
	RCM	
	Safety Manager	
	HSE COORDINATOR	
	HR-ADMIN	
SUB-CONTRACTOR		
	RCM	
	Project Manager	
	Safety Manager	
	Ambulance	
	HR-ADMIN	
Emergency Services		
	Near Hospital	
	Near Fire Station	
	Ambulance Service	
	Police Station	

32.0 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 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.

32.1 DAILY HSE CHECKS

Both the Site Supervisors and safety officer of Subcontractor 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:

- Personal Safety wears & gear compliance.
- Complying with site safety rules and permit-to-work (PTW).
- Positions and postures of workers.
- Use of tools and equipment etc. by the workers.
- The inspection should 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.

32.2 INSPECTION OF PPE

- PPEs shall be inspected by HSE officer at random once in a week as per format no. HSEP:14-F06 for its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
- The applicable PPEs for carrying out particular activities are listed below.

32.3 INSPECTION OF T&Ps

- A master list of T&Ps shall be maintained by each subcontractor.
- All T&Ps being used at site shall be inspected by HSE officer once in a month as per format no. HSEP:14-F07 for its healthiness and maintenance.
- 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.
- The validity of T&P shall be monitored as per "Status of T&Ps" format no. HSEP:14-F08

32.4 INSPECTION OF CRANES AND WINCHES

- 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.
- Cranes and Winches shall be inspected by HSE officer once in a month as per format no. HSEP:14-F09 for healthiness, maintenance and validity of third party inspection.
- The date of third party inspection and next due date shall be painted on cranes and winches.
- The operators/drivers shall be authorized by sub-contractor based on their competency and experience and shall carry the I-card.

32.5 INSPECTION ON HEIGHT WORKING

- Inspection on height working shall be conducted daily by supervisors before start of work to ensure safe working condition including provision of
    - Fall arrestor
    - Lifelines
    - Safety nets
    - Fencing and barricading
    - Warning signage
    - Covering of opening
    - Proper scaffolding with access and egress.
    - Illumination
- Inspection on height working shall be conducted once in a week by HSE officer as per format no. HSEP:14-F10.

- Medical fitness of height worker shall be ensured.
- Height working shall not be allowed during adverse weather.

32.6 INSPECTION ON WELDING AND GAS CUTTING OPERATION

- Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
- Gas cylinders shall be kept upright.
- Use of Flash back arrestor shall be ensured at both ends.
- Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per format no. HSEP:14-F11.
- Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
- Availability of fire extinguisher at vicinity shall be ensured.

32.7 INSPECTION ON ELECTRICAL INSTALLATION / APPLIANCES

- Ensure proper earthing in electrical installation
- Use ELCB at electrical booth
- Electrical installation shall be properly covered at top where required
- Use appropriate PPEs while working
- Use portable electrical light < 24 V in confined space and potentially wet area.
- Monthly inspection shall be carried out as per format no. HSEP:14-F12.

32.8 INSPECTION OF ELEVATOR

- Elevators shall be inspected by concerned supervisors once in a week as per format no. HSEP:14-F13.
- All elevators shall be inspected by competent person and validity shall be ensured.
- The date of third party inspection and next due date shall be painted on elevator.

33.0 HSE PERFORMANCE EVALUATION:

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 mobilisation	7.0,7.1	10	
2	Attendance by the safety officer and site CM (as applicable) in the meeting convened by BHEL	7.2.1 and 7.2.2	5	
3	Level of compliance w.r.t decisions taken in previous meetings/audit/inspection/as reported.	32.0,35.0,36.0	5	
4	Timely submission of monthly report on safety in the prescribed format		3	
5	Timely reporting any incident including near–miss to BHEL /Customer/statutory authority(if required) and submission of investigation report of all LTIs/ Major Property Loss incident and HSE events	10.0	10	

6	Degree of PPE compliance, Fall protection arrangements and safety net coverage	8.3, 19.2,19.3	15	
7	Level of compliance w.r.t safety rules	11.0 to 26.0	25	
8	Availability of proper first-aid facility , ambulance, hygienic labour colony and other adequate labor welfare initiatives, conducting of health check-up as per BOCW requirements	8.4	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, 31.0	6	
10	Level of House-keeping, Environmental Control	27.0, 28.0, 29.0	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.

33.1 HSE PENALTIES/ REWARDS (Performance Related)

- Suitable HSE reward system shall be developed at site level to promote HSE compliance amongst workmen.
- To decide HSE reward performance towards HSE shall be evaluated for workmen and it shall be awarded regularly in public gathering.
- 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.

33.2 PENALTIES AGAINST SPECIFIC NON-COMPLIANCE WITH HSE RULES/ INCIDENTS: (To be operated in addition to any other deduction on unsatisfactory HSE performance under relevant clause in the contract)

S. No	Nature of Non - Compliance	Penalty in Rs.	Remarks
1.	Not wearing safety helmet/ safety shoes/ welding shield	250	Per lapse/ Person/ day
2.	Not wearing double lanyard full body harness while working at height (> 2 metres)or not anchoring to lifeline/ not providing fall arrestor/ safety net Using defective or non-standard or uninspected scaffolding/ scaffolding not properly supported Using defective ladders/ drums for work at height	1000	Per Person/ lapse/day or per lapse/day
3.	Not wearing gloves/ goggle/earplug/nose mask/ apron	250	Per lapse/ Person/ day
4.	Not using 24 V supply for lighting in confined spaces	500	Per occasion

5.	Improper earthing of welding & Other electrical machines and DBs/ no ELCB/ no rubber mat/ not properly covered/ person without valid wireman license/ no Tag in-Tag out	500	Per lapse/ Machine
6.	Electrical plug not used for connection/ loose insertion	200	Per connection
7.	Using damaged slings or not slinging properly/ damaged hooks/ slings without any identification mark/	1000	Per event Per T&P
8.	Use of lifting equipments including cage or man-basket without having valid Test certificate / without SLI display	5000	Per equipment
9.	Using frayed/ broken welding cables / not using double insulation electrical cable	500	Per machine
10.	Non removal of scrap from work areas and shift to scrap yard/ not providing bins/ improper house keeping	1000	Per location
11.	Lifting cylinders without cage or rolling of cylinders	500	Per occasion
12.	Gas cutting without flash back arrestor at both ends	200	Per machine
13.	Gas cutting at height without sheet below/ barricade at level below (Spark falling from height)	500	Per event
14.	Not having valid driving license for the type of vehicle/ T&P/operator identification card/ rash driving or operation/ not having safety devices like reverse horn & light/ overload switch	500	Per driver / operator
15.	Not providing proper barricades / signage/ unauthorized excavation or barricading	500	Per location per day
16.	Not keeping filled gas cylinders vertically/ mix-up of cylinders/ using broken or damaged manifold/ using domestic LPG cylinder	500	Per occasion
17.	Activity carried out without valid safety work permit	1000	Per occasion
18.	Not carrying out mandatory health check up/ not maintaining First aid box/ centre properly	1000	Per occasion
19.	Non reporting of incident in time / completion of CAPA in time	1000	Per occasion
20.	Non-display of emergency numbers/ non-availability of sufficient fire-extinguishers/ insufficient display of safety posters/ insufficient initiative for safety promotion like TBM	1000	Per occasion

- 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
- The penalty amount shall be recovered from subcontractors from the RA Bill, otherwise Final bill.
- The list of non-compliances is not exhaustive. The site CM has liberty to impose a penalty for any other non-compliance and incidents of any nature including fatality and permanent disability.

340 OTHER REQUIREMENTS

- 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 notifying the subcontractor suitably.
- 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 issued by BHEL, 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.
- 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, favorably consider to reward the subcontractor suitably for the performance.
- In case of any damage to property due to lapses by the subcontractor, BHEL shall have the right to recover the cost of such damages from the subcontractor after holding an appropriate enquiry.
- The subcontractor shall take all measures at the sites of the work to protect all persons from incidents and shall be bound to bear the expenses of defense of every suit, action or other proceeding of 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 subcontractor be paid to compromise any claim by any such person, should such claim proceeding be filed against BHEL, the subcontractor hereby agrees to indemnify BHEL against the same.
- The subcontractor 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, overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.
- The subcontractor 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 subcontractor shall adhere to such instructions.
- BHEL may prohibit the use of any construction machinery, which according to the organization is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL.

35.0 HSE AUDIT/INSPECTION

- Regular HSE Audit/inspection shall be carried out by Subcontractor as per Site HSE audit calendar.
- HSE checklist**(Annexure 02)**shall be used for carrying out audit/inspection and report shall be submitted to BHEL site mangement
- All non-conformities and observations on HSE identified during internal or external HSE audit shall be disposed off by site in a time bound manner and reported back the implementation status
- Corrective action and Preventive action on HSE issues raised by certification body issued by Regional HQs shall be implemented by site and reported to Site management.

36.0 MONTHLY HSE REVIEW MEETING

- Site shall hold HSE review meeting every month 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 and Preventive action. The agenda is given below:
  - Implementation of earlier MOM
  - HSE performance
  - HSE inspection
  - HSE audit and CAPA
  - HSE training
  - Health check-up camp
  - HSE planning for the erection and commissioning and installation activities in the coming month
  - HSE reward and promotional activities
- The meeting shall be chaired by Construction Manager, convened by HSE coordinator and attended by all HOS, Site In charge of Subcontractors and HSE officer of Subcontractors. MOM on the discussion will be circulated to the concerned for implementation.

37.0 FORMATS USED (Details available in Annexure-04) (subject to revisions any time during the contract)

SL. No.	Format Name	Format No.	Rev No.
01	Inspection of First Aid Box	HSEP:14-F01:MAITREE	00
02	Health Check Up	FORM-26	00
03	HSE Induction Training	HSEP:14-F03	00
04	Tool Box Talk	HSEP:14-F04	00
05	MONTHLY HSE REPORT AND HSE INDICES	HSEP:14-F05	00
06	Inspection of PPE	HSEP:14-F06	00

07	Inspection of T&Ps	HSEP:14-F07	00
08	Status of T&Ps	FORM-24	00
09	Inspection of Cranes and Winches	HSEP:14-F09	00
10	Inspection on Height Working	HSEP:14-F10	00
11	Inspection on Welding & Gas Cutting	HSEP:14-F11	00
12	Inspection on Electrical Installation	HSEP:14-F12	00
13	Inspection on Elevator	HSEP:14-F13	00
14	Hse Performance and Penalty	HSEP:14-F14	00
15	incident / property damage /fire incident report	HSEP:14-F15	00
16	Crane operators Identification cum Authorization	HSEP:14-F16	
17	List of T&P	FORM-24	00
18	WORK PERMIT- EXCAVATION (DEEP)	HSEP:14-F18	00
19	WORK PERMIT- RADIATION	HSEP:14-F19	00
20	WORK PERMIT- CONFINED SPACE	HSEP:14-F20	00
21	WORK PERMIT- WORK-AT-HEIGHT (ABOVE 1.8M)	HSEP:14-F21	00

36.0 ANNEXURES

ANNEXURE 01

As per Rule 76(2):

(1) The first-aid box shall be distinctively marked with a GREEN Cross and shall contain the following items, namely:

(a) For establishments in which the number of contract labour 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)	A bottle containing 100 tablets (each of 5 grains) of aspirin
(xviii)	Ointment for burns
(xix)	A bottle of suitable surgical anti-septic solution
(xx)	3 packets of ORS

(2) Adequate arrangement shall be made for immediate recoupment of the equipment when necessary.

ANNEXURE 02

HSE AUDIT/INSPECTION CHECKLIST CUM COMPLIANCE REPORT

PROJECT:_____ SUBCONTRACTOR:_____

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				
PERSONNELPROTECTIVEEQUIPTMENTS				
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 $\pm$ 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.				

Bharat Heavy Electricals Ltd **HSEP:13-F04**
Power Sector- Eastern Region **Date:**
PROJECT:_____
(TO BE SUBMITTED IN TRIPLICATES)

EXCAVATION WORK PERMIT

Sl No:

I. Name of the work:
II. Name of Contractor:
III. Exact location of work and item for excavation:
IV. Duration of work: From to
V. Type of excavation: Manual/ by Excavator
VI. Dimension of excavation:

The following items have been checked and compliance shall be ensured during the currency of the permit:

item	**Done**
1. Checked for underground pipe/power cable	
2. Proper illumination provided (for night work)	
3. Plan/drawing available and checked (sloping, shoring provided). Safety of any adjacent structure taken care of.	
4. Access/Egress ensured (in case of manual)	
5. Equipment operator skill checked	

6. Area cordoned off, signage put up	
7. Appropriate PPEs provided	

The following persons are permitted to work for the duration mentioned herein:

Date		No of persons allowed	Time Duration	
From	To		From	To

List of persons to be maintained by contractor separately

Sign of Initiator (Sub-contractor)

Sign of Recommender

Sign of Approver

Work completed/stopped/area cleared at _____on__

The permit stands closed on_____

Sign of BHEL HSE team

Bharat Heavy Electricals Ltd **HSEP:13-F05**
Power Sector- Eastern Region **Date:**
PROJECT:_____
(TO BE SUBMITTED IN TRIPLICATES)

RADIATION WORK PERMIT

Sl No:

I. Name of the work:
II. Name of Contractor:
III. Exact location of work and item for radiography:
IV. Duration of work: From to
V. Name of Radiography agency and its authorised supervisor:

The following items have been checked and compliance shall be ensured during the currency of the permit:

item	**Done**
1. Safety regulations as per BARC/AERB ensured while source in use/transit/stores	
2. Proper illumination provided	
3. Area cordoned off	
4. Appropriate PPEs provided	

The following persons are permitted to work for the duration mentioned herein:

Date		No of persons allowed	Time Duration	
From	To		From	To

List of persons to be maintained by contractor separately

Sign of Initiator (Sub-contractor)

Sign of Recommender

Sign of Approver

Work completed/stopped/area cleared at _____on__

The permit stands closed on_____

Sign of BHEL HSE team

Bharat Heavy Electricals Ltd **HSEP:13-F06**
Power Sector- Eastern Region **Date:**
PROJECT:_____
(TO BE SUBMITTED IN TRIPLICATES)

CONFINED SPACE WORK PERMIT

Sl No:

I. Name of the work:

II. Name of Contractor:

III. Exact location of work:

1. **Condition check of target space**:

Condition	**Y/N**	**NR**
8. Isolated from air/ water/ steam/ gas/ power/radiation source		
9. Thoroughly cleaned/washed		
10. Adequately cooled		
11. Proper illumination provided		
12. Manways open & ventilated		

2. **Protection measures:**

Measure	**Y/N**	**NR**
1. Handlamp is of 24V		
2. Operators wearing recommended PPEs- gloves/ clothing/ear plug/ muff/ safety harness/lifeline/ goggles /face shield		

3. Operators wearing special devices – dust/gas/airline mask, communication equipment, personal gas alarm		
4. Attendant with SCBA/Air mask		
5. Rescue equipment/ team deployed		
6. Fire fighting equipment close-by		

The following persons are permitted to enter the confined space to work for the duration mentioned herein:

Date(s)	No of persons allowed	Name of persons allowed	Duration From	Duration To

Sign of Initiator (Sub-contractor)

Sign of Recommender

Sign of Approver

Work completed/stopped/area cleared at _____on__

The permit stands closed on_____

Sign of BHEL HSE team

Bharat Heavy Electricals Ltd **HSEP:13-F07**
Power Sector- Eastern Region **Date:**
PROJECT:_____
(TO BE SUBMITTED IN TRIPLICATES)

WORK-AT-HEIGHT PERMIT

Sl No:

I. **Name of the work:**
II. **Name of Contractor:**
III. **Exact location of work:**

Sl.	Description of the point to be checked	Pl tick (√) if it is OK
1.	Whether the manpower of the Gang engaged is having adequate number and skill required for the said activity?	
2.	Whether Supervisor has been engaged for this activity?	
3.	Whether following PPEs have been provided to all workers?	
	Full body Harness, Safety Shoe, Helmet	
4.	Whether Lifelines tied with solid anchorage above 1 M level from the job?	
5.	Whether Tool-Box meeting carried out and Hazard related to the said job and safety precaution to be taken told to workers?	
6.	Whether Fall arrestor fixed where staircase is not available for access to job?	
7.	Whether Scaffold/Platform/Place for job is strong enough, has easy access and is safe for the job? Is the Space sufficient for doing work? Whether Safety Net has been fixed?	
8.	Whether all Lifting T&Ps and Tackles have valid Fitness Certificates? Whether Lubrication is Ok? Whether these are free from any defect when visually checked before use?	
9.	Pl ensure that none of the workers of the Gang has Vertigo or High or Very Low Blood Pressure. (Health register to be referred)	

The following persons are permitted to work for the duration mentioned herein:

Date		No of persons allowed	Time Duration	
From	To		From	To

List of persons to be maintained by contractor separately

Sign of Initiator (Sub-contractor)

Sign of Recommender

Sign of Approver

Work completed/stopped/area cleared at _____on__

The permit stands closed on_____

Sign of BHEL HSE team

HSEP:13-F09

BHEL

Bharat Heavy Electricals Limited
Power Sector Eastern Region

INCIDENT (PERSONAL INJURY / PROPERTY DAMAGE) REPORT

(This report is to be sent within 24 hours directly to GM/Q &S/PS-HQ, , Noida with copy to MR(HSE)/PSER in respect of all incidents in addition to immediate Fax / Telegraphic intimation of fatalities and major damages including fires.)

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 INCIDENT		7	DATE RESUMED	
8	NO. OF WORK-DAYS LOST BY VICTIM (If duty not resumed, give estimated figure)				
9	NO. OF MANHOURS 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 INCIDENT / INJURY / DAMAGE					
12	PERSON (NAME & DESIGNATION) WITH MOST CONTROL OVER AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) CAUSING INCIDENT INJURY / DAMAGE				
13	DESCRIBE CLEARLY HOW THE INCIDENT OCCURRED AND IF THE VICTIM WAS WEARING THE APPROPRIATE PPEs. (USE ADDL SHEET, IF REQUIRED).				

ANALYSIS		
14	**WHAT ACTS AND / OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS INCIDENT**	
15	**WHAT ARE THE BASIC REASON FOR THE EXISTENCE OF THESE ACTS AND / OR CONDITION ?**	
16	**WHAT CORRECTIVE ACTIONS HAVE BEEN TAKEN TO PREVENT INCIDENT RECURRENCE ?**	
	DATE :	**SIGNATURE OF SITE HSE COORDINATOR**
17	**COMMENTS OF HEAD / SOX**	
	DATE:	**SIGNATURE OF HEAD/SOX**

BHARAT HEAVY ELECTRICALS LIMITED HSEP:13-F10
POWER SECTOR: EASTERN REGION

INVESTIGATION REPORT FROM PROJECT SITE :

INCIDENT(FATAL/SERIOUS INJURY/PROPERTY DAMAGE/FIRE)

DATE :

Instructions			
This report is to be sent within seven days to GM/Q&S/PS-HQ and RHQ Safety Department, in respect of incident requiring investigation by a committee.			
Report date	**Incident Date**	**Incident Time**	**Incident Type**
Name of Site :			
Scope of work :			
Name & Designation of BHEL Package I/C			
Name of Contractor :			
Incident Location :			
Victim(s) Information			

Name	**Designation**	**Age**	**Sex**	**Address**

Witness Information	
Name	**Address**

1	**Describe, how the incident took place (Attach separate sheets, diagrams, and photographs, if possible.)**
2	**Description of Injury (Attach medical report as applicable)**
3	**Describe property and equipment damaged in the incident and extent of damage.**
4	**Describe any personal protective equipment used and other safety equipment that were in place.**

5	**Describe any perceived actual or possible safety violations in the area of incident.**

6	**Describe events and conditions immediately before the incident.**
7	**Are these conditions still in existence?**
8	**Were any unsafe actions performed by the victim or by others or were any safety rules violated that caused/ contributed to the incident.**

9	**Describe steps taken to secure the area.**

10	**Describe measures to be taken to prevent similar recurrences.**
11	**Any other information**

Prepared by			
Name	**Designation**	**Signature**	**Date**

Submitted to:

1 Construction Manager
2 RHQ: Safety Department
3 GM/Q&S/PS-HQ

POWER SECTOR

TOOL-BOX TALK

FORMAT NO: HSEP:13-F11
REV NO.: 00
PAGE NO. 01 OF 01

Name of Site :

Sub-Contractors Name :

Date : **Topic:**

Attendance Sheet

Name	Signature	Remarks

Signature of Site I/C of Subcontractor :

RECORD OF REVISION

CLAUSE No.	Rev No.	Brief of Revision	Date
All	00	New plan introduced	05.04.17

TENDER NO: PSER:SITE:KLN-C2019:19

VOLUME -IE

FORMS & PROCEDURES

FOR

Package#10E: CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.

BHARAT HEAVY ELECTRICALS LIMITED

(A GOVT. OF INDIA UNDERTAKING)

General Manager & Construction Manager, 2x660 MW Maitree Super Thermal Power Project, PO-Kalekkharber, Union-Rajnagar, Upajila-Rampal, Dist: Bagerhat-9343, Bangladesh

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.

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.				Cost of empty gunny bags and Empty containers not returned				
6.								
7.								
8.								
9.								

10.

Total

Signature of contractor | Signature of Engineer in Charge | Signature of Senior Engineer

Date: | Date: | Date:

Form WAM 6 (contd…)

ANNEXURE D

Name of the Contractor: Contract Agreement No:
Name of the Work: Date:

Sl. No.	Description of item	Unit	Quantity as per Agreement	Quantity as executed	Quantity further anticipated	Total quantity anticipated on completion	Rate as per agreement Rs. P.
1	2	3	4	5	6	7	8

Rate as the executed with any Rs. P.	Amount as per agreement Rs. P.	Amount as executed Rs. P.	Amount further anticipated Rs. P.	Total amount anticipated on completion Rs. P.	Difference _ _ _ _ _ _ _ _ _ _ _ Excess Rs. P.	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 **												
Total as per last running account bill Rs.	Since last running account bill Rs	Total up to date Rs	Item No of the agreement/ work order	Description of work	Quantity as per agreement	Quantity executed up to date	Rate Rs. P	Unit	Payment on the basis of actual measurement up to date Rs P	Quantity since last running account bill	Payment on the basis of actual measurement since last running account bill Rs P	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13

BHARAT HEAVY ELECTRICALS LIMITED,
POWER SECTOR - EASTERN REGION, KOLKATA
TENDER NO. PSER:SITE:KLN-C2019:19

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:

BHARAT HEAVY ELECTRICALS LIMITED,
POWER SECTOR - EASTERN REGION, KOLKATA
TENDER NO. PSER:SITE:KLN-C2019:19

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:SITE:KLN-C2019:19

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

Total Value of Work Done up to date	(A)	
Deduct Value of work shown on the last running account bill	(B)	
Net value of work done since last running account bill	(C)	

Rupees (In Words).....Only

II MEMORANDUM OF PAYMENT

		Rs.	P
1	Total Value of work actually measured as per Account no I coloumn 10 (A)		
	Deduct amount of paym,ents already made as per last running account bill No ……. Dated…….		
2	Forwarded to the Accounts Office on ……. (B)		
3	Payments now to be made { (A) - (B)} (C)		
4	Deduct ammounts recoverable from the contractor on account of :	Rs	P
	a Material suplied by BHEL vide annexure A attached		
	b Hire of Tools & Plants vide Annexure B attached		
	c Other charges vide Annexure C attached		
	d Income Tax		
	Total deduction		
5	Balance		
6	Refund of 50% of security deposite on completion of work		
7	Net amount to be paid to the Contractor		

III. CERTIFICATE OF THE ENGINEER IN CHARGE

The measurement on which the entries in coulmns 7 to 12 of Part I of this bill (Account of work executed) are based were made by ……..

1 (Name and designation)

2 A statement showing the quantities of stores issued to the contractor (whether free or on recovery basis) and their disposal is attached.

Date:

Signature of Engineer in charge
Designation

IV CERTIFICATE OF THE SENIOR ENGINEER

1 Certified that I have personally inspected the work and that the work has been physically completed on the due date in accordance with the terms and
Cretified that the measurements have been check measured to the prescribed extent by …….
…… (Name & designation). And by the the undersigned at site and relevent entries have been initiated in the measurement book (vide
2 pages…… ….)
3 Certified that the methods of measurement are correct
4 Certified that the measurements have been technically checked with reference to contract drawings, deviations etc
5 Certified that all the measurements recorded in the measurement book have been correctly billed for at the contract rates or approved rates.
6 Certified that all the recoverable amounts in respect of stores, tools and pa\lant, e\water, electricity charges etc, have been correctly made vide Annexures A
7 Certified that the issues of all stores as per statement atytached (whether charged to the contractor or direct to the work) have been technically checked and

Certified for payment of * Rs ……. (Rupees…… (Only). To be paid in cash/by cheque in the presence of ……..

ALLOCATION

The expenditure as under and to be included in the accounts for ……..19

Ledger Head	Debit (Gross Amount) Rs. P	Credit (Deduction) Rs. P
……	……	……
Total	……	……

* Here specify the net amount payable

Signature of Senior Engineer
Date

V. ENTRIES TO BE MADE IN THE ACCOUNTS OFFICE

Account Bill no…… Dated …….
Entered in Journal book vide entry No……Dated……
Passed for……..Rs……..
Less Deductions……..Rs……
(Rupees…….Only)
Payable to Shri/M/s…….... by cheque/cash
Entered in contractors' Ledger no..... Page

Assistant Accountant Accounts officer
Date: Date: Date:

ALLOCATION

Estimate No: Code No

Name of the Work ……

Ledger Head	Debit (Gross Amount) Rs P	Credit (Deduction) Rs
…….	.....	.....
Total	.....	.....

VI. Received Rs……..(Rupees……..Only) in full and final settlement of all moneys due under this contract and I / we have no further claims of this contract.

Signature of Witness
Address

Revenue Stamp
Signature of Contractor
Date:

VII . ENTRIES TO BE MADE BY TREASURY SECTION

Cash book entry no and date :

Amount Paid Rs……
Amount unpaid Rs……..
Total Rs……..

Signature of Cashier
Date:

ANNEXURE A

Part I

Statement showing details of material issued to the contractor Shri/M/s…….. In respect of Contract Agreement/Work Order No…….. Dated …….

Sl No	Stores Issue voucher No and date	Issue voucher No and date alloted by stores to the SIV	description of material issued to the contractor	Quantity issued	Quantity actually incorporated in the work	Whether recoverable from the contractor or supplied free	If recoverable from contractor						Remarks
							Rate at which recoverable		Amount Recoverable		Amount recoverable upto previous bill		Balance Now recovered		
							Rs	P	Rs	P	Rs	P	Rs	P	
1	2	3	4	5	6	7	8		9		10		11		12

Total ……

Signature of Contractor
Date

Signature of Engineer in charge
Date

Signature of Senior Engineer
Date

ANNEXURE A

Part II

Statement showing details of material issued to the contractor Shri/M/s…….. in respect of Contract Agreement/Work Order No…….. Dated ……and not covered by the agreement

Sl No	Stores Issue voucher No and date	Issue voucher No and date alloted by stores to the SIV	description of material issued to the contractor	Quantity issued	Quantity actually incorporated in the work	Issue Rate Rs P	Amount Recoverable Rs P	Amount recoverable upto previous bill Rs P	Balance Now recovered Rs P	Remarks
1	2	3	4	5	6	7	8	9	10	11

Total ……

Add Departmental Charges

Add Sales Tax (wherever applicable) ……..

Total ……..

Signature of Contractor
Date

Signature of Engineer in charge
Date

Signature of Senior Engineer
Date

ANNEXURE B

Statement showing TOOLS & PLANTS issued to the contractor Shri/M/s…….. in respect of Contract Agreement/Work Order No…….. Dated ……and not covered by the agreement

Sl No	Description of tools & plants issued	Period for which issued	Rate at which Recivery is to be made	Amount recoverable Rs P	Amount recoverable upto previous bill Rs P	Balance Now recovered Rs P	Remarks
1	2	3	4	5	6	7	8

Total ……

Signature of Contractor
Date

Signature of Engineer in charge
Date

Signature of Senior Engineer
Date

ANNEXURE C

showing detail of other recoveries to be made from the contractor Shri/M/s……
nent/Work Order No……Dated……

Sr.No	Particulars	Unit	Quantity	Rate Rs. P.	Amount recoverable Rs. P	Amount recovered upto previous bill Rs. P.	Amount now recovered Rs. P.	Remarks
1	2	3	4	5	6	7	8	9
1	Water Charges							
2	Electricity Charges							
3	Seignorage Charges							
4	Medical Charges							
5	Cost of empty gunny bags and empty containers not returned							
6								
7								
8								
9								
10								
	Total							

Signature of Contractor
Date

Signature of Engineer Incharge
Date

Signature of Sr. Engineer
Date

Form WAM 7 (Contd.)

ANNEXURE D

DEVIATION STATEMENT

Name of the Contractor :
Name of the Work :

Contract Agreement/Work Order No. :
Date :

Sl. No.	Description of item	Unit	Quantity as per agreement	Quantity as executed	Rate as per agreement Rs. P.	Rate as executed Rs. P.	Amount as per agreement Rs. P.	Amount as executed Rs. P.	Difference		Reason for the deviation with authority, if any
									Excess Rs. P.	Savings Rs. P.	
1	2	3	4	5	6	7	8	9	10	11	12

Signature of Engineer in Charge
Date :

Signature of Senior Engineer
Date :

Form WAM 7 (Contd.)

ANNEXURE E

Statement showing the consumption of materials issued to the contractor Shri/M/s.....
in respect of Contract Agreement/Work Order No..... Dated.....

Name of the Work :

ON RECOVERY BASIS

Sl. No.	Description of material	Unit	Quantity actually issued	Quantity actually incorporated in the work	Balance	Particulars of disposal of balance	Quantity to be issued as per approved data for work actually done	Variation in consumption (Difference between column 5 and 8)		Rate chargeable for excess/ short consumption, if any	Amount recoverable for excess/ short consumption, including materials not returned	REMARKS
								More	Less	Rs. P.	Rs. P.	
1	2	3	4	5	6	7	8	9	10	11	12	13
1.	Cement											
2.	Bricks											
3.	Wood.....											
4.	Asbestos Sheet											
5.	Iron Materials											
6.												
7.												
8.												
9.												
10.												

Signature of Contractor
Date :

Signature of Engineer in Charge
Date :

Signature of Senior Engineer
Date :

Note : 1. The quantities shown in columns 4 and 5 above should tally with those shown in columns 5 and 6 respectively of Annexure A (Part I and II).

2. Data statement of theoretical consumption should be attached in support of quantity specified in column 8.

ANNEXURE F

Statement showing detail of materials issued to the contractor Shri/M/s……
ct of Contract Agreement/Work Order No……Dated……

Name of work; **FREE OF COST**

Sr.No	Stores issue voucher No.	ription of ma	Unit	Quantity issued	Quantity requried as per data	Quantity consumed in the work	Balance(If any)	Nature of disposal for the balance	Rate chargeable for material not returned Rs.P.	Amount recoverable for material not returned Rs. P	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
		Total									

Signature of Contractor
Date

Signature of Engineer Incharge
Date

Signature of Sr. Engineer
Date

Note:Data statement of therotical consumption should be attached in support of the quantity specified in coloumn 6

ANNEXURE G

QUESTIONNAIRE TO BE ANSWERED BY ENGINEER IN CHARGE AND SENIOR ENGINEER	
(Correct particulers and answers to be recorded)	
Name of the work :	
Name of the Contractor :	
Date of commencement of the work:	
Contract agreement/work ordered no. and date:	
Reference to supplementary agreement no,if any :	
Whether adminstrative approval and techanical sanction has been accorded by the cmpetent authority ? If so ,citc reference	
Whether sanction of the competent authority and financial concurrencr of the Accounts Departnment for award of the work has been accorded ? If so,cite reference.	
Wheter the work has been completed in time ? If not ,wheter penalty has been levied or sanction of the competent authority for extension of time granted and communicated to the Accounts Department with reasons for grant of extension? (Due and actual date of completion of the work and reference to letter no. and date granting the extension of time should be given)	
(a) Wheter the rates allowed in the bill have been checked with the contract agreement ? (b) Wheter the rates for extra/supplemental items have been approved by the competent authority and the sanction communicated to the accounts Department together wiht rate analysis? If so,cite reference.	
Wheter deviations have been approved by the competent authority? If yes, give reference to the approval; if not, give reasons.	
Whether the rates of recovery of stores issued to the contractor which are not provided for in the Contract Agreement have been settled in counsultation with Finance?	
Whether discrepancies pointed out by the Accounts Department in the store statement have been reconciled and accepted by the Accounts Department?	

ANNEXURE G

QUESTIONNAIRE TO BE ANSWERED BY ENGINEER IN CHARGE AND SENIOR ENGINEER	
(Correct particulers and answers to be recorded)	
Whether materials issued to the contractor in excess of the theoretical requirements have been returned to the Stores Department and the no. and date of such retuened stores vouchers have been shown in stores statement? If not ,whether the cost of such excess material has been recovered at the prescribed rate? Whethre consumption statements in respect of materials chargeabale to the work have been attached to the bill?	
Whether consumption of materials shown has been technicaly checked by Senior Engineer?	
Whether materials isshued and used in the work is not less then that required for consumption in work accroding to our specification? If comsumption is less, whether necessary recovery has been made in the bill?	
Whether mesurments have been checked by the Engineer and Sr. Engineer to the extent required and certificates of check recorded in the mesurments books?	
Whether contractor has signed the bill and the mesurments books without reservations? If not; whether resones have been intimated to the Accounts Department?	
Whethet arithmatical calculations have been checked and certificate recorded in the mesurment books by a person other than the one who calculated initially	
Whether any work was done at the risk and cost of the contractor and whether such cost has been recovered from him? Give particulers.	
Whether all advance payments on running Accounts have been recovered?	
Whether tall the recovries due to services given to the contractor like rent of accommodation, water charges, electricity charges etc. have been recovered and wheather payments made by the company on behalf of the contractor have been adjusted?	
Whether the files containing abstracts from mesurments books/ standared mesurment books have been completed/ updated?	
Whether hire charges of tools and plant have been recovered and the statement of hire charges with full details attached?	

ANNEXURE G

QUESTIONNAIRE TO BE ANSWERED BY ENGINEER IN CHARGE AND SENIOR ENGINEER	
(Correct particulers and answers to be recorded)	
Whether the certificate of workmanship and completion of work according to specifications, drawings etc. is recorded by Engineer/ Sr. Engineer and whether recoveries have been made for defective works, if any?	
Whether all corrections in the bill/measurement books etc. have been neatly made and attasted and there are no overwriting?	
Whether final measurments have been taken as soon as possibal after completion of work and the cretificate of complition issued? If not, whether resons for delay have been recorded and communicated to Accounts?	
In respect of Quintites reduced in the final bill as compare to the running payment, whether adequate reasons have been recorded and communicated to Accounts	
Whether the Expeinditure has been classified correctly according to heads of Account recorded in the sanctioned estimate?	
Whether the work has been completed within the estimated cost? If not, what is the percentage of excess over thw sanctioned estimate/ addministrative approval? In case the excess is beyond the competency of Sr. Engineer, what action has been taken for the obtaining the approval of the authority complent to sanction the excess?	
(a) If the contractor has furnished bank guarantee in lieu of cash sequrity deposit towards proper exicuation of works and guarantee against defectsduring the maintenance period, whether the period of currency of the bank guarantee cover the entire maintenance period? (b) If not, whether sequrity deposite has been proposed to be recovred from the final bill?	
Whether all the previous audit objections raised on running Account bills have been settled? If so, cite refrence.	
Signature of Engineer in Charge	Signature of Engineer in Charge
Date:	Date:

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.

TENDER NO: PSER:SITE:KLN-C2019:19

VOLUME -IF

TECHNICAL CONDITIONS OF CONTRACT

(TCC-CML)

FOR

Package#10E: CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.

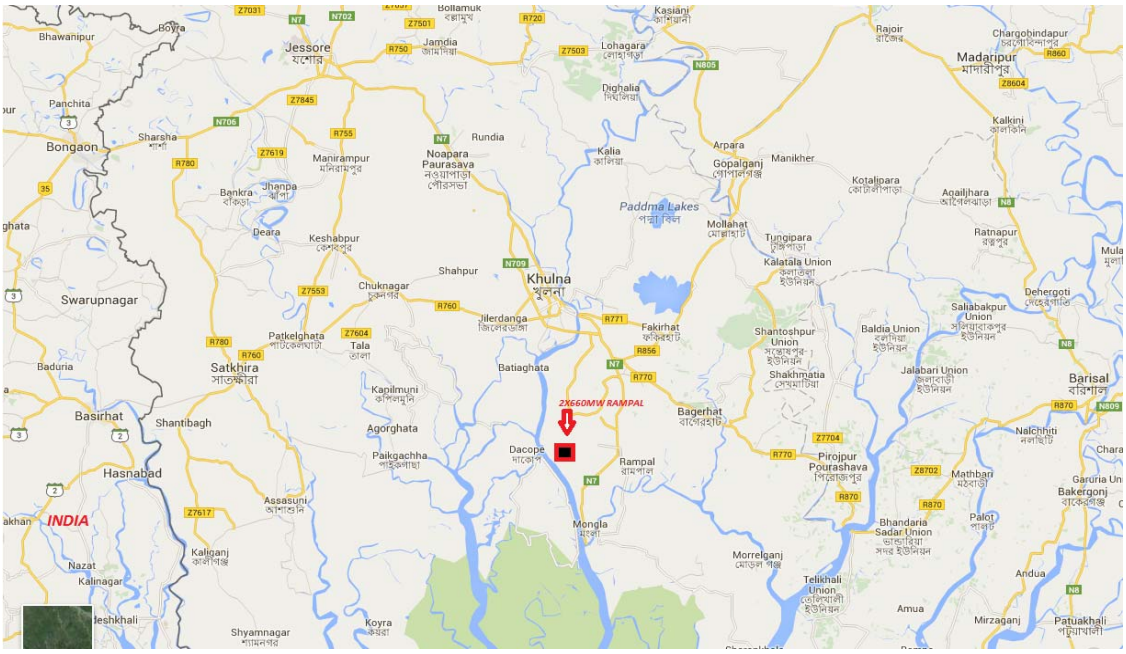
BHARAT HEAVY ELECTRICALS LIMITED

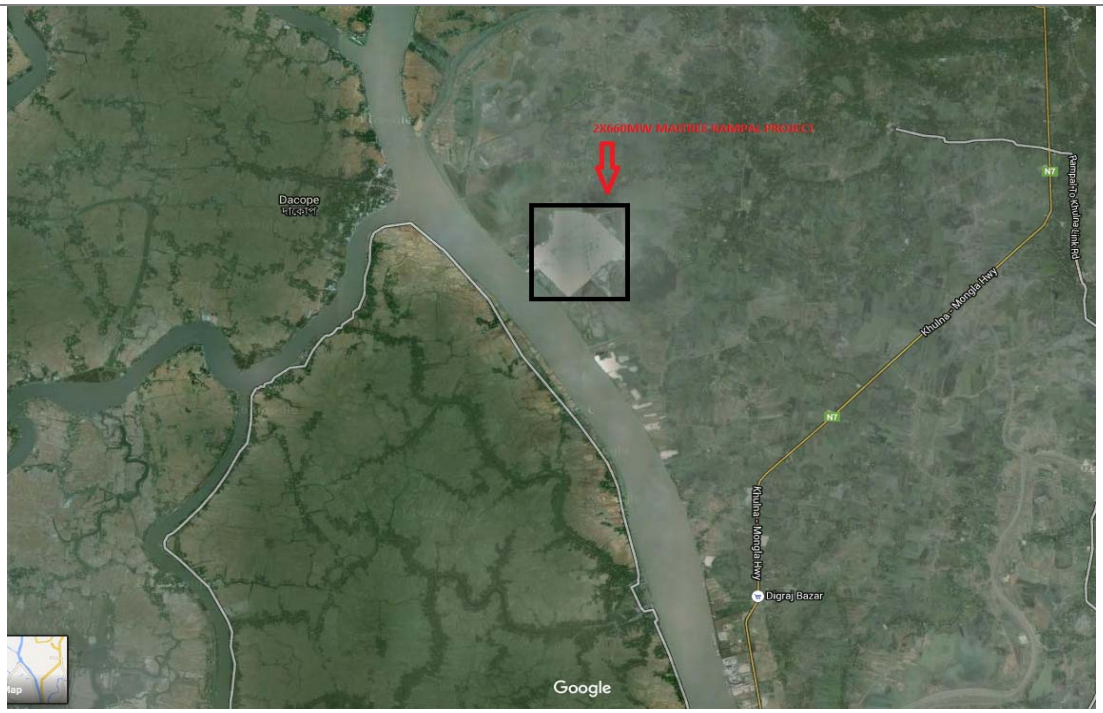
(A GOVT. OF INDIA UNDERTAKING)

General Manager & Construction Manager, 2x660 MW Maitree Super Thermal Power Project, PO-Kalekkharber, Union-Rajnagar, Upajila-Rampal, Dist: Bagerhat-9343, Bangladesh

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1.0	**PROJECT SYNOPSIS AND GENERAL INFORMATION**
1.1	The 2 x 660 MW MAITREE SUPER THERMAL POWER PROJECT is located in Moithara Village, Rampal Upazila, Bagerhat District, Bangladesh. The Bidder shall acquaint himself by a visit to the site, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data / information as may be necessary shall have to be obtained / collected by the Bidder.  LOCATION MAP:2X660MW MAITREE RAMPAL PROJECT



LOCATION MAP:2X660MW MAITREE RAMPAL PROJECT

1.2	APPROACH TO SITE
	The nearest town Khulna is at a distance of 23 km from project site. The site is Connected by road from Mangla- Khulna Highway. Nearest Domestic airport is Jessor, Bangladesh at a distance of about 93 KM and international airport is Dhaka at a distance of 263 KM, Bangladesh
1.3	Owner: BIFPCL (**BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED)**
2.0	**SCOPE OF THE CONTRACT**
2.1	The scope of work is indicative but not limited to the given below. **SCOPE OF WORK** **CIVIL & ARCHITECTURAL WORKS FOR** • **RAW WATER PUMP HOUSE,** • **DESILTING CHAMBER,** • **RW ELECT ANNEXE & RW CHLORINATION** • **ANY OTHER BUILDING/MISC.WORK FOR 2X660 MW MAITREE RAMPAL PROJECT, BANGLADESH.** **SPECIAL NOTE:** **PILE INSTALLATION HAS BEEN ALREADY COMPLETED IN DESILTING CHAMBER, RAW WATER PUMP HOUSE, RAW WATER ELECTRICAL ANNEXE BUILDING BY OTHER AGENCY. PILE HEAD BREAKING SHALL BE CARRIED OUT BY OTHER AGENCY AFTER EXCAVATION AND PCC BY BIDDER. PILE HEAD BREAKING IS NOT INCLUDED IN THE SCOPE OF BIDDER. HOWEVER, IF PILE HEAD BREAKING IS REQUIRED TO BE EXECUTED SAME SHALL BE PAID AS PER RELEVANT ITEM OF BOQ.**

	THE RAW WATER PUMP HOUSE WORK HAS BEEN ALREADY EXCAVATED PARTIALLY BY PREVIOUS VENDOR WITH SHEET PILE INSTALLED. THE ACCUMULATED SILT / MUD REQUIRED TO BE REMOVED SHALLIS INCLUDED IN THE SCOPE AND SHALL BE PAID AS PER RELEVANT ITEM OF BOQ. THE BIDDER IS SPECIFICALLY ASKED TO VISIT THE SITE AND APPRAISE HIMSELF OF THE PREVAILING SITE CONDITION, OBTAIN CLARIFICATION OF ANY QUERRY, BEFORE QUOTING FAILING WHICH THEIR BID IS LIABLE FOR REJECTION.
2.2	The works to be performed under this contract consist of providing all labour, supervision, material, scaffolding, construction equipments, tools and plants, temporary works, supplies including POL, transportation and all incidental items not shown or specified but reasonably implied or necessary for the proper completion of work in all respects. Testing of all materials, concrete, earthwork other allied works, preparation of bar bending schedules on the basis of construction drawings, preparation of fabrication drawings etc. are included on the rates of items of work. Works shall only be carried out with approved structural fabrication drawings.
2.3	The area of work shall be cleared of all vegetation, rubbish and other objectionable matter and materials remove shall be burnt or otherwise disposed of as directed by the Engineer-in-Charge. No separate payment for these operations shall be made. The cost of all these operations shall be deemed to have been included in the unit rates rendered for the different items under bill of quantities.
2.4	All the works areas shall be adequately flood lighted to the satisfaction of the Engineer-in-Charge when the work is in progress during the night shifts.
2.5	The unit rates shall include all material equipment, fixtures, labour construction plant, temporary works and everything whether of permanent or temporary nature necessary for the completion of job in all respects.
2.6	The unit rates for various items of B.O.Q shall include all the stipulations mentioned in Section C and technical specifications under Section D and nothing extra over B.O.Q rates shall be payable.
2.7	Drawings showing enough details for the construction as per the specification shall be furnished to the contractor in a phased manner as far as possible.
2.8	The bidder should fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, local conditions, soil strata and site specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may have not been specifically brought out in the specifications.
3.0	**SITE VISIT**
3.1	Contractor should visit site and acquire full knowledge & information about site conditions prevailing at site and in and around the plant premises together with all the statutory, obligatory, mandatory requirements of various authorities before submission of the bid. In line with the above, site visit confirmation will be required to be submitted by the bidder with the technical bid.
3.1	**OPEN SPACE FOR OFFICE & STORAGE**
3.1.1	Open spaces for material storage yard & construction of temporary site office may be allocated as made available by the customer / BHEL free / hire charges. Contractor has to make his own arrangements for labour colony including Electricity and water for the labour colony.
3.1.2	Construction of necessary stores and storage of materials shall be in contractor's scope. BHEL shall provide available space as received from customer on mutually agreed basis. Security of stores & work place shall be in Contractor's scope.
3.1.3	**REMOVAL OF TEMPORARY FACILITIES**
	When the Work is completed all such temporary structures and facilities shall be removed from the Site and the area shall be restored to its original condition
3.2	**WATER**

3.2.1	BHEL will provide construction water at one point at mutually agreed point or within 500 m from work premises, **free of cost to the contractor**. Bidder to note that no ground water is allowed for construction purpose by the project authority.
3.2.2	Further necessary network for construction water system shall be done by the bidder at his own cost.
3.2.3	Contractor should arrange on their own drinking water in their labour colony.
3.2.4	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.
3.2.5	Contractor will have to arrange for storage of water to meet the day-to-day requirement.
3.2.6	The availability of water (construction as well as drinking) in Maitree 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.
3.3	**ELECTRICITY**
3.3.1	CONSTRUCTION POWER & GENERAL ILLUMINATION NETWORK:- BHEL Shall Provide Construction Power **free of charge** at 415V level at one point (within 500 M from his workplace / batching plant), bidder has to make his own distribution arrangement to draw electricity. The bidder will have to procure & install adequate area illumination system during construction right from start of his work. This system will include temporary pole lighting, portable lighting towers with sufficient DG back-up for area lighting at different working areas for execution of the work & safety of workmen within the quoted rate. The illumination should be such that minimum illumination requirement as specified in specification or any-where 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 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.
3.3.2	The bidder shall have to provide earth leakage circuit breaker at each point wherever human operated electrical drives / T&Ps are deployed.
3.3.3	The power supply will be from the available source of customer. 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.
3.3.4	Bidder will have to arrange sufficient illumination at their own work areas.
3.3.5	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.
3.3.6	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.
3.3.7	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
4.0	**TOOLS & PLANTS**
4.1	All the tools and plants required for execution of the above work are in contractor's scope.
5.0	**MATERIAL HANDLING (BHEL ISSUED MATERIAL)**
5.1.1	Reinforcement (TMT bar) earthing Strip/Bar, structural steel (MS plate/ ISMB/ channel/ angle/chequred plate/ stainless steel plate/liner) 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. Please note that BHEL will only issue the above free materials if has written in the description of the BOQ.
5.1.2	Consignment steel will be directly issued to the contractor as received by BHEL, on weighment basis from its supplier, as per delivery challan of supplier.
5.1.3	Handling of steel of total project including its unloading will be in vendor's scope for which no separate payment will be given by BHEL.
5.1.4	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.
5.1.5	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.
5.1.6	It would be the responsibility of the contractor to sign on the delivery book acknowledgement slip of supplier/ transport authorities etc.
5.1.7	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.
5.1.8	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.
5.1.9	Unloading of materials at the storage yard or at places designated by BHEL, stacking & restacking, shifting & reshifting, 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/equipments 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 of this package). All other material handling equipments like winches, d-shackles, slings of various sizes, max puller, pulley blocks, jacks, trucks, tailors etc required for such material handling of steel etc. shall be arranged by contractor within quoted/accepted rates.

5.1.10	It will be the responsibility of the contractor to submit computerized account of all such consignments of materials received by them, daily to BHEL.
5.1.11	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.
5.1.12	Open land (very limited space) for storage shall be provided by BHEL on free of cost basis as per availability. You shall maintain one centralized fenced store cum bar bending yard (Area Approx. 50mx50m). Hard surfacing of this yard and all round drain shall be carried out by you at your own cost within the accepted rate. Batching plant area shall be provided within plant premises and you shall make use of the area for installation and operation of the Batching Plant at your own cost. You shall make complete arrangement of necessary security personnel, to safeguard all such materials in your custody. Materials issued will be used only for construction of permanent work. You shall take care of material issued by BHEL and shall protect the same from theft, damage and weathering. Barbed wire fencing of the steel storage yard, batching plant area, reinforcement bending yard area etc. are to be done by the contractor at his own cost. 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.
5.1.13	The contractor shall construct waterproof cement store (capacity up to 300 MT) for storing and stacking of cement, CGI / asbestos roofing (slope) with brick masonry wall, PCC flooring or container. 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 cement is to be done as per BS codes with proper illumination and locking arrangements.
5.1.14	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.
5.1.15	Excessive rusting of steel must be avoided. In case, due to any cause attributable to the contractor, such clotting of and/ or rusting of steel occur rendering the same unusable, then such quantity of steel shall be recovered from the interim payment at the penal rate specified in the tender.
5.1.16	No material shall be issued to the contractor except as those indicated above, i.e. steel 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.
5.1.17	The contractor shall maintain proper store account for all the BHEL issued materials and shall give three copies of monthly computerised reconciliation statement of such account to the BHEL.
5.1.18	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.
5.1.19	The contractor shall solely be responsible for the safety & quality of material after it is handed over and issued to contractor by BHEL.
5.1.20	BHEL issued materials shall not under any circumstances be taken out of the project site unless otherwise permitted by BHEL.
5.1.21	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.
5.1.22	No separate rate will be applicable for the above job. The contractor will quote the rate for the items inclusive of all charges for the above job.
5.1.23	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.
5.2	DELETED
5.3	**ISSUE OF STEEL** (Steel shall be provided against respective items of the BOQ where mentioned that Steel shall be supplied by BHEL as free of cost)
5.3.1	The steel shall be issued to the contractor free of cost on the following basis.
5.3.1.1	Structural steel (MS plate, angle, channel, ISMB, Stainless steel plate/Liner, chequered plate and EOT crane rails) – Weighment basis (unit – MT).
5.3.1.2	Reinforcement steel(TMT) and earthing rod (MS round) – Weighment basis (unit – MT).
5.3.2	All the steel (structural steel, reinforcement, earthing strip/bar) issued by BHEL shall be properly accounted for. The total quantity of steel required for the work will be calculated from the approved Bar Bending schedule, fabrication drawings, approved laps, chairs and lugs. The measurement for payment as well as for accounting shall be based on the sectional weights
5.3.3	In case any such sectional weights are not available in the above documents, the manufacturer recommendation shall be binding.
5.3.4	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.
5.3.5	In case MS flats as required in the fabrication of structures are not available, you shall cut such width out of the available MS plates to make flats at no extra cost till such material is available and procured by BHEL.
5.3.3	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.
5.4	**ISSUE OF READY MIX DESIGN(RMC)**
5.4.1	The RMC shall be issued to the contractor free of cost as per item of the Price Schedule.
5.5	**Quarterly requirement of steel** must be positively submitted by the contractor at the last month of the previous quarter, In addition, the contractor shall also furnish the estimated requirement of steel during a month by the third week of the previous month indicating his requirement.
5.6	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
5.7	Bidder to note that steel required for his enabling job like store/ site office etc. shall be arranged at his own cost.
5.8	**RETURN OF MATERIALS**
5.8.1	RETURN OF STEEL INCLUDING SCRAP
5.8.1.1	All surplus steel and all wastage materials will be taken back on weighment basis.

5.8.1.2	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.		
5.8.1.3	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 to handling and transportation and incidental charge.		
5.8.1.4	Scrap for reinforcement steel and structural steel shall be returned separately		
5.9	**RMC & STEEL CONSUMPTION AND WASTAGE**		
5.9.1	READY MIX CONCRETE (RMC) WASTAGE		
5.9.1.1	Allowable wastage – One and half (+1.5%) of theoretical consumption of RMC unless specified otherwise in the technical specification.		
5.9.1.2	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.		
	SL	RMC 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
5.9.5	REINFORCEMENT STEEL CONSUMPTION		
5.9.5.1	The theoretical consumption of various diameters 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.		
5.9.5.2	Actual consumption = Issue – Surplus.		
5.9.5.3	Surplus = Un-tampered and unused quantity of steel returned by the contractor to BHEL store along-with relevant documents. However, cutpieces of length greater than or equal to 5.0 m in good condition as per judgement of the engineer will also be treated as surplus steel. If contractor will be deposited/handed over to BHEL more than wastage quantity as specified in clause No. 5.10.1 & 5.12.1 then same quantity will not be taken in Reconciliation statement and bidder will not be received of any financial benefit.		
5.9.5.4	Wastage = Actual consumption – Theoretical consumption.		
5.10	REINFORCEMENT STEEL & CLADDING SHHET WASTAGE		
5.10.1	Allowable wastage – Three Percent (+3%) of the theoretical consumption shall be considered as allowable wastage.		
5.10.2	Wastage and scrap shall be as per actual weighment basis.		
	SL	Reinforcement steel	Basis of issue & penal recovery
	R-1	Theoretical consumption (without considering wastage and scrap or loss for RS, Cladding sheet lapping will be consider for reconciliation)	Free
	R-2	Wastage limited to plus three percent (+3%) of aforesaid theoretical consumption (R-1) towards allowable wastage.	Free

	R-3	Wastage beyond three percent (+3%) of the theoretical consumption above (R-1).	Penal rate
5.11	STRUCTURAL STEEL CONSUMPTION		
5.11.1	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.		
5.11.2	Actual consumption = Issue – Surplus.		
5.11.3	Surplus = Untempered, unused, uncut quantity of steel returned by the contractor to BHEL store.		
5.11.4	Wastage = Actual consumption – Theoretical consumption.		
5.12	STRUCTURAL STEEL WASTAGE (Except Fabricated Structural Steel as supplied by BHEL as free of cost, NO wastage will be permitted for fabricated structural steel)		
5.12.1	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. four percent).		
	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-2	Wastage limited to plus four percent (+4%) of the aforesaid theoretical consumption (S-1) towards allowable wastage.	Free
	S-3	Wastage beyond four percent (4%) of the aforesaid theoretical consumption (S-1).	Penal rate
5.13	**COPPER STRIP/BAR/CONDUCTOR CONSUMPTION**		
5.13.1	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.		
5.12.2	Actual consumption = Issue – Surplus.		
5.12.3	Surplus = Un-tempered, unused, uncut quantity of steel returned by the contractor to BHEL store.		
5.12.4	Wastage = Actual consumption – Theoretical consumption.		
5.13	**COPPER STRIP/BAR/CONDUCTOR - WASTAGE**		
5.13.1	Allowable wastage – 0.5% (Half percent) of the theoretical consumption shall be considered.		
5.14	All wastage reinforcement, MS round/Copper Strip/Copper bar, structural steel shall be returned to BHEL.		
5.15	**RECONCILIATION OF BHEL ISSUED MATERIALS**		
5.15.1	The contractor shall submit a reconciliation statement of RMC and steel issued to him once in two months. The same may be submitted along with each RA bill.		
5.15.2	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 material are available with contractor's custody at site.		
5.15.3	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.		
5.15.4	The approved drawings/ bar bending schedules are to be considered for the purpose of reconciliation of materials.		
5.16.0	**RECOVERY OF MATERIAL**		

5.16.1	If wastage exceeds the specified limit, the recovery of excess wastage shall be made from monthly RA bill at the penal rate stipulated below.	
5.16.2	PENAL RATE OF MATERIALS	
	Item	Penal rate (USD)
	Reinforcement steel etc.	1000/- per MT.
	Structural steel/GI Flat	1560/- per MT.
	Tined Copper Strip/Bar/Conductor/SS Plate	9000/- per MT.
	Ready Mix Concrete (RMC)	105% of BHEL purchase cost.
6.0	**INSPECTION, TESTING AND INSPECTION CERTIFICATES**	
6.1	The engineer, his duly authorized representative and / or an outside inspection agency acting on behalf of BHEL / owner shall have access at all reasonable times to inspect & examine the materials & workmanship of the works during its manufacture and if part of the works is being manufactured or assembled on other premises or works, the vendor shall obtain for the engineer and for their duly authorized representative permission to inspect as if the works were manufactured or assembled on vendor's own premises or works. Necessary arrangement for carrying out inspection including supply of labour, IMTEs, area illumination and scaffolding, if required will be vendor's responsibility and same has to be carried out within the quoted price.	
6.2	To facilitate advance planning of inspection in addition to giving inspection notice the vendor shall furnish quarterly inspection program indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each 3 consecutive months and shall be furnished before beginning of each calendar month.	
6.3	Before any plant / equipment leaves the place of manufacture, BHEL shall be given the option of witnessing inspections & tests for compliance with specifications & related standards. The vendor shall give the engineer/ inspector 15 days written notice of any material being ready for testing. Such test shall be to the vendor's account except for the expenses of the inspector. The engineer / inspector, unless the inspection is waived will attend such tests within 15 days of the date on which the equipment is notified as being ready for test / inspection, failing which the vendor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports.	
6.4	The engineer or inspector shall within 15 days from the date of inspection as defined herein give notice to the vendor of any objection w.r.t. drawing / equipment / workmanship which in his opinion not in accordance with the specification / contract. The vendor shall either make modification as may be necessary to meet the said objection or explain to the engineer/ inspector giving reasons that no modifications are necessary to comply with the contract.	
6.5	When the factory tests have been completed at the vendor's or sub-vendor's works, the engineer or inspector shall issue a certificate to this effect within reasonable time after completion of tests but if the tests are not witnessed by the engineer or Inspector the certificate shall be issued within 15 days of the receipt of vendor's test certificate by the engineer inspector. Completion of these tests or the issue of the certificates shall not bind BHEL to accept the equipment should it on further tests after erection be found not to comply with the contract.	
6.6	In all cases where the vendor provides the tests at the premises of the vendor or any sub-vendor, the vendor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the engineer/ inspector to carry out effectively such tests on the equipment in accordance with the contract and shall give facilities to the engineer/ inspector to accomplish testing.	
7.0	**INSURANCE**	
	The contractor shall make available the original insurance cover(s) taken by him, against his T&P, assets and workmen compensation and any other cover as may be pertinent to his works and obligatory in terms of law, to BHEL for necessary verification in regard to their adequacy, before	

	commencement of work. However, irrespective of such verification/ acceptance, the responsibility to maintain adequate insurance coverage at all times during the period of the contract shall be of the contractor alone. Such insurance covers to be taken shall be in the joint names of the owner and the contractor. The contractor shall however be authorised to deal directly with the Insurance company(s) and shall be responsible in regard to maintenance of such insurance covers Insurance covers to be taken by BHEL / Customer shall be as stipulated under relevant clause of Volume-IB.
8.0	**DEVIATIONS/ CLARIFICATIONS**
8.1	Normally no deviation with respect to tender is acceptable to BHEL. However, in case of unavoidable circumstances, the bidder may submit their query for seeking clarifications of BHEL as per modality stipulated in NIT or may submit the same along with his offer as per prescribed 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.
9.0	**DEWATERING**
9.1	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.
10.0	**TIME SCHEDULE/ COMPLETION PERIOD**
10.1	The entire work under the scope of work shall be successfully completed in all respect within **8 (Eight) months** from date of start of work, as certified by Construction Manager, BHEL. Mobilization at site shall be done within 20 days from date of written intimation from BHEL. The exact date of start of work shall be reckoned based on certificate of Construction Manager, BHEL.

Sl no.	Major Milestone	Months from the of start of work
1	Construction of Pile Cap of Raw Water PH	2.5 Months
2	Construction of Bottom raft of De-silting Chamber	3.5 Months
3	Readiness of De-silting Chamber	7.5 Months
4	Completion of RWPH	6.5 Months
5	Completion of RW Elect Annexe & RW Chlorination & Balance work, if any.	7 Months
6	Overall Completion and handing over	8 Months

The above milestones have been prepared in line with L2 schedule of BHEL & BIFPCL. A major milestone of different activities in L2 schedule for Unit #1 & Unit #2 with BIFPCL is given below. Contractor shall also responsible to complete the foundations/structures in their scope of contract within schedule time frame of project Milestone as given below.

	Successful bidder shall furnish L-1, L-2/ L-3 schedule indicating break-up of start & finish dates of different activities for matching with following project schedule, for approval of BHEL. The successful bidder should also ensure monitoring of these activities on daily/ weekly/ monthly basis, whenever required by BHEL.
11.0	**PRICE BID**
11.1	Bidders should quote prices in USD as per format, Volume-III-Price Schedule provided in the tender. Bids shall be evaluated based on total price quoted.
12.0	**TERMS OF PAYMENT**
12.1	The contractor shall submit his running bill (RA bill) once in a month at the end of each month in line with payment terms/ billing schedule indicated below. The RA bill complete in all respects accompanied by BHEL engineers certified/ measurement sheet, jointly signed, will be paid after passing of the bill subject to completeness & correctness. The measurement will be taken as specified in terms & conditions of contract and certified by the BHEL engineer of actual work. However, no extra payment shall be made in the event of delay in release of payment. 95% pro-rata monthly RA payment shall be considered for payment based on monthly work completion certificate to be issued by BHEL engineer as per approved BBU/Price Schedule. The payment shall be released within 60 days from the date of receipt of complete invoice along with all necessary documents including Engineering Certificate.
12.2	Out of above 95%, 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 contractor 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.
12.2.1	0.7 % shall be paid on compliance of housekeeping of contractor's working area and store/ office areas.
12.2.2	0.3 % shall be paid on compliance of general illumination of contractor's working area and stores, office area.
12.2.3	0.2 % shall be paid on compliance of applicable OHSAS requirement as per guidelines of BHEL/ PSER and as specified in the tender.
12.2.4	0.3 % shall be paid on compliance of applicable safety requirement as per guidelines of BHEL/ PSER and as specified in the tender.
12.3	Balance 5% of contract value shall be paid against FAC (Final Acceptance Certificate) to be issued by BHEL / BIFPCL after completion of warranty period. However, if desired by vendor, this 5% may be released by BHEL against submission of equivalent amount bank guarantee as per Performance Bank Guarantee format, to be kept valid till warranty period, subject to the followings:
12.3.1	(i) Receipt of certificate that all works are completed in all respects;
12.3.2	(ii) Reconciliation of materials / T&P / MMD;
12.3.3	(iii) Completion of final bill formalities and
12.3.4	(iv) Handing over to BHEL.
12.4	Contractor shall make their own arrangement for making payment of impending labour wages and other dues in the meanwhile.
12.5	Contractor have to submit BHEL entry gate pass of steel, and other materials required for the work, in absence of which their corresponding RA bills shall not be processed.
12.6	Subject to any deduction which BHEL may be authorized to make under the contract, the contractor shall on the certification of the BHEL engineer at site, be entitled to payment explained hereunder.

12.7	The bills will be sent to BHEL, Site Finance for scrutiny and payment will be made after processing / verification only.
12.8	The measurement will be taken by BHEL engineer as per relevant clause of GCC and certify regarding actual work executed in measurement book and bills for work. However no additional payment shall be made in the event of delay in release of payment beyond the stated period.
12.9	All admissible recovery / adjustment, etc. shall be made from interim payable amount.
12.10	BHEL site at its discretion may split up percentage break up and effect payment to suit the site condition, cash flow requirement, according to the progress of work.
12.11	Payment shall be made in USD as per order. However for reasons, solely at the discretion of BHEL, if USD amount is not possible to be paid then BDT equivalent of USD will be paid as per of our currency Matrix. The quoted / accepted rate shall remain Firm throughout the contract period including extension period, if any, without any escalation till handing over.
13.0	DELETED
14.0	**TAXES, DUTIES ETC**
14.1.0	**IMPORT DUTIES:**
14.1	Bidder may please note that import for the project shall be in the name of our Employer / Owner of the Plant / Project and such import other than Office and Household Equipment shall be exempted from payment of Customs Duty, VAT & Supplementary Duty as per Special Order 373/655 Date: 13/12/2018 of National Board of Revenue, Govt. of Bangladesh. Also Regulatory Duty(RD), Advance Trade VAT(ATV) & AIT are exempted / not applicable. Any documentation needed for availing of Duty Free Imports will be submitted by the bidder in reasonable time having regard to the time for delivery of the work and the time for completion.
14.1.2	However, if any of the taxes as mentioned above are paid by the bidder as per the extant law in force in Bangladesh, the same shall be reimbursed at actuals subject to production of documentary evidence in support of such payment. However, the bidder shall obtain prior approval of BHEL before deposition of such taxes.
14.1.3	Temporarily imported erection materials, machineries and spare parts during construction period of Project are exempted from payment of Customs Duty and VAT. Such items shall be exported within six months from the commercial operation date. Documentation for the same to be submitted / maintained by the bidder.
14.1.4	Any Taxes for exporting material from source country & as applicable in the source country shall be on bidder's account. However, bidder to take into consideration Duty Free Export Provisions in source country, as applicable, including that in GST in case of exports from India. As such, while offering the rates, the bidder may take into account the benefit of above provisions, as the cost of input to the bidder will be net of such taxes and adjust their offer price accordingly to make it more competitive.
14.2.0	**BANGLADESH VAT**
14.2.1	The Bidder shall submit copy of VAT registration Certificate (Musak-8), TIN Certificate, Trade License to the BHEL site office immediately after receiving the Order but before raising the first Tax Invoice against this tender.
14.2.2	The subject job shall be a Construction Job. As per Section 6(4aa) of The Bangladesh Value Added Tax Act, 1991, VAT shall not be collected by the bidder from BHEL as the Employer (i.e. Customer of BHEL) shall make deduction of VAT from BHEL's invoice and deposit the same to the Government Treasury. Documentary evidence shall be provided to the bidder
14.2.3	Adequate documents for not charging/ claiming VAT from BHEL shall be made available to the Bidder.
14.2.4	The bidder shall raise Tax Invoice (Challan Patra) as per Rule 16(1) (Musak-11) of the Value Added Tax Rules, 1991 mentioning Name, Address and VAT Registration Number of BHEL site office.

14.2.5	Bidder shall note that the Tax Invoice complying with Rule 16(1) of the Value Added Tax Rules, 1991 must contain the 'Bill to' and 'Ship to' details as below: BHEL Bangladesh VAT Regn. No. 00761853 Bharat Heavy Electricals Limited Power Sector Eastern Region, 2x660 MW Maitree Super Thermal Power Project, Moidara Village, Rampal Upazila, Bagerhat District, Bangladesh
14.2.6	Bidders shall quote price excluding Bangladesh VAT envisaging VAT exemption on the same. In this connection please note that VAT, if and as applicable, on Bidders Quoted Price and in case BHEL is unable to provide exemption documents shall be payable extra. In such case bidder shall submit self-certified copy of the Treasury Challan and / or self-attested copy of the Current Account (Musak-18) along with the Tax Invoice as an evidence of payment of output tax claimed from BHEL.
14.2.7	**Value Added Tax Deduction at Source:**
14.2.7.1	BHEL will not deduct any VAT from Bidder's Gross Bill and such bidder need not to load any Output VAT in Bidder's quoted price
14.3.0	**INCOME TAX DEDUCTION AT SOURCE:**
14.3.1	Bidder should have valid 12-digit TIN number in Bangladesh prior to start of work. Advance Income Tax (AIT) under the Income Tax Ordinance,1984(and rules made thereunder) shall be deducted at prevailing rates on Gross Invoice value from the bills unless Exemption Certificate from the appropriate authority/ authorities is/ are furnished under Income Tax Laws of Bangladesh
14.3.2	Since payment shall be made in Bangladesh. Bangladesh Income Tax (AIT) shall be deducted, if applicable.
14.4.0	The Bidder shall carry out their own tax diligence to get acquainted with the relevant rules and regulations of Bangladesh pertaining to the subject job.
14.5.0	Except otherwise mentioned above bidder shall quote their rates/ price inclusive of all taxes, duties, cess, any State or Central Levy, social security contribution and other Taxes in or outside Bangladesh (but excluding Bangladesh VAT & Import Duties) in line with provisions as mentioned above etc. together with variation thereto during contract period including extension, if any. BHEL shall not release any additional payment in this regard.
14.6.0	The bidder is responsible for compliance of all relevant Tax Laws of Bangladesh and all other related places outside Bangladesh in connection with this contract and BHEL will not bear any such liability.
14.7.0	New tax & duties, if imposed subsequent to latest due date of offer submission, as per NIT & TCN, as applicable, by statutory authority after due date of submission of latest price offer and within the contract period including extension, if any (provided reason for extension is not attributable to vendor), shall be reimbursed by BHEL at actual on production of relevant supporting document to the satisfaction of BHEL. However, the vendor shall obtain prior approval from BHEL before depositing new taxes & duties. 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.
15.0	**PROJECT MANAGEMENT/ CONSTRUCTION MANAGEMENT**
	To meet the need of construction management at site, contractor shall provide the following services within quoted/ accepted rates.
15.1	**CUSTOMS CLEARANCE**
	The Contractor shall be responsible for Bangladesh customs clearance of all materials, supplies, equipment, tools and other articles shipped into Bangladesh by him for the implementation of his works, including the food and the personal effects of the Contractor's personnel. All payment for clearance charge, storage charge, etc. which are imposed by the relevant agencies of the Government of Bangladesh, relating to the clearance of equipment, materials and Plant that will be

	incorporated in the Permanent Works or relating to the Temporary Works shall be borne by the Contractor. Further, if the Contractor is delayed in submitting necessary shipping documents to the Employer, the demurrage charges by the Port Authority will be borne by the Contractor. Tools and equipment and other equipment of the Contractor for use during construction but which are to remain the property of the Contractor and which are to be exported by the Contractor from Bangladesh at the completion of the Work shall be carefully documented and specially listed to facilitate both import and export. The Contractor shall determine prior to shipment the customs regulations applicable to this special case as well as normal import rules and regulations applicable. The Contractor shall also be responsible for inland transport by barge/ truck/train to the Site.
15.2	**RECEIVING, TRANSPORTING, HANDLING AND STORAGE**
	The Contractor shall receive, transport, handle, store and install all materials and equipment furnished under these specifications, or otherwise involved in the implementation of this Contract. It shall be the responsibility of the Contractor to determine the availability and capacity of transportation and unloading facilities (including for the transportation, delivery and receipt of all equipment, materials, Plant to the Site) and to make the required arrangements to secure the necessary facilities for the same. The Contractor shall be responsible for the prompt unloading of all equipment or materials. The Contractor shall pay any demurrage incurred due to delay in unloading and for any other reasons. The Contractor shall handle materials and equipment carefully to prevent damage or loss. The use of bare rope slings for handling will not be permitted unless specifically approved by the Engineer. Special handling devices shall be used when necessary to avoid damage. In addition the Contractor shall also comply with the requirements of Technical Specification with respect to the receipt, transportation, handling and storage. If BHEL has to unload of RS, SS, Copper or any other free issue materials before mobilization of the contractor for the interest of the project or If contractor fails to unload the BHEL free issue materials at site for any reason then BHEL shall be unloading the same and the cost of unloading with following rates shall be deducted from contractor RA Bill. i) For RS, SS, Copper or any other materials:- USD 4/MT or actual cost , whichever is higher.
15.3	**PLATFORMS**
	Open platforms shall be constructed by the Contractor at least 50 cm above grade and shall have adequate flooring and base structure to support the stored materials and equipment.
15.4	**INDOOR STORAGE**
	Indoor storage sheds shall be constructed by the Contractor by suitable means for keeping materials and equipment from contact with the ground and to protect it from the environment and outside atmosphere. Sensitive equipment (including inter-alia, electrical, I&C and other equipment) must be kept in dust proof and ventilated rooms and means have to be provided to maintain the moisture content at required levels, in accordance with Good Industry Practices.
15.5	**SHORING**
	Shoring shall be provided by the Contractor to safely support materials and equipment not less than 30 cm above the ground. The ground shall be compacted and concreted or asphalted.
15.6	**WEATHERPROOF COVERINGS**
	Weatherproof and flame resistant sheeting of sufficient size for outdoor storage shall be provided by

	the Contractor. The sheeting shall be carefully placed and tied down to prevent moisture and wind from entering underneath the sheeting and to otherwise protect the equipment, materials and other Plant.
15.7	**IDENTIFICATION OF CONTRACTOR'S EMPLOYEES, VEHICLES & BUILDINGS**
	The Contractor shall provide each of his employees and his Subcontractor's employees with a name tag bearing the picture, the name or initials of the employee, a serial number and the name of the Contractor. Each employee shall wear his badge visibly to the security personnel at any time. Subcontractor's employees with a name tag bearing the picture, the name or initials of the employee, a serial number and the name of the Contractor. Each employee shall wear his badge visibly to the security personnel at any time. All vehicles and large equipment furnished and used by the Contractor or his Subcontractors on the Work shall be clearly marked with the Contractor's or Subcontractor's business name. The Contractor's offices, stores, depots and other facilities shall also be clearly identified. The detailed requirements are defined in the Health, Safety and Environment (HSE) Plan of BHEL. Around-the-clock security presence and operational routine shall be maintained throughout the year. Passes and temporary identification permits shall be issued and examined and access to any part of the Site, the site offices and living accommodation shall be controlled and limited to those who have an authorization.
15.8	**EXPATRIATE PERSONNEL**
	The Contractor shall submit to Employer data of all personnel he intends to bring into Bangladesh for the performance of the Work. This data shall include the name and present address of each person, his intended assignment and responsibility in connection with the Work and a concise resume of his experience in the type of work to which he will be assigned. This data shall be submitted to the Employer at least thirty (30) days prior to their expected arrival in Bangladesh. Any expense associated with illness of the Contractor's personnel, including replacement thereof, shall be to the Contractor's account. Costs of passports, visas, travel documents, inoculations and other incidental expenses incurred by the Contractor's non-Bangladesh employees and their dependents occasioned by travel to and from Bangladesh shall be borne by the Contractor. All accommodations and amenities for the Contractor’s personnel and families (including all staff and labour) must be provided by the Contractor, and the Employer shall not have any liability for the same.
15.9	**SAFETY**
	The Contractor shall comply with all ordinances and regulations including, but not limited to, National, State, Municipal laws and Department of Labour, Transmigration and Co-operation Regulations, and other Applicable Laws that are in force in the locality of the Works and shall comply with any instructions that may be from time to time issued by Employer. The safety rules and regulations laid down in the Health, Safety and Environment (HSE) Plan are to be strictly adhered to.
	CONTRACT PLANNING AND CONTROL

15.10	Before starting the Work at the Site, the Contractor shall submit the detail site management organization for approval by the Employer. Such proposals shall show clearly the Contractor's key personnel, classification and qualification with the detailed information and curriculum vitae for above key personnel. The Contractor's Representative, site manager and senior key personnel who will be responsible for working closely with the Employers staff to achieve efficient execution of the Contract shall be competent to conduct meetings and communications in the English language. The management organization shall include a planning and programming tools covering the Work, and shall apply the latest techniques in communication and analysis. The Contractor shall nominate a planning engineer to co-ordinate all planning activities.
15.11	**RELEASE OF INFORMATION** The Contractor shall not communicate or use in advertising, publicity, or sales release, photographs or other reproductions of the Work under this Contract, or descriptions of the size, dimensions, quantity, quality, or other information concerning the Work unless prior written permission has been obtained from the Employer.
15.12	**SAFETY AND ACCIDENT PREVENTION** It shall be the Contractor's responsibility to maintain throughout the construction period, a safety and accident prevention program satisfactory to the Employer which meets the requirements of Applicable Laws and of all other Governmental Authorities authority having jurisdiction over the Works. The rules and regulations laid down in the Health, Safety and Environment (HSE) Plan must be adhered to at all times.
15.13	**SECURITY** The Contractor shall be solely responsible for the security of all equipment and materials incorporated or to be incorporated in the Work by him and all equipment, materials, tools, supplies, structures, facilities and others properly used in the execution of the Work while in his care and custody. The Contractor shall conform also to any specific security requirements of Employer but such compliance shall not relieve the Contractor from the total responsibility for security.
15.14	**HOUSING & TRANSPORT** The Contractor shall arrange for suitable housing units together with furnishing and utilities in the close proximity of the construction Site for accommodation of all his expatriate personnel. If the services of any expatriate personnel of the Contractor or its Sub-contractors. If the Contractor decides in consultation with the Employer that the health or safety of any of his personnel is or might be jeopardized by political or health hazards in Bangladesh, the Contractor may, after forty eight (48) hours' notice, order its employees and the employees of its Subcontractors and suppliers to return to their headquarters or other safe location, in which case the Work will be deemed to be suspended for the duration. The Contractor shall provide to the extent agreed transport vehicles for use during construction period by the expatriate as well as local personnel.
15.15	**PROPRIETARY NAMES** Whenever a material or article is specified or described on the plants by using the name of a proprietary product or by using the name of a particular manufacturer or vendor, the specific item mentioned shall

	be understood as establishing the type, function and quantity desired. Unless otherwise specified, other manufacturers' products which in the opinion of the Employer are equivalent of those specified will be accepted. Such items shall be submitted for approval prior to their incorporation in the Works.
15.16	**PERFORMANCE OF THE WORK** The Contractor shall conduct all Works in such a manner as to cause the least possible disturbance or damage to the environment. In cases where some temporary disturbance or damage is unavoidably caused due to the nature of the work, the Contractor shall, as soon as possible, remove the cause of such temporary disturbance, repair the damage and, in general, restore the affected areas to their original condition to the extent possible, and in a manner satisfactory to the Employer, the landowner and any authorities. Prior to commencement of the Work, the Contractor shall provide details of its EMP specifically addressing the following: Environmental management system and manual – policies, standards and procedures, and programs; organization / responsibilities; Training Incident and accident investigation; Management support; Environmental protection, mitigation and restoration; Emergency preparedness and response; • Socio-economic plans, including historical and cultural resources; • audit, monitoring and corrective action; • information and records management; and, • Integration of safety & health requirements with the EMP. All aspects of the EMP and the environment work requirements are the Contractor's accountability and the Contractor, its management and its Site supervisory staff will be held responsible for its implementation. All relevant Health, Safety and Environment (**HSE)** issues, results of audit and monitoring plans and programs, and HSE performance indicators will be communicated to the Contractor's management and the Employer through daily inspection meetings and reports, weekly construction meetings, monthly meetings, and in terms of the monthly project report. The Contractor shall ensure that he has complete knowledge of all the laws, statutes, statutory instruments, regulations, rules, treaties and conventions (by whatever name or title), environmental protection regimes and other Applicable Laws, in each of the jurisdictions where he shall perform the Work. The Contractor shall also take all necessary measures to protect the atmosphere, ocean, rivers, groundwater, seaports and land from pollution. In any event the Contractor shall promptly use its best efforts to eliminate and clean up any pollution caused, directly or indirectly, by the Contractor or which occurs at the Site, or other sites associated with this Work.

	The Contractor shall cooperate in all respects with any participant environmental representatives and with governmental persons, and allow them to inspect any and all equipment or operations that they wish to observe. The Contractor shall, at all times, be ready to discuss the implementation of the Contractor's safety, health and environmental protection program.
15.17	**INSTRUCTION TO WORKERS (ORIENTATION / INDUCTION)** The Contractor shall ensure that all employees, subcontractors, servants and agents (and employees, servants and agents of all Subcontractors) participating in the Work, are advised about the strategy and plan for managing the environmental-social issues related to the work, and on their role and responsibility; instructed on the requirements of environmental laws, rules, regulations and specific permit conditions applicable to the area and the Work; instructed on the application and use of the required personal protective equipment (PPE) for their job duties and functions; and, have received the appropriate training in the use, application and maintenance of PPE.
15.18	**RISK MANAGEMENT** The Contractor shall clearly state the management methods and techniques to be used to identify potential hazards and risks at any stage prior to the execution of a particular activity. If required, specific procedures shall be developed by the Contractor to eliminate or mitigate the hazard to a safe level prior to the work being authorized. All requirements of the project's environmental impact assessments ("EIA") and other relevant assessments and conditions of approvals accorded by the relevant Governmental Authorities must be considered by the Contractor in the development of the Contractor's Health, Safety and Environment (HSE) Plan, EMP and other related/relevant plans. The Contractor is required to implement a system whereby all risks associated with hazardous substances, whether chemicals, by-products, effluents or waste materials, are minimized and/or eliminated. In conjunction with its emergency plans and procedures, the Contractor shall develop and submit to the Employer's Representative a "Safety Philosophy Document" that details the strategy to be adopted for control and shutdown systems, including alarms and programmable electronic control systems.
15.19	**EMERGENCY PREPAREDNESS, RESPONSE & CONTINGENCY PLAN** The Contractor shall prepare an Emergency Preparedness, Response and Contingency Plan (a detailed program of action to minimize the effects of an abnormal event requiring prompt actions beyond normal procedures to protect human life, minimize injury and safeguard the environment) for environmental and personal safety emergencies or incidents. This plan shall be found within the Contractor's Safety & Health and/or Environmental Programs. The purpose of the plan shall be to limit insurance and damage to people, property and the environment respectively. The plans, procedures, and trained personnel shall be in place for the duration of the Contract to manage and control emergency situations and incidents in a proper and expeditious manner.
15.20	**SERVICING AND FUELLING** To ensure adequate response capability in the event of a fuel, ground spill or other spill, all fuel transport vehicles and the Contractor's foreman vehicles shall carry a suitable amount of commercial absorbent material. In addition, floating absorbent pads and booms for spill clean- up on open water shall be kept accessible on the construction Site. All service vehicles and/or equipment utilized for re-fuelling must be equipped with automatic shut-off valves. All equipment or servicing activities with the potential for accidental spills (e.g., oil changes, hydraulic repair, coolants) will require appropriate containment methods to be in place (i.e., storage containers, impervious liners, absorbent materials, etc.) prior to the start of the activity.

15.21	**SOIL AND GROUNDWATER PROTECTION**
	The Contractor shall develop and implement soil and groundwater protection measures. Protection measures shall include building and impervious floors, where appropriate. The Contractor shall make an assessment of groundwater quality prior to the start of construction and prior to commissioning to demonstrate to Employer's Representative that construction activities have not adversely affected the environment. Groundwater quality shall be monitored throughout the construction phase.
15.22	**HEALTH HAZARDS**
	Worker and public health is a critical part of any HSE management program. The Contractor shall control substances and materials that may be a hazard to worker's health. These controls shall be a combination of hazard communication, safe work systems and the controlled handling and disposal of hazardous materials The Contractor's controls shall commence at contract preparations and procurement stages, where all vendors and subcontractors shall be required to submit Material Safety Data Sheets ("MSDS") for all hazardous materials that will be supplied, provided or brought onto the Site. These MSDSs shall be forwarded to Contractor's HSE Manager for review and records management. In the event hazardous materials are to be used, the Contractor shall carry out assessments according to recognized international standards, to determine if there are any more suitable or less hazardous materials that could be substituted for the original materials. Only when the Project Manager, Employer and his Engineer and the Contractor are satisfied that assessments have been completed, and control measures are adequate to protect worker health, the materials shall be allowed on the project worksite. The Contractor's control measures shall include: • Material transport, storage, labelling, packaging, and disposal, • Personnel protective equipment (PPE), • Health surveillance and monitoring, and • Emergency procedures and training. All explosive materials to be used for blasting during Site preparation shall only be handled by approved and qualified personnel. All explosive materials shall be stored in a secure, limited access sites, protected from workers and the public, and removed from the site every day and immediately after use. All radioactive equipment and materials shall only be used by qualified, approved and permitted personnel. Radioactive materials must be stored in approved and protected containers Radioactive materials and waste products shall not be disposed of on-site but removed in protective containers and disposed at government approved storage and disposal sites
15.23	**WASTE MATERIAL MANAGEMENT**
	The Contractor shall ensure that waste management identification, handling, transport and disposal are addressed in the development of their HSE management plans. The Contractor's employees responsible for handling hazardous materials (including wastes) shall receive training and certification in the handling, transport, storage and disposal of chemicals and regulated or hazardous materials. Where applicable, Workplace Hazardous Materials Information

	System (“WHMIS”) certification and training, or its equivalent, shall be made available to employees. Regular written updates shall be included for continued employee awareness. The Contractor shall ensure proper segregation and isolation for wastes that could react together in the event of a leak or other incident. These facilities shall include lockable, fire proof cabinets or storage in shelving units separated by fireproof barriers or walls. The Contractor shall dedicate a space for waste and drum storage. The storage area must be easily accessible for spill containment and emergency response and not be susceptible to flooding. For any waste storage area which could accumulate hazardous gases, vapors, or dust due to the nature of the wastes stored, the Contractor must supply suitable ventilation or other controls to ensure exposure by employees is kept below required minimum standards. Storage areas for hazardous wastes shall be designated as restricted areas and shall be suitably equipped to control an incident involving a leak or spill. The Contractor shall make available suitable fire extinguishing equipment and proper electrical bonding equipment in all areas involving the handling and storage of flammable and reactive wastes. Disposal of wastes by burning will not be allowed on the construction site. Sumps and waste pits shall not be used for waste storage at the work site. Sumps should only be used for temporary control and containment of spills, equipment leaks, etc. If the Contractor encounters former sump sites or waste pits during ground surveys, the Contractor shall be identify and investigate the same. If any contamination is suspected, the Contractor shall excavate, remove and where required replace with an approved sump container system. The Contractor shall develop and implement a waste disposal control system. This system shall control every load of waste leaving the worksite, detailing the type of waste disposal, waste origin and destination, approximate weight, date and transport details on a waste manifest/document. These documents shall be audited.
15.24	**SPILL RESPONSE AND CONTROL**
	All spills shall be stopped and cleaned up immediately to avoid potential impact to water and soil quality. All spills shall be reported using the Incident Management Process. Under no circumstance contaminated material may be “stored” on the work site. All spills shall be rapidly stopped and appropriately eliminated as defined in the Contractor’s Emergency Preparedness, Response and Contingency Plan. Spills shall be contained in a way that will prevent their redistribution. All ground spills shall be contained as quickly as possible through diking, suction methods, excavation and the use of absorbents or other appropriate recovery techniques. A list including the type, quantity and location of the storage of retaining and clean up equipment to be used during construction shall be prepared. The list shall include the procedures and mitigation measures to be used in case of a spill. A written inventory will also be prepared, before starting construction works, including lubricants, fuels, solvents, chemicals and other materials that might be accidentally discharged during construction. All on-site fuel storage tanks shall be located in an impermeable secondary containment area with a

	holding capacity equal to 110% of the largest tank within the berm. For above ground tanks, the tanks shall be surrounded by a berm, the entire area covered with a suitable commercial absorbent material and with a sealed plastic liner to form an area that can be pumped out in the event of a leak in the tank. A waste handling plan shall be made with the purpose of identifying the procedures necessary for cleaning and disposing of residues from a major spill. In the event of a spill, the Contractor shall make all resources available to contain and clean up the spill. Traffic shall be minimized in and around the spill site.
15.25	**NOISE CONTROL**
	Noise level specifications to be followed by the Contractor in design, assessment and monitoring activities are based upon the maximum (acceptable) levels which plant personnel may be exposed during their normal working duties. The Contractor shall be familiar with and comply with the environmental guidelines as issued by the relevant Governmental Authorities in Bangladesh, including the Department of Environment, Government of Bangladesh and other relevant Applicable Laws. All internal combustion motors of vehicles, machinery and equipment used during the construction phase, shall have adequate noise silencers, and shall be kept in good operating conditions, during the entire construction period. Where temporary noise pollution of greater than 85 dBA will occur, temporary silencers shall be used. Equipment noise should not exceed the specified limits at accessible locations.
15.26	**CONSTRUCTION TRAFFIC PLANNING**
	The Contractor shall ensure that the construction Site is organized in such a way that pedestrians can move safely and without risk. The Contractor shall firstly select the lowest period of traffic flow for equipment crossings; and secondly, ensure that traffic patterns and entrances to private and public roads for access are not obstructed during construction activities. All site entry will be controlled by vehicular passes. Road closures, on-site and off-site, shall be with the approval of the Contractor's site manager and/or road closure permit. Site traffic shall be minimized and speed limits posted and enforced.
15.27	**HOUSEKEEPING**
	All construction debris and other garbage shall be continuously collected and disposed at an approved facility. At the end of each day, all waste material shall be removed from the construction Site and deposited at the approved allocated area. The approved procedures to manage waste shall be specified in the Contractor's waste management plan. All empty hazardous material containers shall be removed from the work area as soon as is practicable. All empty gas containers and bottles shall be returned to their storage area and secured properly. The Contractor's shall prepare a pest and vector control program to address specific site conditions, including a mosquito control program.
15.28	**CONSTRUCTION CAMPS**
	The location of work places, camps, areas of storage and installation of works, compression, regulation and communication stations shall be located on levelled land, avoiding areas with non-cohesive soils to avoid erosive processes. Health conditions in the camp shall be controlled in order to prevent contamination of adjacent groundwater or surface water resources. Domestic sewage generated at the construction sites shall be eliminated by two systems of septic/absorption tanks or chemical toilets located on the sites. Solid combustible garbage shall be collected and secured daily, until disposal, to prevent the

	attraction of livestock, vermins and wild animals. Residue shall be disposed of, along with non-combustible garbage, in a disposal location approved by the Authorities. Upon abandonment, the camp site area shall be cleared of all trailers, piping, cable, insulation, lumber, blockage, metal wastes, etc., and re-graded according to the landscaping concept. These guidelines and procedures for the management of domestic and other waste shall be specified in a plan.
15.29	**SITE REGULATION MANUAL**
	The Contractor shall thirty (30) days prior starting any Work at the Site furnish a detailed and comprehensive site regulation manual for its proposed operation and works on the Site, which shall be based on the site related regulations and requirements in the Contract and which shall be subject to Employer's approval. All work on the Site, shall be carried out in compliance with the so approved site regulation manual.
15.30	**PLANNING & MONITORING**
15.30.1	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 subsystems / components 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.
15.30.2	The bidder shall also prepare progress report indicating progress on key activities, management summary for critical activities and 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.
15.30.3	The contractor's site office must have facilities of communications like Fax, E-mail, and telephone with STD facility within a month from LOI.
15.30.2	**PROGRESS REPORTING**
15.30.2.1	The bidder shall submit daily, weekly and monthly progress reports for work force, materials reports, consumables (steel / gases / electrodes) report and other reports as per pro-forma considered necessary by 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.
15.30.2.2	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.
15.30.2.3	The daily work force reports shall clearly indicate the work force deployed, category-wise specifying also the activities in which they are engaged.
15.30.2.4	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.
15.30.2.5	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.

15.30.2.6	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 USD 260 per month shall be deducted from contractor's RA bill.	
15.30.2.7	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 CD (as per requirement) and handed over to BHEL as per requirement.	
15.30.2.8	**PHOTOGRAPHS** The Contractor shall furnish to the Employer three (3) hard copies (and three (3) soft copies in .jpeg or .pdf format on separate CDs/DVDs) of each photograph taken to show shop assembly of equipment and the monthly stages of equipment installation. Each photograph shall show upon its face, the date, the Contractor's name, and description of the view taken. Photographs shall be taken of each assembly or sub- assembly to indicate the progress of the Work. Additional photographs shall be taken when and where required as directed by Employer and/or the Engineer. Shop photograph shall be not smaller than 120 mm by 150 mm in size.	
15.30.3	**SITE ORGANIZATION**	
15.30.3.1	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 from start of work.	
15.30.3.2	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.	
15.30.3.2.1	Qualified safety officers with assistants (exclusive for safety supervision for project jobs).	Officer – Minimum One No. Assistant – Minimum Two Nos. Manpower and Infrastructure details available in Annexure B. Contractor shall be implemented / deployed of Manpower at site as mentioned in Annexure B.
15.30.3.2.2	Engineer & Supervisors for quality inspection.	Engineer-One Number Two supervisor
15.30.3.2.3	Site supervising engineer and supervisors for civil works	As per requirement
15.30.3.2.5	Chemist/Quality engineer for Civil Laboratory	One no.
15.30.3.2.6	Planning Engineer (exclusively for planning)	One no. Engineer
15.30.3.3	Deputation of above man-power shall be jointly decided at site in line with construction schedule.	
15.30.3.4	Engineer / supervisor for other functions like store & purchase, material management, fin, administration etc. are to be provided as per site requirement and **not considered above.**	
15.30.3.5	In the event of non-deputation of engineer/ supervisor by the bidder as per above agreed schedule, BHEL shall reserve the right to deduct USD 1050 per man-month for engineer, USD 650 per man-	

	month for the supervisor / safety officer / chemist and USD 650 per man-month for safety supervisor from RA bills. Further induction of manpower regarding site supervisor & site engineer will be decided at site as per requirement without any financial implication.
15.30.3.6	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.
15.30.3.7	In addition to above, a well experienced qualified engineer to be designated, as 'Project Co-coordinator', 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.
15.30.3.8	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.
15.30.3.9	The contractor should also submit network programs for the erection of various items. These networks shall show the BIFCL/ BHEL hold points, which have to be cleared by BIFCL/ BHEL, or their authorized representatives before further erection can take place. These programs for the erection would clearly identify responsibilities of the contractor and BIFCL/ 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 from start of work.
16.0	**QUALITY CONTROL & QUALITY ASSURANCE**
16.1	Contractor's engineers & supervisors shall be adequately qualified and also inclined to do a quality job. The quality assurance engineer shall co-ordinate all aspects of quality control, inspection, implementation of quality assurance procedures laid down in Quality Plan and technical specification by BHEL. He shall fill up quality assurance log sheets / formats and submit to BHEL for joint inspection and acceptance. The contractor shall fill up, maintain & preserve the quality records in computerized media. BHEL's authorized representative shall be given free access at all time to such quality related records etc. for inspection, review etc.
17.0	**QUALITY ASSURANCE PROGRAMME**
17.1	The contractor shall arrange for suitable quality assurance programme to control all activities pertaining to the scope of work, as necessary. Such programs shall be outlined by the contractor & shall be finally accepted by BHEL. A quality assurance programme of the contractor shall generally cover the following
17.2	Organization structure and qualification data for key personnel of the contractor for the management and implementation of proposed quality assurance programme
17.3	The procedure for source inspection, incoming raw material inspection, verification of material purchased etc.
17.4	System for maintenance of records.
18.0	**GENERAL REQUIREMENTS – QUALITY ASSURANCE**
18.1	All materials, components and equipment covered under the specification shall be procured, manufactured, erected, commissioned and tested, as applicable, at all stages as per comprehensive quality assurance program. An indicative program for inspection / test, to be carried out by the contractor, for some of the major items is given in the respective technical specification.
18.2	Field quality plan will detail out the quality practices and procedures etc. to be followed by the contractor's site quality control organization, during various stages of site activities from receipt of material / equipment at site.
18.3	BHEL reserves the right to carry out quality audit 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.
18.4	Quality audit / 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 any way limit the liabilities and responsibilities of the contractor in earning satisfactory performances of equipment/ service as per specification.

18.5	Repair / rectification procedure to be adopted to make any job acceptable shall be subject to the approval of BHEL.
18.6	All the latest relevant codes as per technical specification should be available with the contractor at site within 15 days from the date of placement from start of work or otherwise specified by Construction Manager/ Project Manager, BHEL.
19.0	**HEALTH, SAFETY & ENVIRONMENT**
19.1	**REFER DOCUMENT NUMBER :-HSEP:14-MAITREE:VENDOR: DATE: 05.05.16**
	DOCUMENT TITLE:-HEALTH, SAFETY AND ENVIRONMENT PLAN FOR 2X660MW MAITREE SUPER THERMAL POWER PROJECT
20.0	**SPECIFIC REQUIREMENTS FOR ISO 9002**
20.1	Contractors shall ensure that all their staff / employees are exposed to periodical training programs conducted by qualified agencies/ personnel on ISO 9002 Standards.
20.2	Contractor shall ensure that the quality is maintained in all the works connected with this contract at all stages of the requirement of BHEL.
20.3	Contractor shall ensure that all MMDs that are used, whether owned by the contractors or used on loan, are calibrated by the authorized agencies and the valid calibration certificate will be available with them for verification by BHEL. A list of such instruments possessed by the contractor at site with its calibration status is to be submitted to BHEL Engineer for control.
20.4	Contractor shall ensure that fitness certificate of the tools & plants, that are in use, whether owned by contractor or issued on loan, are tested by authorised agency and the valid fitness certificate is available for verification by BHEL.
20.5	Contractors shall arrange for the inspection of the works at various stages as required by BHEL. The contractors shall take immediate corrective action for the non-conformances if any, observed and pointed out by BHEL.
21.0	**INTEREST BEARING RECOVERABLE ADVANCE/ MOBILISATION ADVANCE**
21.1	Not applicable for this tender.
22.0	**OVER RUN CHARGES**
23.0	**REVISION ON ACCEPTED CONTRACT RATE**
23.1	Not applicable in this tender
24.0	**PRICE VARIATION CLAUSE / ESCALATION**
24.1	Not applicable for this tender.
25.0	**LIQUIDATED DAMAGE**
25.1	**Intermediate Milestones**
25.1.1	In case delay in achieving the Milestone as mentioned in Serial No. 2 of CL. No. 10.1 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.
25.1.2	In case delay in achieving the Milestone as mentioned in Serial No. 4 of CL. No. 10.1 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.

25.1.3	Amount already withheld, if any against slippage of Serial No. 2 of CL. No. 10.1 above, shall be released only if there is no delay attributable to contractor in achievement of Milestone as mentioned in Serial No. 4 of CL. No. 10.1 above.
25.1.4	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.
25.1.5	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.
25.1.6	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.
25.2	**Overall Completion**
25.2.1	If the contractor fails to maintain the required progress of work which results in delay in the completion of the works 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 ceiling specified below. 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, Supplementary / Additional Items and PVC.
25.2.2	If Completion of work goes beyond specified contract period of **8 (Eight) months** from date of start of work, as certified by Construction Manager, BHEL, LD will be imposed with maximum LD amount shall be 10 % of total contract value.
25.2.3	BHEL shall deduct the amount of such compensation from any money due or which may become due to the contractor and/or recover such compensation from the bank guarantees / security deposit of the contractor. To be entitled to impose such compensation, BHEL will not be required to prove that he has incurred such amount as actual damage.
25.2.4	BHEL reserve the right to cancel the order/ contract or a portion thereof at the risk & cost of the contractor and the contractor shall be liable to BHEL for any excess costs thereof.
Note:-	***Executable Contract value-** *Value of work for which inputs/fronts were made available to contractor and were scheduled for execution till the date of achievement of that milestone.*
26.0	**GUARANTEE / WARRANTY**
26.1	The contractor will be responsible for the quality of workmanship, quality of materials/ items and design for which the contractor is responsible.
26.2	Guarantee / warranty period shall be 24 months from the date of issue of PAC including dredging work till completion of the Guarantee/Warranty period as per relevant clause of GCC. Commencement of guarantee period shall be from the date completion of work under the contract as certified by BHEL.
27.0	**EXTENSION OF TIME FOR COMPLETION**
27.1	If the completion of work as detailed in the scope of work gets delayed beyond the contract/ completion period due to reasons not attributable to contractor, the contractor shall make request for an extension of the contract and BHEL at its discretion may extend the contract. However such extension shall not entitle the vendor for price revision or price compensation as this being FIRM price contract.
27.2	Based on review of agreed & jointly signed L-2 / construction schedule (as enumerated in the tender), the balance work 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 contractor. Further 'Time extension' or 'Time extensions' at the end of previous extension shall be worked out similarly.

27.3	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.
27.4	A joint program 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.
27.5	During the period of 'Time extension', contractor shall maintain their resources as per mutually agreed program
27.6	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 solely to contractor after adjusting delay attributable to BHEL& Force majeure and recoverable from the dues payable to the contractor.
28.0	**EARNEST MONEY DEPOSIT (EMD / SECURITY DEPOSIT (SD) / PERFORMANCE BOND (PB)**
28.1	EARNEST MONEY DEPOSIT (EMD)
28.1.1	EMD is to be paid by tenderers for securing fulfilment of any obligations in terms of the NIT. In case of EMD submitted in USD by the successful tenderer, the same shall be converted and adjusted towards the required amount of Security Deposit of 50%. In case of EMD in INR, whole EMD shall be converted into USD as per stipulated selling conversion rate of INR to USD as per State Bank of India (SBI) publication on tender floating date. In case of EMD in BDT, whole EMD shall be converted into USD as per stipulated selling conversion rate of BDT to USD as per Bangladesh Bank publication on tender floating date. Tender cost & EMD can be submitted in INR/ USD/ BDT for this tender. Exchange Rate of currency as available in the web site of Bangladesh Bank on the tender floating/publishing date. If the date happens to be a holiday / or rate is not published, then the exchange rate of next day / next published day will be considered. Irrespective of submission in any of the aforesaid modes, amount of refund of EMD shall be net of submitted EMD less applicable Bank charges.
28.1.2	EMD & Tender cost amount can also be submitted directly by Foreign Bidders (other than Indian bidders) to the followings Bharat Heavy Electricals Limited bank account in Bangladesh- EMD & Tender cost amount can also be submitted directly by Foreign Bidders (other than Indian bidders) to the followings Bharat Heavy Electricals Limited bank account in Bangladesh- 1. SBI (Branch Address:-Khulna, Bangladesh), A/C No. **05620257520201**, BDT Account., SWIFT: SBINBDDH056, Routing number : 220471543 2. SBI (Branch Address:- Khulna, Bangladesh), A/C No. **05620257520202,** USD Account, SWIFT: SBINBDDH056, Routing number : 220471543

28.1.3	EMD & Tender cost amount can also be submitted directly by Indian Bidders to the followings Bharat Heavy Electricals Limited bank account in India- 1. SBI(Branch Address:-Commercial Branch, Saltlake, Sector V, Kolkata ,Branch Code SBIN0004289),A/C No. 11107800029,INR Account.
28.1.4	Amount of EMD exceeding INR 20 Lakh may be submitted in the form of Bank Guarantee (INR or eqv. USD).
28.1.5	All other terms & conditions shall be as per GCC.
28.2	SECURITY DEPOSIT(SD)
28.2.1	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.
28.2.2	At least 50% of the required Security Deposit, including the EMD, shall be collected in before start of the work. Balance of the Security Deposit shall be collected by deducting 10% of the gross amount in USD progressively from each of the running bills of the Contractor till the total amount of the required Security Deposit is collected. If the value of work done at any time exceeds the contract value, the amount of Security Deposit shall be correspondingly enhanced and the additional Security Deposit shall be immediately deposited by the Contractor or recovered from payment/s due to the Contractor. 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 the authority competent to award the work.
28.2.3	All other terms & conditions shall be as per GCC.
28.3	**PERFORMANCE BOND**
28.3.1	Performance bond is not applicable.
29.0	**CERTIFICATE TOWARDS COMPLETION**
29.1	The work under the scope of the contractor shall be deemed to have been completed in all respects only when so certified by BHEL / owner. The decision of BHEL in this regard shall be final and binding on the contractor.
30.0	**CIVIL LABORATORY**
30.1	Contractor shall establish and maintain civil laboratory with necessary equipment (as per Annexure-A) for conducting relevant tests at site, as required. Any testing required to be carried out at site as per joint discussion at site and technical specification have to be arranged by you for all the works at your own cost.
31.0	**CONSTRUCTION SCHEDULE**
31.1	Entire work shall be carried out in accordance with the broad construction schedule given in CL No.10.1 above. Within 30 days from start of work, 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.
31.2	Deleted
31.3	The contractor shall plan his work in such a manner so as to meet the overall project schedule, in consultation with BHEL/ BIFCL engineer.

31.4	Contractor shall submit daily work program based on above construction schedule. Deferment of above schedule is not acceptable. Contractor will adhere to schedule and resource planning to be augmented to ensure completion as per schedule.	
31.5	Periodic progress reviews on the entire activities of execution in respect of supply & works in scope of contractor 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.	
31.6	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/BIFCL Engineer.	
32.0	**PAYMENT FOR ADDITIONAL/EXTRA ITEMS FOR CIVIL FOUNDATION WORKS**	
32.1	It shall be as per relevant clause of the GCC. However, “BPWD Schedule of Rates 2014” as mentioned in the price schedule will be considered.	
33.0	DELETED	
34.0	**TOOLS & PLANTS (TO BE PROVIDED BY CONTRACTOR)**	
34.1	Tentative list of T&P to be deployed by contractor for successful completion of work is detailed below.	
34.2	It may be noted that the list is not exhaustive and is only for general 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 may 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 along with tender bid.	
34.3	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 be at liberty to arrange the same at the risk & cost of contractor including transportation cost of same from any of BHEL site/ other agency & charges as applicable shall be deducted from contractor’s RA bill. Decision of BHEL in this regard will be final & binding on contractor.	
34.4	Following Major T&Ps to be arranged by contractor within the indicated time	
	Major T&P items	**Broad Mobilizing time from date of start of work**
34.4.1	Deleted	
34.4.2	1 no 75 T capacity crawler crane for structural erection	As per site requirement
34.4.3	One complete set of arrangement for Sheet pile installation including crane, vibro hammer, DG set etc and Steel Sheet Pile (this will be required if excavation is carried out with provision of sheet pile)	Within 15 days
34.4.4	1 no. TRX of Escorts group or equivalent (12/ 14 T cap)	As per site requirement.
34.4.5	2 nos. welding rectifier	As per site requirement.
34.4.6	1 no. trailor – 15T	As per site requirement.
34.4.7	Deleted	

34.4.8	Deleted	
34.4.9	Deleted	
34.4.10	4 Nos. hydraulic excavator / Poclain (2 nos long boom and 2 nos normal boom length)	1st – before start of work Bal 3 nos – within 15 Days of start work
34.4.11	1 No. JCB / Pay Loader	1st –before start of work
34.4.12	6 nos. transit mixer (4.5/5/6 M3 capacity)	1st – before start of work Balance 5 nos – As per site requirement.
34.4.13		
34.4.14	2 nos. concrete pump (1 nos 90cum/ hr min capacity & lift 70M and 2nd 60 cum / hr min.)	1 nos within 15 days 2nd as per site requirement
34.4.15	1 no. Concrete cutting power tools (DD2E of HILTI/BOSCH make)	Deleted
34.4.16	1 no. Concrete core Cutting machine for drilling in concrete upto 300 mm dia alongwith diamond bits	Deleted
34.4.17	2 nos. Dredging pump 32 HP (diesel/ electric)	1 no within 15 days 2nd as per site requirement
34.4.18	One no. 10 HP submersible mono-block electric pump (KOS-1040+ of Kirloskar or equivalent),	Within 30 days.
34.4.19	1 nos. self priming dewatering pump 2 HP (diesel/ electric)	Within 30 days.
34.4.20	2 nos. curing pump – 1.5 /2 HP (pump for curing at heights)	Within 30 days.
34.4.21	1 no. dozer.	As per site requirement
34.4.22	4 nos. dumper	As per requirement.
34.4.23	Deleted	
34.4.24	2 nos. reinforcement cutting machine	Within 30 days.
34.4.25	2 nos reinforcement bending machine	Within 30 days
34.4.26	Deleted	
34.4.27	Deleted	
34.4.28	1 no. compression testing machine (200 T cap)	Deleted
34.4.29	2 nos. electric winch with building hoist	Within 90 days.
34.4.30	1 no total station with adequate arrangement for Surveyors	Within 7 days.

34.4.31	1 no. auto level & staff + 2 nos as required	Within 15 days.
34.4.32	30 nos concrete cube moulds	Within 30 days.
34.4.33	Adequate no. of small trucks 2T/5T for movement within site	As per requirement.
34.4.34	Two nos drinking water tank – 5000 lit.	Within 30 days.
34.4.35	1 nos truck mounted water tank (minimum 5000 lit) capacity with sprinkler arrangement.	Deleted
34.4.36	1 No. 125KVA Electric Generator	As per requirement.
34.4.37	6 Nos. Concrete vibrator with adequate needle (3Nos. diesel driven +7Nos. electric driven)	3 Nos (at least 2nos. diesel driven) within 30 Days. Balance diesel/electric by 60 to 75 days
34.4.38	Portable fire extinguishers as below: Soda acid – 10 sets. Dry chemical powder – 10 sets CO2 – 5 sets. Water & sand bucket (4 buckets in one stand) – 5 sets. Fire hose with nozzle (50 M length) – 4 sets.	Within 40 days
34.5	T&P shown in the above mentioned list are tentative based on planned progress requirement. Actual Mobilization schedule, based on front availability, drawings, construction schedule and material availability at site is to be reviewed and mutually agreed with BHEL site periodically from time to time for mobilization of major T&Ps, and the same have to be adhered to. No change will be permitted without written approval of Construction Manager, BHEL site. Further requirement will be reviewed time to time at site and contractor will provide additional T&P/equipment's 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.	
34.6	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.	
34.7	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 at the following rates	
	Major T&P items	**Recovery rates**
34.7.1		
34.7.2	75 T capacity crawler crane for pre-assembly with adequate plates for movement	USD 500 /- per week or part thereof
34.7.3	crawler cranes 40/45 T capacity crawler/tyre mounted crane	USD 350/- per week or part thereof
34.7.4	4 nos. TRX of Escorts group or equivalent (10/ 12 T cap	USD 200/- per week or part thereof

34.7.5	Magnetic base drill machine (All Cut)	USD 70/- per week or part thereof
34.7.6	submerged arch welding machine	USD 70/- per week or part thereof
34.7.7	MIG machine	USD 50/- per week or part thereof
34.7.8	welding rectifier	USD 15/- per week or part thereof
34.7.9	Trailor – 15T	USD 150/- per week or part thereof
34.7.10	Trailor – 30T	USD 170/- per week or part thereof
34.7.11	Power driven HSFG bolt tightening m/c	USD 70/- per week or part thereof
34.7.12	Torque tightening m/c. (2 no. Capacity up to 30 dia HSFG bolt tightening)	USD 70/- per week or part thereof
34.7.13	Jack hammers/pavement breakers	USD 70/- per week or part thereof
34.7.14	Power winch – 3T	USD 30/- per week or part thereof
34.7.15	Power winch – 5T	USD 50/- per week or part thereof
34.7.16	ultra-sonography testing machine for structural work.	USD 50/- per week or part thereof
34.7.17	Hydraulic excavator / Poclain	USD 800/- per week or part thereof
34.7.18	JCB / Pay Loader	USD 800/- per week or part thereof
34.7.19	Deleted	
34.7.20	Deleted	
34.7.21	Transit mixer (4.5/5/6 M3 capacity), peak period 4 nos. transit mixer	USD 100/- per week or part theirof
34.7.22	Truck mounted concrete mixer cum pump along with placing boom minimum 40 m high	USD 300/- per week or part thereof
34.7.23	concrete pump (20 cum/ hr min capacity & lift 70M)	USD 300/- per week or part thereof
34.7.24	Concrete cutting power tools (DD2E of HILTI/BOSCH make)	USD 70/- per week or part thereof
34.7.25	Concrete core Cutting machine for drilling in concrete upto 75mm dia along with diamond bits	USD 70/- per week or part thereof
34.7.26	self-priming dewatering pump 5 HP (diesel/ electric)	USD 25/- per week or part thereof
34.7.27	10 HP submersible mono-block electric pump (KOS-1040+ of Kirloskar or equivalent),	USD 25/- per week or part thereof

34.7.28	self-priming dewatering pump 2 HP (diesel/ electric)	USD 25/- per week or part thereof
34.7.29	curing pump – 1.5 /2 HP (pump for curing at heights)	USD 25/- per week or part thereof
34.7.30	dozer	USD 625/- per week or part thereof
34.7.31	dumper	USD 70/- per week or part thereof
34.7.32	reinforcement bending machine	USD 70/- per week or part thereof
34.7.33	reinforcement cutting machine	USD 70/- per week or part thereof
34.7.34	power driven earth rammer	USD 10/- per week or part thereof
34.7.35	vibromax (earth compacter)	USD 625/- per week or part thereof
34.7.36	Vibro compactor/ plate compactor – drum width 750mm	USD 300/- per week or part thereof
34.7.37	compression testing machine (200 T cap)	USD 50/- per week or part thereof
34.7.39	Electric winch with building hoist	USD 25/- per week or part thereof
34.7.40	Total station with adequate arrangement for Surveyors	USD 70/- per week or part thereof
34.7.41	Auto level & staff + 1 nos if required	USD 70/- per week or part thereof
34.7.42	drinking water tank – 5000 lit.	USD 70/- per week or part thereof
34.7.43	truck mounted water tank (minimum 5000 lit) capacity with sprinkler arrangement.	USD 140/- per week or part thereof
34.7.44	Concrete vibrator with adequate needle (3 Nos. diesel driven + 6 Nos. electric driven)	USD 50/- per week or part theirof
34.7.45	Mobile lighting mast with DG set attachment (8 mtrs. High & above capacity. (These towers shall be of 30 ft. height, noiseless, have 4x1000W metal halide lights, with Fuel tank capacity of 12 hrs. duty cycles, completed with panels, self-starter for DG set, manual winch etc.)	USD 70/- per week or part theirof
34.7.46	Any other instrument	As per discretion of the BHEL engineer
35.0	**T&P TO BE PROVIDED BY BHEL**	
35.1	Not Applicable	
36.0	**OTHER TERMS**	
39.1	All other term & conditions of this specification shall be governed by the pertinent provisions of GCC and other volumes of this tender, 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
1	Concrete Compressive test	Digital Compressive Testing Machine with 2000 KN capacity.	2000KN capacity
2	Concrete Cube casting	Concrete testing Mould	Minimum 125 sets desired considering major concerting activity.
3	Workability of concrete	Slump cone	Standard, at least 04 Nos.
4	Course aggregate 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
5	Fine aggregate sieve analysis	Sieve set	Minimum 200 mm dia Brass sieves; Size 4.75 mm, 2.36 mm, 1.18 mm 600 micron, 300 micron, 150 micron, 75 micron, 75 micron, Pan and cover
	Soil Testing Equipment (Levelling & Grading)		
1	Compaction of filling test	Core cutter apparatus	Rammer, 6 Nos. of standard core cutter mould, dolly
2	Proctor density test	Standard proctor Compaction apparatus	Standard
3	Moisture Content	Rapid moisture meter	Standard, at least 02 Nos.
	Process Control Accessories		
1	Electronic balance	1 Nos.	600gx0.01g, 10g and 10 kg
2	Physical balance	5 kg capacity	Weights up to 5 kg
3	Thermometer	Temperature range 0° C to 150° C. 2 Nos.	Digital
4	Measuring jars	2 Nos. set of each size	100ml, 200ml, 500ml & 1000 ml
5	Spatula	2 Nos. each size	100mm & 200 mm with long blade wooden handle
6	Venire calipers	2 Nos. each	12" and 6" Sizes
7	Digital pH meter	01 Nos.	.01 mm least count
8	Digital micrometer	01 Nos.	0.01 mm least count
9	GI tray	02 Nos. each	600x450x50mm, 450x300x40mm, 300x250x40mm
10	Rebound hammer test	01 Nos.	Digital Rebound hammer
11	Screw Gauge	02 Nos.	0.1 mm-10mm, Least count 0.05

ANNEXURE B

HSE REQUIREMENTS-MAITREE PROJECT

MANPOWER AND INFRASTRUCTURE

SL NO.	ITEM	REQUIREMENTS	REMARKS
1	HSE Manager	1 No. if no of HSE officers more than 1.	CV to be vetted by customer. Candidate should have • Degree/ diploma in Engg/Technology • Degree/ Diploma in H&S, • min 5 years' experience in field of safety incldg min 3 years experience in construction
2	Shift HSE Officer	Min 1 for every 500 workers or part thereof. Any sub-contractors with more than 20 workers must have a HSE officer. Each major work area must have a dedicated shift HSE officer as advised by BHEL HSE manager/officer.	Candidate should have • Degree/ diploma in Engg/Technology • Degree/ Diploma in H&S, min 2 years' experience in field of safety for Degree holder in Engg or Min 5 years with Diploma holder in Engg
3	Shift HSE stewards	Min 1 Steward for every 100 workers or part thereof. Deployment to be approved by BHEL HSE manager.	Candidate should have passed HSC(12^{th} standard) and attended a certificate course on construction safety or allied subjects
4	First aid box	1 in each office and major work area/floor	Items as per clause 76(2) of Bangladesh labour Rules and clause7.4.5.3 of HSE plan for sub-contractors
5	Shift First aider	1 for each 150 workers Minor contractors may have tie up with major contractor with permission of BHEL HSE manager in this regard.	The candidate must have passed HSC and have a certificate from Bangladesh Red-cross society or as recognized by Govt. (Pl refer 7.4.5.2 of HSE Plan for sub-contractors)
6	Ambulance	Round the clock experienced paramedical personnel with first aid facility & one ambulance including driver, fuel etc. shall be arranged/provided by you/other vendor . The above facilities will be shared by various BHEL	On running cost sharing basis with other sub-contractors Modalities to be worked out by site team.

		contractors working at site on chargeable basis to the providing agency (actual cost distributed among the various vendors present at site availing the facility on a prorate basis). The subject facility will be strengthened as per the requirement during peak work progress at site, by other vendor. Individual vendor may co-ordinate with the providing agency in this regard.	
7	Sick room	Shall be available at site, being provided by other agency.	Pl refer 7.4.5.1 of HSE Plan for sub-cntractors for details. Running cost & construction cost to be shared among all sub-contractors Modalities to be worked out by site team
8	Emergency vehicle	To be available in all shifts of work	Must be a 4-wheeler.
10	Walky-talky	If contractor engaged in height works- 1 No.	
11	Binoculars	If contractor engaged in height works- 1 No.	
12	Height Rescue-kit	If contractor engaged in height works- 1 No.	
15	HSE related instruments	1. Lux meter- 1no, 2. ELCB Tester-1 no.- 3. Earth Megger- 1 No. 4. Anemometer-1 no- 5. Alcohol Breath Analyser-1	To be made available to BHEL as and when demanded or to be shared with other sub-contractors as instructed by BHEL

Special Notes:

1. The following welfare measures, in addition to those covered above, are to be taken at the site :
   a. Adequate Drinking Water
   b. Adequate no of toilets and washing area
   c. Canteen
   d. Rest Shed
   e. Hygienic Accommodation (Labour Colony) and allied facilities
2. Water sprinkling arrangement for suppression of dust to be made
3. A Safety Park will be put up with participation by all major contractors
4. It must be ensured that no contaminated water including those discharged from Toilets, Canteen, Office and Labour Colony shall be discharged to under-ground water table and river water
5. AS THIS SITE IS LOACTED IN A CYCLONE-PRONE AREA, ALL BUILDINGS AND SHED MUST BE CONSTRUCTED STRONG ENOUGH TO WITHSTAND ADVERSE WEATHER CONDITION
6. FURTHER TO POINT#6, MASS EVACUATION OF PEOPLE FROM SITE MAY BE CALLED FOR, IF ADVISED SO, BY GOVT AGENCIES. AS IT WILL BE EXTREMELY DIFFICULT TO FIND A REST SHELTER FOR A FEW THOUSAND PEOPLE, IT IS FURTHER EMPHASISED THAT ACCOMMODATION MUST BE STRONG ENOUGH TO SURVIVE SUCH EXTREME WEATHER CONDITION.
7. BHEL shall be provided drawing for labour accommodation and contractor shall be constructed as per BHEL drawing with contractor own contribution/expenses.
8. It is assumed that First aider will be sitting in a porta-cabin.

TENDER NO: PSER:SITE:KLN-C2019:19

VOLUME -IF

TECHNICAL CONDITIONS OF CONTRACT

(TCC-TS)

FOR

Package#10E: CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.

BHARAT HEAVY ELECTRICALS LIMITED

(A GOVT. OF INDIA UNDERTAKING)

General Manager & Construction Manager, 2x660 MW Maitree Super Thermal Power Project, PO-Kalekkharber, Union-Rajnagar, Upajila-Rampal, Dist: Bagerhat-9343, Bangladesh

ANNEXURE A

FICHTNER

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BHEL EVALUATION REPORT FOR SUB-VENDOR NO.

(Information marked with asterisk (*) is mandatory)

(APPLICABLE FOR SERVICE/ WORK CONTRACTS)

PACKAGE & PROJECT * :

EQUIPMENT / ITEM* :

CATEGORY (A, DR, N, acc. Vol I-B)* :

JUSTIFICATION (wrt EPC Contract)*:

GENERAL INFORMATION

1. **PROPOSED SUB-SUPPLIER'S NAME**

   WORKSHOP ADDRESS*

2. **CONTACT PERSON* :**

   TELEPHONE (LAND LINE/MOB.) :

   FAX :

   E-MAIL* :

3. **BRIEF SPEC. OF EQUIPMENT * ITEM / MODEL / TYPE / RANGE / CAPACITY:**

4. **REFERENCE LIST (LIST OF PROJECTS THE EPC HAS PERFORMED TOGETHER WITH THE PROPOSED SUB-SUPPLIER FOR THE PROPOSED SERVICES/ WORKS)***

CUSTOMER/ LOCATION WITH ADDRESS AND CONTACT PERSON	Proposed Works / Services	DATE OF COMPLETION	NO. OF YRS. IN OPERATION	PERFORMANCE FEEDBACK

5. **COMPLIANCE WITH RESPECT TO TECHNICAL SPECIFICATION**

   BHEL CONFIRMS THAT THE PROPOSED SUB SUPPLIER IS IN COMPLIANCE WITH RESPECT TO CONTRACT TECHNICAL SPECIFICATION AND HAS UNDERGONE SUCCESSFUL INTERNAL APPROVAL PROCESS FOR THE PROPOSED SERVICE / WORK CONTRACT INCLUDING PROVENNESS REQUIREMENT.

6. **CONCLUSION**

   BHEL CONFIRMS THAT SUB-SUPPLIER FULFILLS ALL REQUIREMENTS AS REQUESTED BY MFS AND IS DEEMED AS CAPABLE FOR ENVISAGED TASK.

Name Designation Signature Date

ANNEXURE B

SUB-VENDOR QUESTIONNAIRE

FICHTNER

(Information marked with asterisk (*) is mandatory)

(APPLICABLE FOR SERVICE/ WORK CONTRACTS)

Name of the proposed SERVICES/ WORKS *

1. **Name of Proposed Sub-Vendor ***: _____

Website *: _____

2. **Address of Regd. Office ***: **Details of contact person ***:
Name_____
Mobile no._____
Desig._____
E-mail:

- **Country of Head Office ***
- **Field of activities ***

3. **Address of Works*** **Details of contact person:**
Name_____
Mobile no._____
Desig._____
E-mail:

4. **Branch / Liaison office in Dhaka*** **Details of contact person:**
Name_____
Mobile no._____
Desig._____
E-mail:

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5. **Annual Turnover * & Profit in past three years *:**

#	Annual Turnover in Mn USD	Profit After tax in Mn USD
2015-2016		
2014-2015		
2013-2014		

6. Present & Peak Manpower Handled Status*:

Division Status	Permanent Manpower			Peak Manpower		Remarks
	Graduate		Diploma	Number	Project	
	Technical	Non-Technical				

a) Enclose organization chart of the proposed works (Y / N)

b) Enclose Organization chart of QA / QC Deptt. (Y / N)

c) Enclose List of Qualified Welders with process etc. (Y / N)

d) Enclose List of Qualified NDT personnel with area (Y / N)

7. Approval/ Certificates by National/ International standards/ accredited agency applicable for the proposed services/ works

8. Furnish Experience list of the proposed services/ works *

9. Enclose End User's operational feedback certificate for the proposed services/ works *.

10. Enclose list of equipment & machinery specific to the proposed services/ works*.

This should include name of equipment, capacity, year of manufacturing & nos. etc.:

11. Enclose list of Site Infrastructure & Services Available *

11. Quality management*

11.1 General

11.1.1 Work Instruction for different processes available. (Y / N)
if yes, furnish list.

11.1.2 Records generated during inspection maintained & available for review? (Y / N)

11.1.3 Statistical quality control techniques used? (Y/N)
If yes please furnish details.

11.1.4 ISO certificate for the works available? (Y/ N)
If yes, enclose copy of the certificate.

11.1.5 Quality & HSE Manual for the works available (Y / N)
If yes, enclose copy of the manual.

11.2 Corrective action

11.2.1 Specifically confirm whether System for identifying & disposition of Non Conformity in the process / product is available (Y / N)

11.2.2 Specifically confirm whether System for Customer complains & their satisfactory disposal is available. (Y / N)

11.3 Documentation Control

11.3.1 Procedure available for documentation control (Y / N)

11.4 Control of Inspection, measuring & testing equipment.

11.4.1 Procedure for calibration of testing & measuring instrument available. (Y / N)

12. Certification of sub-vendor *

I CERTIFY THAT THE INFORMATION SUPPLIED HEREIN (INCLUDING ALL PAGES ATTACHED) IS CORRECT.

SEAL

M/S.

Name

SIGNATURE

DESIGNATION

MOBILE NO

EMAIL

PLACE

DATE

13. Certification by Main Supplier *:

ABOVE INFORMATION HAVE BEEN VERIFIED AND FOUND IN ORDER TO COMPLY WITH TECHNICAL SPECIFICATION AS PER EPC-CONTRACT.

SEAL

M/S.

Name

SIGNATURE

DESIGNATION

MOBILE NO

EMAIL

PLACE

DATE

NOTE:

1. COLUMN SHALL NOT BE LEFT UNFILLED. IN CASE OF NOT APPLICABLE / NOT AVAILABLE, THE SAME SHALL BE INDICTED IN THE PROVIDED SPACE.
2. IN CASE PROVIDED SPACE IS NOT ADEQUATE, INFORMATION SHALL BE PROVIDED AS AN ATTACHMENT.
3. PRODUCT CATALOGUE FOR THE PROPOSED EQUIPMENT / ITEM / PROCESS, IF AVAILABLE, SHALL BE ENCLOSED

ANNEXURE C

UNDERTAKING
(To be submitted in the company's letter head)

THIS UNDERTAKING ("Undertaking") executed at **(Location)** on this **(Date)** by:

1. (**Company Name**), registered office at _____,

IN FAVOUR OF

2. **Bharat Heavy Electricals Limited**, a company incorporated under the company Act, 1956 of India having its registered office at BHEL House, Siri Fort, New Delhi-110049 and Power Sector Eastern Region Office at DJ-9/1, Sector-II, Saltlake City, Kolkata-700091, India.

1. UNDERTAKING

1.1 We hereby confirm that we are not a black listed company/organization by EXIM Bank of India as on the latest due date of bid submission.

1.2 During scrutiny if it is found otherwise w.r.t. undertaking furnished above, BHEL shall have right to cancel our bid for further evaluation.

Signed & Delivered on behalf of

(Company Name):
Official Representative:-
Designation:-
Date:-

APPROVED
Checked and Approved.

Date: 24-Jan-2018

*Approval doesn't absolve the EPC contractor of it's responsibility as specified in the Contract.

FIELD QUALITY PLAN
for
STEAM GENERATOR STRUCTURES

2X660 MW MAITREE SUPER THERMAL POWER PROJECT

BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED

OWNER'S CONSULTANT

FICHTNER

Fichtner GmbH & Co. KG, Germany

BIFPCL DOC. NO. : MAITREE-00-UH-QA-300006-PSE, REV. NO. : 3

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR - EASTERN REGION
KOLKATA – 700091

BHEL DOC. NO. : QPE-MTE-660-BR-12
REV No.: 3

APPROVED
Checked and Approved.

Date: 24-Jan-2018

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FIELD QUALITY PLAN
for
STEAM GENERATOR STRUCTURES

2X660 MW MAITREE SUPER THERMAL POWER PROJECT

BIFPCL DOC. NO. : MAITREE-00-UH-QA-300006-PSE

PREPARED BY	DE/QLY, BHEL, PSER	APPROVED BY	HEAD / QLY, BHEL, PSER
FQP NO.		**QPE-MTE-660-BR-12**	
ORIGINAL DATE OF ISSUE		01/08/2017	
REVISION NO. & DATE		3, Dt. 23/01/2018	
COPY NO.			
ISSUED TO			
DATE OF ISSUE			
PURPOSE :			
ISSUED BY (SIGNATURE & DESIGNATION)		DE / QLY, BHEL, PSER	

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR - EASTERN REGION
KOLKATA – 700091

APPROVED
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Date: 24-Jan-2018

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PSER	FIELD QUALITY PLAN FOR STEAM GENERATOR STRUCTURES	FQP NO: MAITREE-00-UH-QA-300006-PSE BHEL Doc. No. : QPE-MTE-660-BR-12
		Rev. No. : 3
		SHEET 1 / 1 SHEETS

CONTENTS

S. No.	Description	No. of Sheets
1.0	Contents	01
2.0	Status of Revisions	01
3.0	Authorization for checks and nonconformity disposition	01
4.0	Statement of Checks	09
5.0	Log Sheets	15

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Date: 24-Jan-2018

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PSER	FIELD QUALITY PLAN FOR STEAM GENERATOR STRUCTURES	FQP NO: MAITREE-00-UH-QA-300006-PSE BHEL Doc. No. : QPE-MTE-660-BR-12
		Rev. No. : 3
		SHEET 1 / 1 SHEETS

STATUS OF REVISIONS

SL. NO.	REFERENCE OF SHEETS REVISED	REVISION NO. & DATE	REMARKS
01	All	A, Dtd.: 01.08.17	Document prepared as per the owners specifications
02	Authorization for checks & nonconformity disposition, Statement of Checks and L-06	1, dtd. 26.10.17	Document generally revised to align with FQPs for other equipment and as per comments dated 20.09.17 from BIFPCL/OE
03	Sheet 2 & 5 of Statement of Checks	2, dtd. 11.12.17	Document revised as per comments dated 23.11.17 from BIFPCL/OE
04	Sheet 1 of Log Sheet No. L-09	3, dtd. 23.01.18	Document revised as per comments dated 23.01.18 from BIFPCL/OE

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Date: 24-Jan-2018

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PSER

AUTHORISATION FOR DIFFERENT CATEGORY OF CONSTRUCTION/ ERECTION CHECKS & NONCONFORMITY DISPOSITION

Category of Check	Inspection Authority	Witness Authority	Nonconformity (if any) Disposition Authority	Accepting Authority
'A' (Customer Hold Point)	BHEL Engineer	OWNER / CONSULTANT	BHEL ENGG Centre/ Head (Quality): BHEL PS-ER	OWNER / CONSULTANT
'B' (Formal intimation shall be forwarded by BHEL. Check shall commence at notified time whether parties show-up or not)	BHEL Engineer	OWNER / CONSULTANT	BHEL ENGG Centre/ Head (Quality): BHEL PS-ER	OWNER / CONSULTANT
'C'	BHEL Engineer	BHEL Engineer	BHEL ENGG Centre/ Head (Quality): BHEL PS-ER	BHEL HOS

Abbreviations used:

HOS – Head of Section

Note:

1. Nonconformity Disposition authority for all categories of checks shall be as under:

   Product nonconformities: BHEL Engineering Centre.

   Process/System nonconformities: Head (Quality): BHEL, PS ER.

2. Wherever log sheet is not called for, suitable record shall be maintained in protocol / Site register.

3. In case of nonconformity, accepting authority will consider the solution for the nonconformity as proposed by the Nonconformity Disposition Authority before acceptance, and such solution shall be reflected in the log sheets/protocols.

4. Owner's Engineer is authorized to carry out surveillance in any of B & C category of checks at his discretion.

5. Concerned agencies shall ensure that instruments having valid calibration are only used for measurements.

6. Quantum of check shall be 100% for all characteristics unless otherwise mentioned specifically in Field Quality Plan/ reference documents.

7. Only authorised persons with proper safety gears to enter construction area

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Date: 24-Jan-2018

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PSER	FIELD QUALITY PLAN FOR STEAM GENERATOR STRUCTURES	FQP NO: MAITREE-00-UH-QA-300006-PSE BHEL Doc. No. : QPE-MTE-660-BR-12
		Rev. No. : 3
		SHEET 01 / 09 SHEETS

STATEMENT OF CHECKS

Capacity / Type :	660MW
System :	BOILER & AUXILIARIES
Sub-system :	BOILER & AUXILIARIES SUPPORT STRUCTURE
Area :	ERECTION

NOTES :

1. As an evidence of having carried out the work satisfactorily, a general purpose log sheet, L-00 shall be maintained for all the checks.
2. Abbreviations used:

R – Record Verification

V – Visual Check

P – Physical Check

M – Measurement

T – Test

MTC – Manufacturer's Test Certificate

SR – Site Register

MDR – Material Discrepancy Report

EWS – Erection Welding Schedule

QSGM – Qualified Steam Generator Manufacturer

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Date: 24-Jan-2022
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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **STEAM GENERATOR STRUCTURES** STATEMENT OF CHECKS	FQP NO.: **MAITREE-00-UH-QA-300006-PSE** BHEL Doc. No. : QPE-MTE-660-BR-12 REV.NO.: 3 SHEET 02 / 09 SHEETS
SYSTEM: BOILER & AUXILIARIES	SUB-SYSTEM: BOILER & AUXILIARIES SUPPORT STRUCTURE	AREA: ERECTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
A	**GENERAL REQUIREMENTS**							
A.01	Ensure availability of requisite equipment in good working condition well before commencement of concerned activity. All MMRs in the field shall be calibrated before commencement of tests and then at interval as per manufacturer's recommendations and as per direction of BIFPCL / OE.	P & R	-	A	Once prior to start of work and thereof monthly	- Technical Specifications & Drawing -The calibration certificate shall specify the fitness of the MMRs within the limit of tolerance for use.	SR	-Functioning of MMRs in proper working condition to be verified on monthly basis. -calibration of MMRs shall be done by approved lab and the report shall be submitted to BIFPCL/ OE.
A.02	Ensure availability of approved drawings & erection welding schedule.	R	-	A	100% for each structure before start of activity	Owner's Technical Specifications	SR	
B	**MATERIAL RECEIPT**							
B.01	Check availability of Bill of materials (BOM) / packing slip, dispatch documents.	V	-	C	100%	-	-	
B.02	Check materials for completeness, correctness, and shortages / excesses as per Bill of Materials / Dispatch documents / Packing slip.	V	-	C	100%	BOM / Dispatch documents / Packing slip	Logbook	
B.03	Check components / boxes carefully for physical condition - a) In case of external damage to boxes, remove the top cover so that contents can be seen thoroughly. If the contents are sealed / intact, cover the contents / packing with original plastic sheeting / additional tarpaulin cover. b) In case of damage to contents, check the contents to ascertain the nature & quantum of damage. Re-pack contents in original packing, keep them in dry condition & follow step B.04	V	-	C	100%	Dispatch documents/ Packing slip	Logbook	
B.04	Ensure that nonconforming / rejected components are identified, stored separately and reported to supplier for rectification / replenishment.	V	-	C	100%	Work instructions for site Operations	MDR	
B.05	Control of receipt and issue of all components	V	-	C	100%	Work instructions for site Operations	Register	
C	**STORAGE & PRESERVATION**							
C.01	Storage & Preservation of components at site	V & P	As required	C	as per Section-IV of reference doc.	MAITREE-00-H-DC-300066-PSE	SR	

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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **STEAM GENERATOR STRUCTURES** STATEMENT OF CHECKS	FQP NO.: **MAITREE-00-UH-QA-300006-PSE** BHEL Doc. No. : QPE-MTE-660-BR-12 REV.NO.: 3 SHEET 03 / 09 SHEETS
SYSTEM: BOILER & AUXILIARIES	SUB-SYSTEM: BOILER & AUXILIARIES SUPPORT STRUCTURE	AREA: ERECTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
D	**CHECKS ON FOUNDATION**							
D.01	Availability of identified & protected permanent benchmark.	V	-	A	100%	GA Drawing	JOINT PROTOCOL	
D.02	Elevation of top of foundation pedestals with reference to permanent benchmark.	M	Dumpy level, Water level & Measuring Tape	A	100%	Drawing & Within tolerance given in L-01	L -01	For pedestals not shown in L-01, separate joint protocol to be made & numbered
D.03	Disposition of foundation pedestals with reference to longitudinal axis of boiler and reference axis.	M	Measuring Tape/ Total station	A	100%	Drawing & Within tolerance given in L-02	L -02	For pedestals not shown in L-02, separate joint protocol to be made (& numbered) recording the disposition of the pedestals with reference axis & spacing between the pedestals as per project specific layout drawing.
D.04	Spacing between foundation pedestals	M	Measuring Tape/ Total station	A	100%	Drawing & Within tolerance given in L-02	L -02	
D.05	Diagonals of main column foundation pedestals.	M	Measuring Tape/ Total station	B	100%	Drawing & Within tolerance given in L-03	L -03	
D.06	Pitch distance of foundation pedestal bolts on both axis and their diagonals.	M	Measuring Tape	B	100%	Drawing & Within tolerance given in L-04	L -04	
E	**WELDING & NON DESTRUCTIVE EXAMINATIONS**							
E.01	Availability of correct WPS, Welding & Heat Treatment Schedule from BHEL-Trichy at site	R	-	A	100%	Drawing / EWS	- ②	WPS endorsed by 3rd party inspector shall be reviewed at site
E.02	Review of MTC of welding electrodes & other consumables	R	-	A	100%	Relevant AWS specifications as per applicable WPS	SR ②	The copy of MTCs to be reviewed & signed by BHEL and record to be maintained in Site Register. BIFPCL/OE will conduct spot checks of review conducted by BHEL.
E.03	Welders' performance qualification.	V & T	-	A	100%	WPS & ASME BPVC Sec.-IX	WQR	
E.04	Adoption of correct procedure, approved electrodes and methods.	V	-	B	100%	Drawing/EWS & WPS	SR	
E.05	Drying / baking of electrodes (where ever applicable)	V & R	-	B	Random in each shift	Recommendations of electrode manufacturer	SR	
E.06	Pre heating of weld joints, as applicable.	V/M	Thermo-chalk or Non-contact type Thermometer	A	As per EWS / WPS	Drawing / EWS & WPS	SR	

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Checked and Approved.
Date: 24-Jan-2018
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BHARAT HEAVY ELECTRICALS LIMITED
PS:ER, KOLKATA

FIELD QUALITY PLAN
FOR
STEAM GENERATOR STRUCTURES
STATEMENT OF CHECKS

FQP NO.: **MAITREE-00-UH-QA-300006-PSE**
BHEL Doc. No. : QPE-MTE-660-BR-12
REV.NO.: 3
SHEET 04 / 09 SHEETS

SYSTEM: BOILER & AUXILIARIES
SUB-SYSTEM: BOILER & AUXILIARIES SUPPORT STRUCTURE
AREA: ERECTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
E.07	Ensure proper sequence of welding.	V	-	C	100%	Construction drawings	SR	
E.08	Visual Inspection of All weldments	V & M	As required	B	100%	Drawing & ASME BPVC Sec-V	SR	
E.09	Review of qualification of NDT inspectors	R	-	A	Once before engagement of each inspector	Level-II or above of ASNT NDT Certification or equivalent	NDT Inspector Register	
E.10	MPI / LPI on back gouged/ ground grooves prior to welding from second side.	V	As required	B	100%	ASME BPVC Sec-V	MPI/ LPI report	
E.11	MPI / LPI on finished groove welds for t < 25 mm.	V	As required	B	10% of weld length at random	ASME BPVC Sec-V	MPI/ LPI report	
E.12	MPI/ LPI on finished groove welds for t > 25 mm < 32 mm.	V	As required	B	100%	ASME BPVC Sec-V	MPI/ LPI report	
E.13	RT on finished groove welds for t ≥ 32 mm. Where RT is not possible due to practical difficulties, UT may be performed.	V	As required	A	100%	ASME BPVC Sec-V	RT / UT report	
E.14	MPI / LPI on finished fillet welds	V	As required	B	-100% MPI/ LPI on field welds joining web to tension flanges of Girder - MPI / LPI on other fillet weld : 5% of weld length	ASME BPVC Sec-V	MPI/ LPI report	
E.15	Spot radiography of Coal Bunker & Hoppers	T	RT Source	A	5% spot radiography (In case of failure of any welds in SPOT RT or UT the % of retesting shall be doubled at that particular location)	AWS D1.1M-2015	RT / UT report	Where access is not available, UT shall be carried out with prior intimation to Engineer in-charge

APPROVED
Checked and Approved.
Date: 24-Jan-2018
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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **STEAM GENERATOR STRUCTURES** STATEMENT OF CHECKS	FQP NO.: **MAITREE-00-UH-QA-300006-PSE** BHEL Doc. No. : QPE-MTE-660-BR-12 REV.NO.: 3 SHEET 05 / 09 SHEETS
SYSTEM: BOILER & AUXILIARIES	SUB-SYSTEM: BOILER & AUXILIARIES SUPPORT STRUCTURE	AREA: ERECTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
F	**Checks for Permanent bolts, Nuts, Washer and checks for bolting**							
F.01	Ensure materials are procured from BIFPCL / OE approved source	R	Review of MTC	A	Once in each lot of supply	BIFPCL / OE approved list of manufacturers	SR	In case of bolts supplied by BHEL-Trichy, only MDCC (from BIFPCL/OE) shall be reviewed
F.02	Check that Manufacturer's Test Certificate available for fastener materials and review physical & chemical properties	R	Review of MTC	A	Once in each lot of supply	ASTM F 3125M-15A or equivalent European Norm as specified in drawing	SR	
F.03	Check the faying surfaces before assembly	V	-	C	100% for each joint	No rust & other foreign materials	SR	
F.04	Check condition and number of bolts	V	-	B	100%	Drawing & Manufacturer's Recommendations	SR	
F.05 △2	Inspection of snug tightened joint & Inspection of marking	V	-	B	100%	clause no.7.2.2, 8.1 & 8.2 of IS 4000	SR	
F.06 △2	Tightening of HSFG bolts	V	As required for part-turn method of bolt tightening	B	100%	Part-turn method of tensioning as per table 4 of IS 4000	L-07	Tolerance on rotation: one-sixth of a turn (60 degrees) over; no under tolerance.
G	**ASSEMBLY & ERECTION OF COLUMNS & OTHER SUPPORT STRUCTURES**							
G.01	Check of marking of all components before assembly & erection	V	-	A	100%	Drawing / EWS	-	
G.02	Pre-assembly of columns & other members before erection wherever required.	V & M	Measuring Tape, Piano wire & Water level	B	100%	Drawing	SR	
G.03	Individual column piece camber and sweep.	M	Measuring Tape, Piano wire & Water level	B	100%	Drawing & Within 1 mm / M; 10 mm max.	SR	
G.04	Camber and sweep for assembled columns.	M	Measuring Tape, Piano wire & Water level	B	100%	Drawing & Within 1 mm / M; 18 mm max.	SR	

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BHARAT HEAVY ELECTRICALS LIMITED
PS:ER, KOLKATA

FIELD QUALITY PLAN
FOR
STEAM GENERATOR STRUCTURES
STATEMENT OF CHECKS

FQP NO.: **MAITREE-00-UH-QA-300006-PSE**
BHEL Doc. No. : QPE-MTE-660-BR-12
REV.NO.: 3
SHEET 06 / 09 SHEETS

SYSTEM: BOILER & AUXILIARIES
SUB-SYSTEM: BOILER & AUXILIARIES SUPPORT STRUCTURE
AREA: ERECTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
G.05	Total length of column before erection.	M	Measuring Tape	B	100%	Drawing & Within ± 15 mm max.	SR	
G.06	Check orientation of columns and other members Check for match mark, elevation mark, member erection mark No., splice size etc.	V	-	C	100%	Drawing	SR	
G.07	Ensure matching of centreline of base plate with pedestal axis.	V	-	C	100%	Drawing	SR	
G.08	Grouting gap below column base.	M/V	Measuring Tape	C	100%	Drawing/ Erection Manual /Grouting procedure & Grouting Gap: Min. 20 mm; max.70 mm	L-06	
G.09	Elevation of column at 1 meter level with reference to bench mark.	M	Measuring Tape & Water level	B	100%	Drawing & Elevation With in ± 5 mm.	SR	
G.10	Alignment of column	P	Digital Theodolite & Measuring Tape	C	100%	Drawing & Within tolerance given in L-05	SR	
G.11	Bolting of Column erection joints	refer Sl. No. F for checks						
G.12	Alignment of horizontal beams and vertical bracings .	M	Measuring Tape & Water level	C	100%	Drawing & Position w.r.t. reference axis within ± 10mm; elevation within ± 10 mm.	SR	
G.13A	Bolting of horizontal beams, bracings and vertical bracings (where bolted joint is shown in drawing)	refer Sl. No. F for checks						
G.13B	Welding of horizontal beams, bracings and vertical bracings (where welded joint is shown in drawing)	refer Sl. No. E for checks						
G.14	Verticality checking of columns at every 5M from EL 0.0M and at column erection joints.	V	Digital Theodolite & Measuring Tape	A	100%	Drawing & Within tolerance given in L-05	L-05	
G.15	Verification of test certificates and batch certificates of grout material.	V/R	-	A	100%	Drawing & Grout Manufacturer's Instructions	L -06	BIFPCL / OE approved manufacturers
G.16	Tightening of Foundation bolts & Grouting of column bases	P	As required	B	100%	Drawing & Grout Manufacturer's Recommendations	L-06	Cubes to be taken during grouting and compressive test to be done & witnessed by FQA

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BHARAT HEAVY ELECTRICALS LIMITED
PS:ER, KOLKATA

FIELD QUALITY PLAN
FOR
STEAM GENERATOR STRUCTURES
STATEMENT OF CHECKS

FQP NO.: **MAITREE-00-UH-QA-300006-PSE**
BHEL Doc. No. : QPE-MTE-660-BR-12
REV.NO.: 3
SHEET 07 / 09 SHEETS

SYSTEM: BOILER & AUXILIARIES
SUB-SYSTEM: BOILER & AUXILIARIES SUPPORT STRUCTURE
AREA: ERECTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
G.17	Tier-wise erection of staircase, platforms & handrails.	P	As required	B	100%	Drawing	JOINT PROTOCOL	For welding & bolting checks refer Sl No. E & F respectively
G.18	Erection of hoist support structures at different locations	V & M	As required	B	100%	Drawing	JOINT PROTOCOL	For welding & bolting checks refer Sl No. E & F respectively
H	**ASSEMBLY & ERECTION OF CEILING GIRDERS**							
H.01	Check of marking of all components before assembly & erection	V	-	A	100%	Drawing / EWS	SR	
H.02	Camber and sweep of individual ceiling girder pieces.	M	Measuring Tape, Piano wire & Water level	B	100%	Drawing & Within 1 mm / M, maximum 5 mm.	LOGBOOK	
H.03	Camber, sweep, diagonal and overall length before and after welding	M	Measuring Tape, Piano wire & Water level	B	100%	Drawing & Within 1 mm / M, maximum 15 mm.	LOGBOOK	
H.04	Edge preparation for groove joints and fit up. Ensure proper root gap and .	V	-	B	100%	Drawing	LOGBOOK	Note: LPI of edges as per Sl. No. E if thickness is 40mm & above
H.05	Welding of Ceiling girder pieces	refer Sl. No. E for checks						
H.06	Post Weld Heat Treatment of welds & HAZ	V / M	Time-Temperature Recorder	A	As per EWS / WPS	Drawing / EWS, WPS	HT Chart	
H.07	Inspection for completion of structure prior to ceiling girder erection	V / R	As required	B	100%	Drawing	L-08	In addition to visual checks, all Logsheets & Protocols of previous activities are to be reviewed.
H.08	Blue-matching of Girder Pin Seats with Column & Girder	V	As required	C	100%	Drawing & Min. 60% contact	SR	The coating of rust preventive oil on the Pin & pin seats to be thoroughly wiped off before erection and Pin Seats to be lubricated
H.09	Alignment of erected ceiling girders	M	Measuring Tape, Plumb bob, Piano wire & Water level	A	100%	Drawing & Within tolerance given in L-09.	L -09	

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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **STEAM GENERATOR STRUCTURES** STATEMENT OF CHECKS	FQP NO.: **MAITREE-00-UH-QA-300006-PSE** BHEL Doc. No. : QPE-MTE-660-BR-12	
		REV.NO.: 3	
		SHEET 08 / 09 SHEETS	
SYSTEM: BOILER & AUXILIARIES	SUB-SYSTEM: BOILER & AUXILIARIES SUPPORT STRUCTURE	AREA: ERECTION	

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
H.10	Bolting of Ceiling Girders	refer Sl. No. F for checks						
H.11	Verticality of girder supporting columns after ceiling girder erection (at top and at as may markings are visible w.r.t. EL 0M).	M	Digital Theodolite & Measuring Tape	A	100%	Drawing & Verticality within 1 MM/ M, Max. 25 MM.	L -05	
H.12	Centreline of ceiling girders marked w.r.t. longitudinal axis of boiler transferred from ground level to top.	M	Digital Theodolite/ Measuring Tape	A	100%	Drawing & Alignment with in tolerances given in L-09.	L -09	
H.13	Erection & Alignment of other ceiling structures					Drawing	SR	
H.14	Bolting checks for ceiling structure beams	refer Sl. No. F for checks						
I	**CLEARANCE FOR MILESTONE ACTIVITY (START OF PRESSURE PARTS' ERECTION)**							
I.01	Clearance for start of Pressure parts Erection *	V & R	-	A	100%	Drawing	JOINT PROTOCOL	* QSGM Review of Log sheets & Protocols
J	**ASSEMBLY & ERECTION OF BUNKERS**							
J.01	Check of marking & check of any visual damage of all components before assembly & erection	V	-	B	100%	Drawing / EWS	SR	
J.02	Edge preparation for groove joints and fit up. Ensure proper root gap	V & M	-	B	100%	Drawing, Table D.1.9 of EN 1090-2: 2008 +A1:2011	SR	Note: LPI of edges as per Sl. No. E if thickness is 40mm & above
J.03	Assembly checks of Bunkers, Ring Girder & Hopper	M	Measuring Tape, Piano wire & Water level	B	100%	Drawing, Table D.1.6 & D.1.9 of EN 1090-2: 2008 +A1:2011	SR	
J.04	Welding of assembled components	refer Sl. No. E for checks						
J.05	Erection of Bunkers, Ring Girder & Hopper	V & M	-	B	100%	Drawing, verticality tolerance shall be limited to erection tolerance of columns	SR	tolerances on erected Hopper outlet shall be limited to the deviations permitted by the coal pulverisers.
J.06	Welding / Bolting of erected components (as specified in drawing)	refer Sl. No. D for welding checks & Sl .no E for bolting checks						

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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **STEAM GENERATOR STRUCTURES** STATEMENT OF CHECKS	FQP NO.: **MAITREE-00-UH-QA-300006-PSE** BHEL Doc. No. : QPE-MTE-660-BR-12 REV.NO.: 3 SHEET 09 / 09 SHEETS
SYSTEM: BOILER & AUXILIARIES	SUB-SYSTEM: BOILER & AUXILIARIES SUPPORT STRUCTURE	AREA: ERECTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
K	**REMOVAL OF TEMPORARY SUPPORTS**							
K.01	Removal of temporary supports.#	V	-	C	100%	Drawing	SR	# Class of Check for removal of temporary locking at ceiling girder Pin & rocker arrangement shall be Class 'B' & joint protocol to be made for each rocker arrangement
L	**PAINTING**							
L.01	Visual inspection of surface to be painted	V	-	C	100%	No rust, oil & other foreign materials	SR	Temporary weldings are to be gouged off & ground smooth.
L.02	Review of MTC of Paints (MTC to be reviewed & invoice to be co-related)	R	-	A	Each batch of paint	Approved painting schedule & ISO 12944	JOINT PROTOCOL	Paints to be procured from BIFPCL/OE approved source
L.03	Touch-up of primer / paint in damaged portions (if required)	V	-	B	100%	Approved painting schedule	SR	
L.04	Checking of final painting dry film thickness & acceptance	M & V	Digital DFT Gauge	B	100%	Approved painting schedule	JOINT PROTOCOL	

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PSER-QUALITY

RECORD OF QUALITY CHECKS

SHEET NO. OF QPI	CHECK NO.	RESULTS ACHIEVED OK/ NOT OK	REFERENCE DRAWING/ DOCUMENT	FORMAT OF RECORD	CHECKED BY SIGN. & DATE	ACCEPTED BY SIGN. & DATE	REMARKS

Note: Any protocol made is to be numbered & mentioned in "Format of Record" column.

		SYSTEM	SUB-SYSTEM	AREA	DOC NO.: QPE-MTE-660-BR-12
PROJECT					REV. NO. : 3
UNIT NO.					LOG SHEET NO.: L-00
RATING					SHEET:

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Date: 24-Jan-2018

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PSER-QUALITY

INSTRUMENT REGN.NO.		
DATE OF INSPECTION		
DRAWING / DOCUMENT REF.		

BOILER FOUNDATIONS TOP OF PEDESTAL

All dimensions are in mm

Top elevation of pedestals as per drawing _____ mm

Tolerance : + 30 mm, - 20 mm & Top level difference between Pedestals : 15 mm

Sl, No.	Pedestal Designation	Top Elevation	Sl. No.	Pedestal Designation	Top Elevation	Sl. No.	Pedestal Designation	Top Elevation
1.	S1L		30.	S30L		59	S22R	
2.	S2L		31.	EX1L		60	S23R	
3.	S3L		32.	EX2L		61	S24R	
4.	S4L		33.	D1L		62	S26R	
5.	S5L		34.	D2L		63	S27R	
6.	S6L		35.	D3L		64	S28R	
7.	S7L		36.	D4L		65	S29R	
8.	S8L		37.	LC1		66	S30R	
9.	S9L		38.	LC2		67	EX1R	
10.	S10L		39.	LC3		68	EX2R	
11.	S11L		40.	LC4		69	D1R	
12.	S12L		41.	S1R		70	D2R	
13.	S13L		42.	S2R		71	D3R	
14.	S14L		43.	S3R		72	LC5	
15.	S15L		44.	S4R		73	LC6	
16.	S16L		45.	S5R		74	LC7	
17.	S17		46.	S6R		75	LC8	
18.	S18L		47.	S7R				
19.	S19L		48.	S8R				
20.	S20		49.	S9R				
21.	S21L		50.	S10R				
22.	S22L		51.	S11R				
23.	S23L		52.	S12R				
24.	S24L		53.	S13R				
25.	S25		54.	S14R				
26.	S26L		55.	S15R				
27.	S27L		56	S16R				
28.	S28L		57	S19R				
29.	S29L		58	S21R				

Note: Refer project specific layout drawing for pedestal designation.

			NAME	SIGNATURE & DATE	QP NO.: **QPE-MTE-660-BR-12**
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO.		CLEARED BY			LOG SHEET NO.: **L-01**
RATING		CUSTOMER			PAGE **1** of **1**

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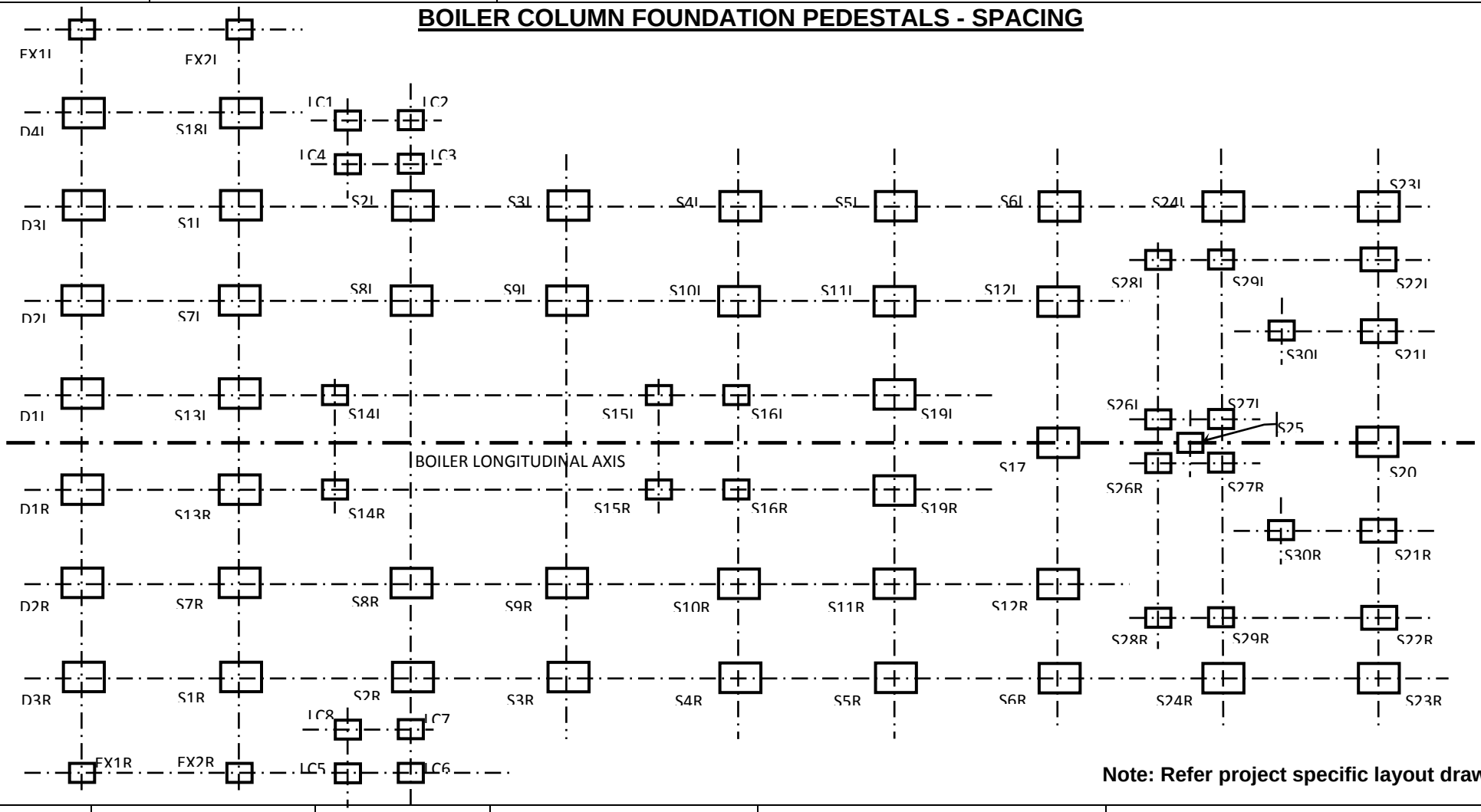
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INSTRUMENT REGN.NO.		
DATE OF INSPECTION		
DRAWING / DOCUMENT NO.		

BOILER COLUMN FOUNDATION PEDESTALS - SPACING



Note: Refer project specific layout drawing.

			NAME	SIGNATURE / DATE	QP NO.: **QPE-MTE-660-BR-12**
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO.		CLEARED BY			LOG SHEET NO.: **L-02**
RATING		CUSTOMER			PAGE **1** OF **3**

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INSTRUMENT REGN.NO.		
DATE OF INSPECTION		
DRAWING / DOCUMENT REF.		

BOILER COLUMN FOUNDATION PEDESTALS - SPACING

S. No.	Spacing Between Column	As per drawing	Actual	S. No.	Spacing Between Column	As per drawing	Actual
1.				31.			
2.				32.			
3.				33.			
4.				34.			
5.				35.			
6.				36.			
7.				37.			
8.				38.			
9.				39.			
10.				40.			
11.				41.			
12.				42.			
13.				43.			
14.				44.			
15.				45.			
16.				46.			
17.				47.			
18.				48.			
19.				49.			
20.				50.			
21.				51.			
22.				52.			
23.				53.			
24.				54.			
25.				55			
26.				56			
27.				57			
28.				58			
29.				59			
30.				60			

Note: Refer project specific layout drawing for pedestal designation.

Tolerances:

1. Between adjacent foundation pedestals centers: **1 mm / M, ± 5 mm max.**
2. Spacing between first and last row of foundation: **1 mm / M, ± 15 mm max.**

All dimensions are in mm.

			NAME	SIGNATURE & DATE	QP NO.: **QPE-MTE-660-BR-12**
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO.		CLEARED BY			LOG SHEET NO.: **L-02**
RATING		CUSTOMER			PAGE **2** OF **3**

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Date: 24-Jan-2018

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PSER-QUALITY

INSTRUMENT REGN.NO.		
DATE OF INSPECTION		
DRAWING / DOCUMENT REF.		

BOILER COLUMN FOUNDATION PEDESTALS - SPACING

Sl.No.	Spacing Between	As per drawing	Actual	Sl.No.	Spacing Between	As per drawing	Actual
61				82			
62				83			
63				84			
64				85			
65				86			
66				87			
67				88			
68				89			
69				90			
70				91			
71				92			
72				93			
73				94			
74				95			
75				96			
76				97			
77				98			
78				99			
79				100			
80							
81							

Note: Refer project specific layout drawing for pedestal designation.
Tolerances:

1. Between adjacent foundation pedestals centers: **1 mm / M, ± 5 mm max.**
2. Spacing between first and last row of foundation: **1 mm / M, ± 15 mm max.**

All dimensions are in mm.

*** ADD MORE SHEETS IF REQUIRED**

			NAME	SIGNATURE & DATE	QP NO.: **QPE-MTE-660-BR-12**
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO.		CLEARED BY			LOG SHEET NO.: **L-02**
RATING		CUSTOMER			PAGE **3** OF **3**

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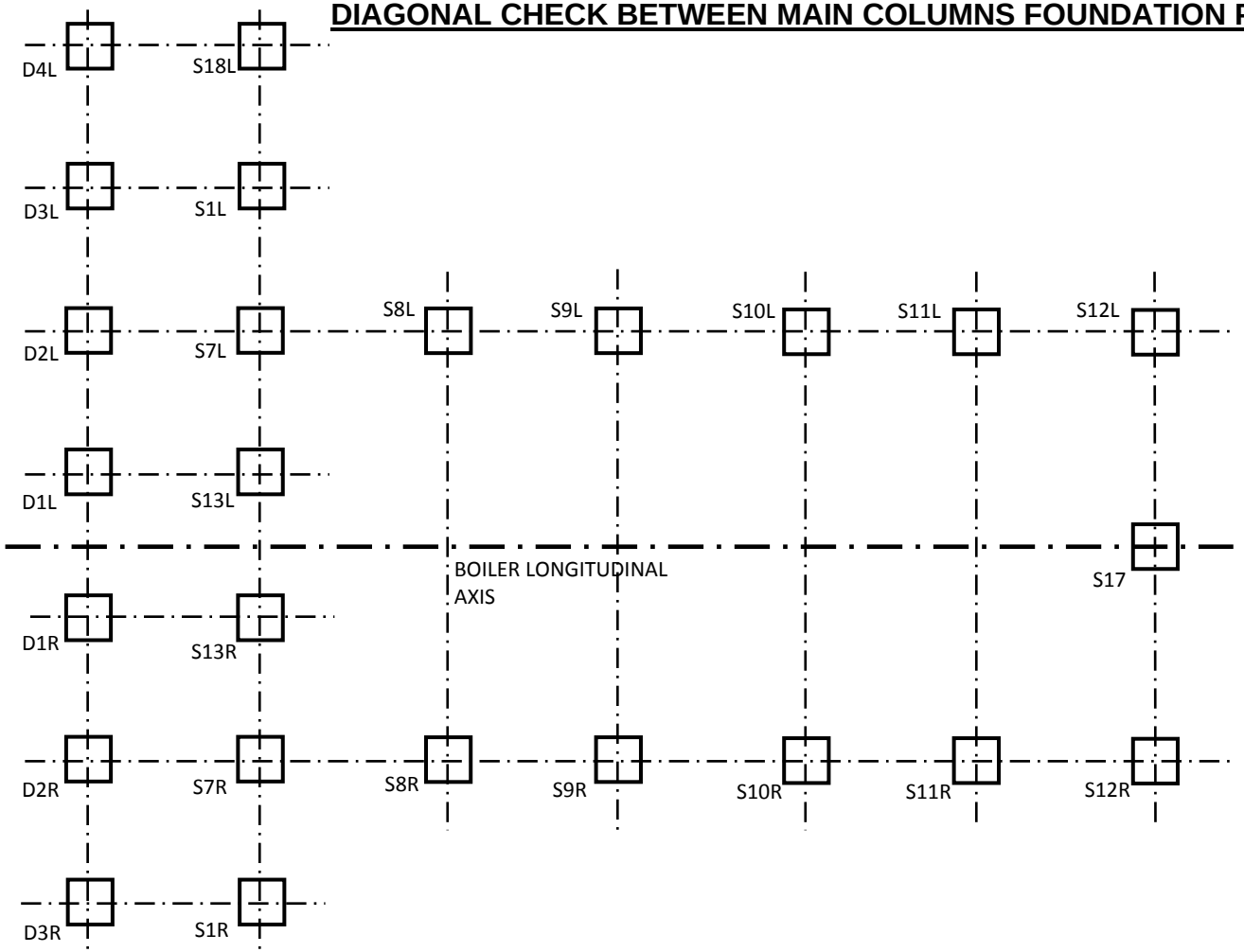
Date: 24-Jan-2018

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PSER-QUALITY

INSTRUMENT REGN.NO.		
DATE OF INSPECTION		
DRAWING / DOCUMENT NO.		

DIAGONAL CHECK BETWEEN MAIN COLUMNS FOUNDATION PEDESTALS



Note: Refer project specific layout drawing.

			NAME	SIGNATURE / DATE	QP NO.: QPE-MTE-660-BR-12
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO.		CLEARED BY			LOG SHEET NO.: **L-03**
RATING		CUSTOMER			PAGE **1** OF **2**

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Date: 24-Jan-2018

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PSER-QUALITY

INSTRUMENT REGN.NO.		
DATE OF INSPECTION		
DRAWING / DOCUMENT REF.		

DIAGONAL CHECK BETWEEN MAIN COLUMN FOUNDATION PEDESTALS

Sl. No.	Diagonal between	Measurement	Difference	Sl. No.	Diagonal between	Measurement	Difference
1	S7L & S8R			19	S13L & D2L		
2	S7R & S8L			20	S7L & D1L		
3	S8L & S9R			21	S7L & D3L		
4	S8R & S9L			22	S1L & D2L		
5	S9L & S10R			23	S1L & D4L		
6	S9R & S10L			24	S18L & D3L		
7	S10L & S11R						
8	S10R & S11L						
9	S11L & S12R						
10	S11R & S12L						
11	S7R & S12L						
12	S12R & S7L						
13	S1R & D2R						
14	S7R & D3R						
15	S7R & D1R						
16	S13R & D2R						
17	S13R & D1L						
18	S13L & D1R						

Tolerances:

1. Foundation pedestals diagonal difference : **1 mm / M, 10 mm max.**
2. Cumulative diagonal difference : **1 mm / M, 25 mm max.**

Note: Refer project specific layout drawing for column designation.

All dimensions are in mm.

			NAME	SIGNATURE & DATE	QP NO.:
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO.		CLEARED BY			LOG SHEET NO.: **L-03**
RATING		CUSTOMER			PAGE **2** OF **2**

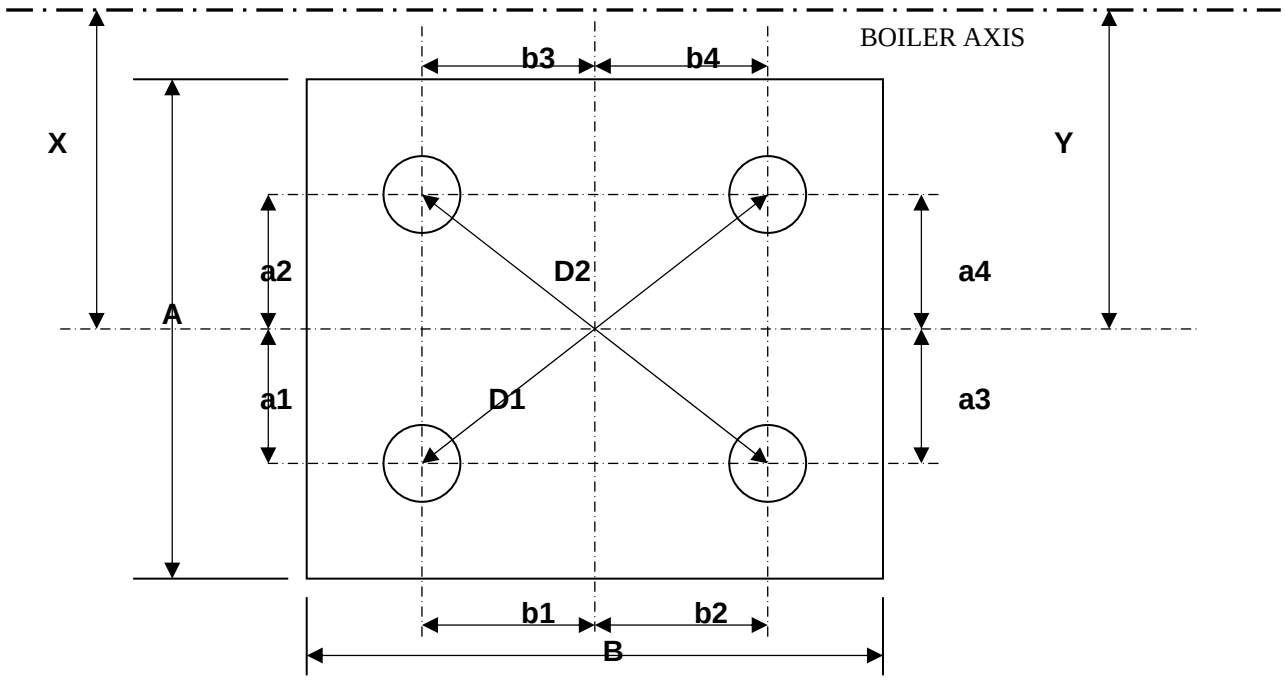
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PSER-QUALITY	INSTRUMENT REGN.NO.		
	DATE OF INSPECTION		
	DRAWING / DOCUMENT REF.		

PITCH DISTANCE OF FOUNDATION BOLTS AND DIAGONALS



AS PER DRAWING															
PEDESTAL DESIGNATION		A	B	a1	a2	a3	a4	b1	b2	b3	b4	D1	D2	X	Y
	L														
	R														
	L														
	R														
	L														
	R														
	L														
	R														
	L														
	R														

Tolerances: 1. Pitch Distances : ± **3 mm**

All dimensions are in mm

2. Diagonal Difference : **5 mm max.**
3. **X – Y** : **5 mm max.**

Note: Refer project specific layout drawing for column designation.

			NAME	SIGNATURE & DATE	QP NO.: QPE-MTE-660-BR-12
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO		CLEARED BY			LOG SHEET NO.: **L-04**
RATING		CUSTOMER			PAGE **1** OF **1**

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PSER-QUALITY

INSTRUMENT REGN.NO.		
DATE OF INSPECTION		
DRAWING / DOCUMENT REF.		

VERTICALITY OF COLUMNS

Tolerance: **1mm / M, 25 mm Max.** **All dimensions are in mm**

Column Number	Elevation	Inclined towards			
		East	West	North	South

			NAME	SIGNATURE & DATE	QP NO.: QPE-MTE-660-BR-12
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO.		CLEARED BY			LOG SHEET NO.: **L-05**
RATING		CUSTOMER			PAGE **1** OF **1**

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PSER-QUALITY	INSTRUMENT REGN.NO.		
	DATE OF INSPECTION		
	DRAWING / DOCUMENT REF.		

GROUTING OF COLUMN BASES

1. Column Numbers :
2. Grouting gap below column base :
3. Foundation bolt tightened : Yes / No
4. Grout Material Specification & MTC Ref. No. :
5. Ratio of proportion of grout mix :
6. Whether any additives added : Yes / No

   If yes, details :

7. Date of grouting :
8. Whether test cubes have been taken : Yes / No

   If yes, test results –

   a) compressive strength after 3 days :

   b) compressive strength after 7 days :
9. Remarks :

The following column bases_____ are cleared for further erection after _____ days of curing.

			NAME	SIGNATURE & DATE	QP NO.: QPE-MTE-660-BR-12
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO.		CLEARED BY			LOG SHEET NO.: **L-06**
RATING		CUSTOMER			PAGE **1** OF **1**

APPROVED
Checked and Approved.

Date: 24-Jan-2018

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PSER-QUALITY	INSTRUMENT REGISTRATION NO.	
	DATE OF INSPECTION	
	DRAWING / DOCUMENT REF.	

LOGSHEET FOR HSFG BOLT TIGHTENING OF BOILER STRUCTURES

SL.NO.	TIER / LOCATION	MEMBER MARK NO. (PG-MA-DU)	COMPLETION OF FIXING, SNUG TIGHTENING OF HSFG BOLTS & MARKING ON NUTS	COMPLETION OF PART TURN OF NUTS	REMARKS

			NAME	SIGN & DATE	QP NO.: QPE-MTE-660-BR-12
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO.		CLEARED BY			LOG SHEET NO.: **L07**
RATING					PAGE **1** OF **1**

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PSER-QUALITY	INSTRUMENT REGN.NO.		
	DATE OF INSPECTION		
	DRAWING / DOCUMENT REF.		

JOINT INSPECTION PROTOCOL FOR COMPLETION OF STRUCTURE PRIOR TO CEILING GIRDER ERECTION

Sl.No.	Activity	Observation
1	Completion and verification of all applicable log sheets / records of erection.	
2	Erection completion of :	
	a) All columns	
	b) Horizontal beams between columns(except for the locations strategically left out for pressure parts erection)	
	c) Vertical bracings and tie members (except for the locations strategically left out for pressure parts erection)	
	d) Horizontal bracing on all main brace levels (MBLs)	
	e) Grouting & proper curing	
	e) Readiness of staircase with handrails	
3.	Completion of HSFG bolts tightening of columns & Beams / Bracings	
4.	Cleaning of all mating surfaces viz. column top, girder bottom, pin connection surfaces.	
5.	Availability & adequacy of temporary platforms with suitable fall protection arrangement at top	
6.	Fixing of handrails on top of crane girder & ladder with fall protection arrangement on sides of girder	
7.	Remarks :	

Boiler supporting structure is cleared for start of ceiling girder erection.

			NAME	SIGNATURE & DATE	QP NO.: **QPE-MTE-660-BR-12**
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO.		CLEARED BY			LOG SHEET NO.: **L-08**
RATING		CUSTOMER			PAGE **1** OF **1**

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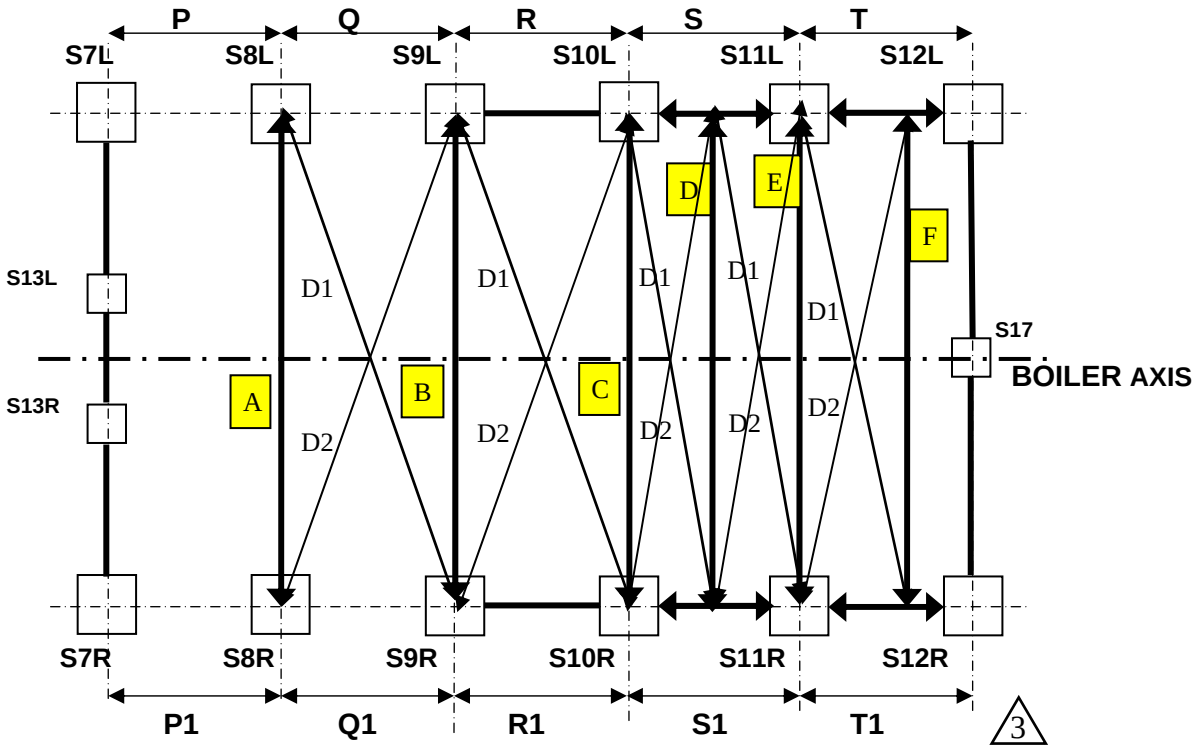
Date: 24-Jan-2018

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PSER-QUALITY

INSTRUMENT REGN.NO.		
DATE OF INSPECTION		
DRAWING / DOCUMENT REF.		

CEILING STRUCTURES ALIGNMENT



Note: Refer project specific layout drawing.

SPACING BETWEEN CEILING GIRDERS: Tolerance: **± 5 mm Max.**

Location	As per drawing	Actual	Location	As per drawing	Actual
P			P1		
Q			Q1		
R			R1		
S			S1		
T			T1		

All dimensions are in mm

E & C			NAME	SIGNATURE & DATE	QP NO.: QPE-MTE-660-BR-12
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO.		CLEARED BY			LOG SHEET NO.: **L-09**
RATING		CUSTOMER			PAGE **1** OF **2**

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PSER-QUALITY

INSTRUMENT REGN.NO.		
DATE OF INSPECTION		
DRAWING / DOCUMENT REF.		

CEILING STRUCTURES ALIGNMENT

DIAGONAL DIFFERENCE BETWEEN ADJACENT CEILING GIRDERS

Tolerance: **25 mm Max.**

Between Girders	D1	D2	D1~D2
A – B			
B – C			
C – D			
D – E			
E – F			

CEILING GIRDER C. L. VARIATION W.R.T. BOILER AXIS :

Tolerance: **12 mm Max.** **All dimensions are in mm**

Girder Designation	Variation w.r.t. boiler axis	
	Towards Left	Towards Right
Girder - A		
Girder – B		
Girder – C		
Girder – D		
Girder – E		
Girder – F		

Note: Refer project specific layout drawing.

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PSER	INSTRUMENT REG. NO./TAG		
	DATE OF INSPECTION		
	DRAWING / DOCUMENT REF.		

PROTOCOL

			NAME	SIGNATURE & DATE	FQP. NO.: QPE-MTE-660-BR-12
PROJECT		INSPECTED BY			REV. NO. : 3
UNIT NO.		CLEARED BY			PROTOCOL NO.
RATING		CUSTOMER			PAGE:

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Date: 28-Nov-2017

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FIELD QUALITY PLAN

for

CIVIL WORKS

(EXCEPT PILING WORK)

2X660 MW MAITREE SUPER THERMAL POWER PROJECT

BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED

OWNER'S ENGINEER

FICHTNER

Fichtner GmbH & Co. KG, Germany

BIFPCL DOC. NO. : MAITREE-00-U-QA-300001-PSE, REV. NO. : 2

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR - EASTERN REGION
KOLKATA – 700091

BHEL DOC. NO. : QPE-MTE-660-CL-01
REV No.: 2

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Checked and Approved.

Date: 28-Nov-2017

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FIELD QUALITY PLAN

for

CIVIL WORKS

(EXCEPT PILING WORK)

2X660 MW MAITREE SUPER THERMAL POWER PROJECT

BIFPCL DOC. NO. : MAITREE-00-U-QA-300001-PSE, REV. NO. : 2

PREPARED BY	BHEL, PSER KOL-91 QUALITY DEPT. DE/QLY, BHEL, PSER	APPROVED BY	HEAD / QLY, BHEL, PSER

FQP NO.	**QPE-MTE-660-CL-01**
ORIGINAL DATE OF ISSUE	20/07/2017
REVISION NO. & DATE	2, Dt. 15/11/2017
COPY NO.	
ISSUED TO	
DATE OF ISSUE	
PURPOSE :	
ISSUED BY (SIGNATURE & DESIGNATION)	DE/QLY, BHEL, PSER

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR - EASTERN REGION
KOLKATA – 700091

APPROVED
Checked and Approved.

Date: 28-Nov-2017

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PSER

FIELD QUALITY PLAN FOR CIVIL WORKS (EXCEPT PILING WORK)

FQP NO.: MAITREE-00-U-QA-300001-PSE BHEL Doc. No. : QPE-MTE-660-CL-01

REV No.: 2

SHEET 1 / 1 SHEETS

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6.0	Annex - II	02
7.0	Annex - III	01
8.0	Log Sheets (L-00 TO L02)	04

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Date: 28-Nov-2017

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PSER	FIELD QUALITY PLAN FOR CIVIL WORKS (EXCEPT PILING WORK)	FQP NO.: MAITREE-00-U-QA-300001-PSE BHEL Doc. No. : QPE-MTE-660-CL-01
		REV No.: 2
		SHEET 1 / 1 SHEETS

STATUS OF REVISIONS

SL. NO.	REFERENCE OF SHEETS REVISED	REVISION NO. & DATE	REMARKS
01	All	**A**, Dated 20/07/2017	Document prepared as per Technical Specifications of BIFPCL
02	Sl. No. A.01 in Sheet 02 of 'Statement of Checks'	**1**, Dated 15/09/2017	Revised as per comment dated 12/09/2017 from BIFPCL / OE
03	Sl. No. A.02 in Sheet 02 of 'Statement of Checks'		Revised as per comment dated 12/09/2017 from BIFPCL / OE
04	Sl. No. B.07A, B.07B, B.07C in Sheet 02 of 'Statement of Checks'		Revised as per comment dated 12/09/2017 from BIFPCL / OE
05	Sl. No. C.01 in Sheet 03 of 'Statement of Checks'		1. Review of physical & compositional requirement added 2. quantum of check changed
06	Sl. No. C.05 in Sheet 04 of 'Statement of Checks'		Revised as per comment dated 12/09/2017 from BIFPCL / OE
07	Sl. No. D.03 in Sheet 04 of 'Statement of Checks'		Revised as per comment dated 12/09/2017 from BIFPCL / OE
08	Sl. No. D.05B in Sheet 04 of 'Statement of Checks'		Revised as per comment dated 12/09/2017 from BIFPCL / OE
09	Sl. No. D.08 in Sheet 05 of 'Statement of Checks'		Revised as per comment dated 12/09/2017 from BIFPCL / OE
10	Sl. No. D.09F in Sheet 06 of 'Statement of Checks'		Quantum of check changed & remarks added.
11	Sl. No. E.01 in Sheet 06 of 'Statement of Checks'		Revised as per comment dated 12/09/2017 from BIFPCL / OE
12	Sl. No. G.01 in Sheet 08 of 'Statement of Checks'		Revised as per comment dated 12/09/2017 from BIFPCL / OE
13	Sl. No. H.01C, H.01D, H.03C & H.03D in Sheet 10 of 'Statement of Checks'		Revised as per comment dated 12/09/2017 from BIFPCL / OE
14	Sl. No. L.06C in Sheet 13 of 'Statement of Checks'		Revised as per comment dated 12/09/2017 from BIFPCL / OE
15	Sl. No. Q.03A in Sheet 16 of 'Statement of Checks'		Revised as per comment dated 12/09/2017 from BIFPCL / OE
16	Sl. No. Q.03A in Sheet 16, Q.04A in Sheet 17 & Q.05A in Sheet 19 of 'Statement of Checks'		Revised as per comment dated 12/09/2017 from BIFPCL / OE
17	Annex-II		Revised as per comment dated 12/09/2017 from BIFPCL / OE
18	AUTHORISATION FOR DIFFERENT CATEGORY OF CONSTRUCTION/ ERECTION CHECKS & NONCONFORMITY DISPOSITION	**2**, Dated 15/11/2017	Revised as per comment dated 14/11/2017 from BIFPCL / OE
19	Sl. No. B.07C in Sheet 2, B.07D in Sheet 3 & M.03 in Sheet 13 of 'Statement of Checks'		

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AUTHORISATION FOR DIFFERENT CATEGORY OF CONSTRUCTION/ ERECTION CHECKS & NONCONFORMITY DISPOSITION

2

Category of Check	Inspection Authority	Witness Authority	Nonconformity (if any) Disposition Authority	Accepting Authority
'A' (Customer Hold Point)	BHEL Engineer	OWNER / CONSULTANT	BHEL ENGG Centre/ Head (Quality): BHEL PS-ER	OWNER / CONSULTANT
'B' (Formal intimation shall be forwarded by BHEL. Check shall commence at notified time whether parties show-up or not)	BHEL Engineer	OWNER / CONSULTANT	BHEL ENGG Centre/ Head (Quality): BHEL PS-ER	OWNER / CONSULTANT
'C'	BHEL Engineer	BHEL Engineer	BHEL ENGG Centre/ Head (Quality): BHEL PS-ER	BHEL HOS

Abbreviations used:

HOS – Head of Section

Note:

1. Nonconformity Disposition authority for all categories of checks shall be as under:

   Product nonconformities: BHEL Engineering Centre.

   Process/System nonconformities: Head (Quality): BHEL, PS ER.

2. Wherever log sheet is not called for, suitable record shall be maintained in protocol / Site register.

3. In case of nonconformity, accepting authority will consider the solution for the nonconformity as proposed by the Nonconformity Disposition Authority before acceptance, and such solution shall be reflected in the log sheets/protocols. (2)

4. Owner's Engineer is authorized to carry out surveillance in any of B & C category of checks at his discretion.

5. Concerned agencies shall ensure that instruments having valid calibration are only used for measurements.

6. Quantum of check shall be 100% for all characteristics unless otherwise mentioned specifically in Field Quality Plan/ reference documents.

7. Only authorised persons with proper safety gears to enter construction area

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PSER	FIELD QUALITY PLAN FOR CIVIL WORKS (EXCEPT PILING WORK)	FQP NO.: MAITREE-00-U-QA-300001-PSE BHEL Doc. No. : QPE-MTE-660-CL-01
		REV No.: 2
		SHEET 01 / 19 SHEETS

STATEMENT OF CHECKS

Capacity / Type :	660MW
System :	CIVIL WORKS
Sub-system :	CIVIL WORKS (EXCEPT PILING WORK)
Area :	CONSTRUCTION & TESTING

NOTES :

1. As an evidence of having carried out the work satisfactorily, a general purpose log sheet, L-00 shall be maintained for all the checks.
2. Abbreviations used:

   R – Record Verification

   V – Visual Check

   P – Physical Check

   M – Measurement

   T – Test

   MTC – Manufacturers Test Certificate

   SR – Site Register

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Date: 28-Nov-2017

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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **CIVIL WORKS** (STATEMENT OF CHECKS)	FQP NO.: MAITREE-00-U-QA-300001-PSE BHEL Doc. No. : QPE-MTE-660-CL-01 REV.NO.: 2 SHEET 02 / 19 SHEETS
SYSTEM: CIVIL WORKS	SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK)	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
A	**GENERAL REQUIREMENTS**							
A.01	Ensure availability of requisite laboratory set up and equipment in good working condition well before commencement of concerned activity. All MMRs in the field shall be calibrated before commencement of tests and then at interval as per manufacturer's recommendations and as per direction of owner / OE. 1	P & R	-	A	Once prior to start of work and thereof monthly	- Technical Specifications & Drawing -The calibration certificate shall specify the fitness of the MMRs within the limit of tolerance for use. 1	SR	-Functioning of laboratory equipment in proper working condition to be verified on monthly basis. -calibration of MMRs shall be done by approved lab and the report shall be submitted to owner/ OE. 1
A.02	Sampling for testing of building materials for concrete mix design etc.	P		A	Once per each source & each grade of concrete	- do -	Joint Protocol 1	
A.03	Ensure availability of following - a) approved drawing b) approved Design mix of concrete	P	-	A	100% for each structure & each grade of concrete	ACI 211.1-97 (Design Mix of Concrete) & ACI 318-14 OR BS EN 206:2013A1:2016 (Acceptance criteria for fresh & hardened concrete)	-	Concrete Mix design to done as per ACI 211.1-97 and in line with the requirements of approved drawing,
B	**EARTH WORK (EXCAVATION, BACKFILLING, LEVELLING, GRADING & COMPACTION)**							
B.01	Identification of disposal points for excavated material	P	-	B	Before start of excavation	The Conditions of Contract	Joint Protocol	
B.02	Nature, type of soil / rock before and during excavations	V	As required & agreed	B	Random in each shift	Owner's Tech. Specifications & Drawing	SR	
B.03	Initial ground level before start of excavations	M	As required & agreed	B	100%	Drawing, BS 6031:2009	SR	
B.04	Final shape and Dimensions of excavations.	M	As required & agreed	B	Random in each shift	Drawing, BS 6031:2009	SR	
B.05	Final excavation levels	M	As required & agreed	B	100%	Drawing, BS 6031:2009	SR	
B.06	Side slope of final excavation	M	As required & agreed	C	100%	Drawing, BS 6031:2009	SR	
B.07	EXCAVATION IN HARD ROCK - IF REQUIRED							
B.07A	Receipt, Storage, accountability of Explosive	P	As required	1 A	Randomly once in a week	Bangladesh Explosive Act and any other statutory requirement	SR	OWNER approved specialist blasting agency 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.
B.07B	Execution of Blasting Operation	P	As required	1 A	Random in each shift	Approved Method, BS 6031:2009 & BS 5607:1998	SR	
B.07C	Submission of Blasting report to EIC	P	As required	2 C	Each blast	-	Report	

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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **CIVIL WORKS** (STATEMENT OF CHECKS)	FQP NO.: MAITREE-00-U-QA-300001-PSE BHEL Doc. No. : QPE-MTE-660-CL-01 REV.NO.: 2 SHEET 03 / 19 SHEETS
SYSTEM: CIVIL WORKS	SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK)	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
B.07D	Excavation in Hard Rock (Blasting Prohibited)	P	As required	A (2)	100%	Drawing, Owner's Tech. Specifications BS 6031:2009	SR	
B.08	Checks for suitability of borrow fill material	T	As required	A	As Per Annex-II	Annex -II & Drawing	SR / Lab Report	The parameters should not be worse than the parameter of the existing soil in plant area
B.09	Standard proctor Test of fill material before fill	T	As required	A	As Per Annex-II	Annex -II & Drawing	SR / Lab Report	
B.10	Moisture content of fill material before compaction	T	As required	A	As Per Annex-II	Annex -II & Drawing	SR / Lab Report	
B.11	Dry density by core cutter method OR Dry density in place by sand displacement method	T	As required	A	As Per Annex-II	Annex -II & Drawing	SR / Lab Report	
B.12	Relative density (Density Index)	T	As required	A	As Per Annex-II	Annex -II & Drawing	SR / Lab Report	
B.13	Dry Density by proctor needle penetration	T	As required	A	As Per Annex-II	Annex -II & Drawing	SR / Lab Report	
B.14	Checking of level after compaction	M	Auto level / Total station	B	100%	Drawing	PROTOCOL	
C	**RAW MATERIALS FOR CONCRETE**							
C.01	Tests on Cement : A. Review of MTC for both physical & compositional requirement (Type of cement with clinker composition for Bogue's compounds viz. C3S, C2S, C3A, C4AF) (1) B. Field Tests - i) Consistency of cement & Initial and final setting time ii) Compressive strength - 3 days & 7 days iii) Fineness iv) Sulphate Resistance (if applicable)	R & T	Vicat Needle, Compressive Testing Machine, Cube Mould, Vibrator, Curing chambers, Weighing Devices	A	for each batch or per month whichever is earlier (1)	A) Drawing, Mix Design, ASTM C150M - 16 & ASTM C1157M - 11 B-i) ASTM C191M B-ii) ASTM C109/C109M B-iii) ASTM C 430M-08(2015) B-iv) ASTM C452M	MTC & SR	To be sourced from BIFPCL / OE approved supplier. Each consignment of cement shall be duly correlated with manufacturers TC
C.02	Tests on Fine Aggregate (Sand)	T	As required	A	As per Annex-I	Mix Design, BS EN 12620:2002+A1:2008 / ASTM C 33M-16E1	PROTOCOL / Lab. Report	To be sourced from BIFPCL / OE approved supplier. Each size of aggregate shall be separately stored & the material shall be handled in a manner that will prevent contamination & intermixing.
C.03	Tests on Coarse Aggregates	T	As required	A	As per Annex-I	Mix Design,, BS EN 12620:2002+A1:2008 / ASTM C 33M-16E1	PROTOCOL / Lab. Report	

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BHARAT HEAVY ELECTRICALS LIMITED
PS:ER, KOLKATA

FIELD QUALITY PLAN
FOR
CIVIL WORKS
(STATEMENT OF CHECKS)

FQP NO.: MAITREE-00-U-QA-300001-PSE
BHEL Doc. No. : QPE-MTE-660-CL-01
REV.NO.: 2
SHEET 04 / 19 SHEETS

SYSTEM: CIVIL WORKS | SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK) | AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
C.04	Admixtures (Type & suitability)	R	-	B	Each batch of supply	Mix Design, ASTM C1017M-13E1 (high-slump concrete producing admixtures), ASTM C 494M-16 (Water-reducing, Accelerating, Retarding admixtures) & ASTM C1582M – 11 (Chloride-Induced Corrosion Inhibit admixture)	MTC & SR	- To be sourced from BIFPCL / OE approved supplier & Review of MTC at site - Trial mix to be made using the cement, aggregates and admixture using the mixture proportions, batching sequence and other physical conditions proposed for the specific work (refer D.01)
C.05	Construction Water	R / T (1)	-	B	Once per month	ASTM C1602M – 12 OR BS EN 1008:2002	Test Report	Test for pH shall be done weekly at site. (1)
D	**CONCRETING (MIXING, CONVEYING, PLACEMENT, COMPACTION, CURING & TESTING)**							
D.01	Trial Mix (Trial mixes of each mix design to ascertain the workability and cube strength)	P	-	A	One for each mix proportion	ACI 211.1-91 (2009) & ACI 318-14 OR BS EN 206:2013+A1:2016 (Acceptance criteria for fresh & hardened concrete)	SR / Lab. Report	1. Concrete Mix Design by ACI 211.1-91 2. Slump test of fresh concrete & compressive strength test at 7 days & 28 days to be done.
D.02	Mixing of concrete	V	Calibrated batching plant	A	100%	ASTM C94M − 16b	Batching plant ticket / slip	Batching plant to be calibrated at the time of starting and subsequently once in three months or in event of major repair. Provision of online printer is mandatory
D.03	Temperature control of concrete & mix adjustment/batch correction	V	As required	A	100%	Owner's Technical Specifications, Designed mix., drawing & ACI 318-14 OR BS EN 206:2013+A1:2016	SR	Temperature control check of concrete shall be for mass concreting & hot weather concreting.
D.04	Arrangement for transportation of concrete.	V	As required	C	100%	-	SR & Checklist	As per approved construction methodology
D.05	TESTS ON FRESH CONCRETE :							
D.05A	Review of grade of Concrete (at pouring point)	R	-	C	Each truck	Drawing & ACI 318-14 OR BS EN 206:2013+A1:2016	SR	Review batching plant ticket / slip
D.05B	Slump Test (at pouring point)	T	Slump Test Apparatus	B	As required (1)	BS EN 12350-2 or ASTM C 143/C 143M-15A	SR	

APPROVED
Checked and Approved.

Date: 28-Nov-2017

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BHARAT HEAVY ELECTRICALS LIMITED
PS:ER, KOLKATA

FIELD QUALITY PLAN
FOR
CIVIL WORKS
(STATEMENT OF CHECKS)

FQP NO.: MAITREE-00-U-QA-300001-PSE
BHEL Doc. No. : QPE-MTE-660-CL-01
REV.NO.: 2
SHEET 05 / 19 SHEETS

SYSTEM: CIVIL WORKS | SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK) | AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
D.05C	Sampling for compressive strength (at pouring point)	P	Cube / Cylinder moulds	B	As per Table 17 of BS EN 206:2013+A1:2016	ASTM C 31M-15AE1, BS EN 206:2013+A1:2016	SR	Min. of 6 cubes for each sample. 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days
D.05D	Workability time (at batching plant & pouring point)	T	Slump Test Apparatus	B	First truck each day	BS EN 12350-2 or ASTM C 143/C 143M-15A	SR	Check for Change of slump from Batching plant to site
D.06	Placement of concrete.	P & M	Measuring tape / Auto level	C	100%	ACI 318-14 OR BS EN 206:2013+A1:2016	SR & Checklist	As per approved construction methodology
D.07	Compacting of concrete.	P	As required	C	Random in each shift	ACI 318-14 OR BS EN 206:2013+A1:2016	SR & Checklist	As per approved construction methodology
D.08	Curing of concrete.	P	As required	C	Random in each shift	ACI 308R - 16 △1	SR & Checklist	As per approved construction methodology. If used, curing compound shall comply with ASTM C309
D.09	Tests / Checks on hardened concrete :							
D.09A	Visual inspection of concrete surface of foundations just after removal of shuttering	V	-	B	100%	Owner's Tech. Specification & Drawing	SR & Checklist	
D.09B	Dimensional check on finished structures	M	Measuring tape / Auto level	B	100%	Owner's Tech. Specification & Drawing	SR	
D.09C	Pulse velocity test through concrete of Top deck of TG & other vibrating equipment (viz. BFP, ID fan, FD fan, PA fan etc.)	R	As required	A	100% for top deck of major equipment only	ASTM C 597-16 OR equivalent European Standard	Test Report & SR	BIFPCL/ OE approved agency to be deployed for test
D.09D	Embedment of inserts in concrete shall be checked for gap if any using hammer for all major equipment foundations	T	Hammer	B	100% for major equipment foundations	No hollow sound	SR	
D.09E	Workmanship and dimensions of precast concrete members	M	As required	B	100%	BS EN 13369:2013 OR equivalent American Standard	SR	

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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **CIVIL WORKS** (STATEMENT OF CHECKS)	FQP NO.: MAITREE-00-U-QA-300001-PSE BHEL Doc. No. : QPE-MTE-660-CL-01 REV.NO.: 2 SHEET 06 / 19 SHEETS
SYSTEM: CIVIL WORKS	SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK)	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
D.09F	Type test on precast concrete members △1	T	as required	A	1 no for every 1000 nos. or part thereof for each type △1	BS EN 13369:2013 OR equivalent American Standard	SR	- When the design of a product has been approved by owner / OE, type-test is not required. - for other products, rebound hammer test / flexural strength test to be done. △1
D.10	JOINTS IN CONCRETE							
D.10A	Joint material - bitumen impregnated fibre board, PVC/Copper water stops, Sealing compound, Expanded polystyrene board, Hydrophillic strip, Acrylic polymer etc.	R	-	A	Each batch of delivery at site	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of co-related MTC
D.10B	Acceptance of installation	V	-	B	100%	Drawing	SR	
D.11	EMBEDDED Parts (INCLUDING RAILS & ANCHOR BOLTS)							
D.11A	Material	R	-	A	Each lot of delivery at site	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of co-related MTC - for shop fabricated parts, MDCC shall be review
D.11B	Fabrication Checks (if site fabricated) - cutting, bending, forming, welding, final dimension & primer painting	V & M	Measuring tape	B	100%	Owner's Tech. Specifications & Drawing	SR	
D.11C	Position / alignment / levels of embedded parts / bolts / pipe sleeves / rails / PVC pipes / etc.	V & M	Measuring tape / Auto level	B	100%	Drawing	SR	for shop fabricated parts, MDCC shall be reviewed
E	**REINFORCEMENT BARS**							
E.01	Review of MTC for Mechanical, Physical and Chemical Properties for each lot △1	R	-	A	Each lot of supply	BS 4449:2005+A2:2009 & drawing	MTC & SR	To be sourced from BIFPCL / OE approved supplier & Review of MTC at site
E.02	Visual inspection of steel (freedom from cracks, surface flaws, Lamination & rust)	P	As required	B	Random in each shift	BS 4449:2005+A2:2009 & drawing	SR	1. To be checked at site. 2. Steel should be free from excessive rust. 3. To be stored on concrete slippers without touching the earth and as per Technical Specs.
E.03	Bar bending schedule with necessary lap, Spacers & Chairs	R	As required	B	100%	Drawing & BS 8666:2005/ ACI 315-99 & ACI 307 (for chimney)	BBS	
E.04	Bending of bars, cutting tolerance	V	As required	C	100%	Drawing & BBS	SR	

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1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
E.05	Acceptance - Cover, spacing of bars, spacers and chairs after the reinforcement cage is put inside the formwork	V & M	As required	B	100%	Drawing	SR	
F	**FORM WORK & STAGING**							
F.01	Materials and accessories	V	-	B	ANNEX-III	ACI 347R-14 OR Equivalent European Standard	SR	
F.02	Soundness of staging, shuttering and scaffolding including application of mould oil / release agent	R	-	B	ANNEX-III	ACI 347R-14 OR Equivalent European Standard	SR	Review of method statement. * For TG deck, the form work & staging to be vetted by BIFPCL/OE approved third party
F.03	Acceptance of formwork before start of concreting	V & P	As required	B	ANNEX-III	Method statement	SR	
F.04	SPECIAL CHECKS FOR SLIP-FORM SHUTTERING							
F.04A	Review of Slipform System Design.	R	-	A	Before Commencement of work	ACI 347R-14 OR Equivalent European Standard	Report	- The design is to be vetted by a BIFPCL / OE approved third party -Submission of vetted design to BIFPCL / OE for review
F.04B	Review of method statement for Positions and arrangement of Jack rods, proposed method for concrete curing and protection and Proposed arrangement for continuous readings	R	-	A	Before Commencement of work	Owners Technical Specifications, BS EN 12810 & BS EN 12811	Method Statement	Submission to BIFPCL / OE for review
F.04C	Acceptance of the Slipform shutters before start of concreting	V & P	As required	B	100%	Slip Form Design & Method statement	SR	* Customer Hold Point
F.04D	Check for All type of openings, Chases, Fixing of Blocks and similar built-up features	V & M	As required	B	100%	Drawing & ACI 307	SR	
F.04E	Checks for Temporary Lightening protection & Aircraft warning lights during construction	V & P	As required	A	Once prior to start of work and thereof weekly	as per approved methodology	SR	
F.04F	Check for Sliding Operation	P	As required	C	Six hourly intervals	Owner's Technical Specifications, ACI 307 & Clause No. 7.2 of BS EN 206	SR	

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1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
F.04G	Checking of wall faces for finishing & appearance	V	-	C	-do-	Owners Technical Specifications & ACI 307	SR	Random 10% Surveillance check by BIFPCL/OE
F.04H	Progress Height	M	Measuring tape	B	-do-	Drawing	L-01	
F.04I	Centre line in relation to the centres at the base	M	Plumb	B	-do-	drawing, Tolerance as per ACI 307	L-01	
F.04J	Diameter	M	Measuring tape	B	-do-	-do-	L-01	
F.04K	Wall thickness	M	Measuring tape	B	-do-	-do-	L-01	
F.04L	Twist	M	Plumb / Laser Beam	B	-do-	-do-	L-01	
F.04M	Correction of level w.r.t. bench mark	M	Totalstation & water level	B	At every internal platform level	drawing	L-02	
G	**MASONRY WORK**							
G.01	Test on Clay Bricks - Dimensions , shape, compressive strength, water absorption, warpage, efflorescence.	M & T	As required	A	At least ten individual brick shall be selected for lots of 100000 bricks or part thereof, △1	BS EN 771-1:2011+A1:2015 or a> ASTM C 62-13A (*STANDARD SPECIFICATION FOR BUILDING CLAY BRICKS*) & b> ASTM C 67-16 (STANDARD TEST METHODS FOR SAMPLING AND TESTING BRICK)	SR	For larger lots, five additional specimens shall be selected from each additional 500000 brick or fraction thereof
G.02	Test on AAC masonry units - Dimensions , shape, compressive strength, dry bulk density, drying shrinkage, % of flyash content (if used).	R & M	As required	A	One Sample for 30,000 nos. or part thereof	BS EN 771-4:2011+A1:2015 OR a> ASTM C 1691-11 (Standard Specification for Unreinforced Autoclaved Aerated Concrete Masonry Units) & b> ASTM C 1693-11 (Standard Specification for Autoclaved Aerated Concrete)	SR	- to be sourced from BIFPCL/OE approved manufacturer - Only dimensional checks shall be done at site as per column '6'. - for other tests results, Manufacturer TC shall be reviewed

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1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
G.03	Tests on Mortar -							
G.03A	Tests on Mortar aggregates	T	As required	A	Once every 50m^3 or part thereof	ASTM C 144-11 (Standard Specification for Aggregate for Masonry Mortar)	SR	
G.03B	Compressive strength	T	As required	A	random in each shift	ASTM C 109M-16A (Standard Test Method for Compressive Strength of Hydraulic Cement Mortars)	SR	
G.04	Masonry construction - Workmanship, verticality and alignment	V	As required	B	As per Standard	TMS 602-08 / ACI 530.1-08 / ASCE 6-08	SR	
G.05	Curing of masonry construction	V	As required	C	100%	Owner's Tech. specifications, drawings and agreed methodology	SR	
G.06	PLASTERING							
G.06A	Tests on aggregates for plaster	T	As required	A	Once every 50m^3 or part thereof	ASTM C C897 − 15 (Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters)	SR	
G.06B	Thickness, finishing of plaster & trueness of plastering system	T	As required	A	random in each shift	ASTM C 926-17 (STANDARD SPECIFICATION FOR APPLICATION OF PORTLAND CEMENT-BASED PLASTER)	SR	
G.06C	Curing of plaster	V	As required	C	100%	Owner's Tech. specifications, drawings and agreed methodology	SR	
G.07	Galvanized wire netting for plastering	R	-	B	100%	Drawing & ASTM C 1032−14	SR	BIFPCL/OE approved source & Review of MTC
G.08	DAMP PROOF COURSE							
G.08A	Material - Hot bitumen and water proofing materials etc. (for checks on concrete for DPC, relevant points of this FQP to be referred)	R	-	A	Each batch of delivery at site	Drawing & BS 6398:1983	SR	BIFPCL/OE approved source & Review of MTC
G.08B	Acceptance of damp proof course	V	-	B	100%	Drawing	SR	

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SYSTEM: CIVIL WORKS	SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK)	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
H	**PAINTING & FINISHING**							
H.01	PAINTING SYSTEM - CONCRETE WORKS AND PLASTERED MASONRY SURFACES							
H.01A	Materials and accessories- Hot Bitumen, Bituminous Paint, Oil Bound, Acrylic Emulsion, Epoxy Chemical Resistant, Oil Resistant Paint etc.	R	-	A	Each batch of delivery at site	Drawing / Paint Schedule & relevant European or American Standards	SR	BIFPCL/OE approved source & Review of MTC
H.01B	Surface preparation	V		B	Random in each shift	Drawing / Paint Schedule & Paint manufacturer's recommendation	SR	
H.01C	Primer application	V & M	As required	1 B	100%	Drawing / Paint Schedule & Paint manufacturer's recommendation	SR	10% Random surveillance checks by BIFPCL / OE
H.01D	Final Paint application & acceptance of painted surfaces	V & M	As required	1 A	100%	Drawing / Paint Schedule	SR	
H.02	STONE GRIT PLASTER / GRANULAR TEXTURED FINISH							
H.02A	Materials and accessories	R	-	A	100%	Drawing & Owner's Tech. Specifications	SR	- BIFPCL / OE approved source - Review of MTC ('MTC shall contain all the parameters specified in the technical specifications)
H.02B	Thickness & finishing of plaster	P	As required	B	100%	Drawing & Manufacturer's recommendations	SR	
H.03	PAINTING SYSTEM - STEEL WORKS (OTHER THAN STRUCTURAL STEEL WORKS)							
H.03A	Materials and accessories- Oil Bound, Acrylic Emulsion, Chemical Resistant, Oil Resistant Paint etc.	R	-	A	Each batch of delivery at site	Drawing / Paint Schedule & relevant European or American Standards	SR	BIFPCL/OE approved source & Review of MTC
H.03B	Surface preparation	V		B	Random in each shift	Drawing / Paint Schedule & Paint manufacturer's recommendation	SR	
H.03C	Primer application	V & M	As required	1 B	100%	Drawing / Paint Schedule & Paint manufacturer's recommendation	SR	10% Random surveillance checks by BIFPCL / OE
H.03D	Final Paint application & acceptance of painted surfaces	V & M	As required	1 A	100%	Drawing / Paint Schedule	SR	

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SYSTEM: CIVIL WORKS	SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK)	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
I	**GROUTING**							
I.01	Material	R	-	A	Each batch of delivery	ASTM C 1107M-14a : Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)	SR	- BIFPCL/OE approved source - Review of MTC - Compressive strength test at 1 day & 3 days to be done from each batch prior to start of grout
I.02	Mixing, placement, application and grout pressure (if required)	P	As required	B	Random in each shift	Manufacturer recommended procedure	SR	
I.03	Compressive strength	T		A	Random in each shift	Drawing	SR	Compressive strength test at 3 days, 7 days & 28 days to be done.
I.04	Acceptance of the grouts	V		B	Each grout section	Drawing	SR	
J	**PERMANENTLY COLOUR COATED METAL DECK SHEET & METAL CLADDING**							
J.01	Material	R	-	A	Each lot of delivery	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of MDCC
J.02	Storage	V	-	C	Once in a week	Manufacturer's recommendations	SR	Prevention of distortion / blemishing / water staining.
J.03	Finishing and acceptance (Installation, lap alignment & workmanship).	M	As required	B	100%	Drawing	SR	
K	**INSULATION WORK**							
K.01	Material - Insulation material, galvanised wire net, aluminium foil, fasteners	R	-	A	Each lot of delivery	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of MDCC for Insulation & MTC for other materials
K.02	Acceptance of each type of installation	V & M	As required	B	100%	Drawing	SR	

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SYSTEM: CIVIL WORKS	SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK)	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
L	**DOOR, WINDOWS, LOUVERS, GLAZING FENCING & FALSE CEILING**							
L.01	STEEL & FIRE DOORS							
L.01A	Source of supply	R	Review of MTC & additionally review of approved drawing in case of fire proof doors	A	Each type of door	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - The Fire proof door drawing proposed for supply should have been tested and approved by CSIR-CBRI Roorkee or HBRI, Bangladesh or any other vetting agency approved by BIFPCL/OE for the similar dimensions & similar fire rating.
L.01B	Receipt inspection (Dimensions & Finish) - Door & accessories	V & M	As required	B	100%	Drawing	SR	
L.01C	Fixing (Finishing and acceptance)	V	As required	B	100%	Drawing	SR	
L.02	ANODISED ALUMINIUM WORKS							
L.02A	Material - Aluminium sections & accessories	R	-	A	Each Lot of supply	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of MTC
L.02B	fabrication (Dimensions & Finish) - Door & accessories	V & M	As required	B	100%	Drawing	SR	
L.02C	Fixing (Finishing and acceptance)	V & M	As required	B	100%	Drawing	SR	
L.03	STEEL WINDOW, LOUVERS, GRILL / ROLLING SHUTTERS							
L.03A	Material (including accessories)	R	-	A	Each Lot of supply	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of MTC
L.03B	Receipt inspection (Dimensions & Finish) - including accessories	V & M	As required	B	100%	Drawing	SR	
L.03C	Fixing (Finishing and acceptance)	V & M	As required	B	100%	Drawing	SR	

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1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
L.04	GLAZING (GLASS, POLY CARBONATE SHEET - SINGLE WALL & MULTI WALL, PVC SHEET ETC.)							
L.04A	Material	R	-	A	Each Lot of supply	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of MTC
L.04B	Installation finishing and acceptance	V & M	As required	B	100%	Drawing	SR	
L.05	FENCING & GATES							
L.05A	Material (including accessories)	R	-	A	Each Lot of supply	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of MTC
L.05B	Installation finishing and acceptance	V & M	As required	B	100%	Drawing	SR	
L.06	FALSE CEILING							
L.06A	Materials (gypsum glass, glass fibre membrane, fibre board acoustical tiles, metal false ceiling panels support system etc.)	R	-	A	Each Lot of supply	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of MTC
L.06B	Installation finishing and acceptance	V & M	As required	B	100%	Drawing	SR	
△1 *L.06C*	Acceptance of erected supporting rail / hangers	P	As required	B	100%	Drawing	SR	
M	**WATER PROOFING (INCLUDING ROOF TREATMENT)**							
M.01	Methodology for the application of water proofing system	R	-	A	Before start of work	Owner's Tech. Specifications & Drawing	Method Statement	- BIFPCL / OE approved source - Review of methodology
M.02	Material	R	-	A	Each Lot of supply	Owner's Tech. Specifications & Drawing	SR	MTC shall contain all the parameters specified in the technical specifications
M.03	Acceptance of water proofing work	V & M	As required	△2 A	100%	Drawing & approved method statement	SR	
N	**FLOOR FINISHES AND ALLIED WORKS (Cement Concrete Flooring, Tiles, Interlocking Blocks, Kota Stone, Granite, Marble, Metallic / non-metallic hardener, Acid / alkali and oil resistant high built seamless epoxy finish & Rubber Flooring)**							
N.01	Materials	R	-	A	Each Lot of supply	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of MTC ('MTC shall contain all the parameters specified in the technical specifications)

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SYSTEM: CIVIL WORKS	SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK)	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
N.02	Finishing and acceptance	V & M	As required	B	100%	Drawing	SR	Experienced workers to be deployed & work to be done as per recommendation of manufacturer.
O	**WATER SUPPLY / SANITARY INSTALLATIONS (Water supply fittings and fixtures; Sand cast iron / cast iron pipes; Sanitary fittings and fixtures; RCC Pipes & Water Storage Tanks)**							
O.01	Materials	R	-	A	Each Lot of supply	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of MTC ('MTC shall contain all the parameters specified in the technical specifications)
O.02	Finishing and acceptance	V & M	As required	B	100%	Drawing	SR	Experienced workers to be deployed.
P	**OTHER SPECIAL ITEMS**							
P.01	BITUMEN LAYER FOR TANK FOUNDATION							
P.01A	Material (Grade of bitumen)	R	-	A	Each Lot of supply	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of MTC ('MTC shall contain all the parameters specified in the technical specifications)
P.01B	Acceptance and workmanship	V & M	As required	B	100%	Drawing	SR	
P.02	COMPOSITE ALUMINIUM PANELS AND STRUCTURAL GLAZING							
P.02A	Material (Type of aluminium panels / structural glazing / fasteners and fixtures / silicon sealant)	R	-	A	Each Lot of supply	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of MTC ('MTC shall contain all the parameters specified in the technical specifications)
P.02B	Acceptance and workmanship	V & M	As required	B	100%	Drawing	SR	Experienced workers to be deployed.

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1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
P.03	Pressure Release Valves							
P.03A	Material	R	-	A	Each Lot of supply	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source - Review of MTC ('MTC shall contain all the parameters specified in the technical specifications)
P.03B	Acceptance and workmanship	V & M	As required	B	100%	Drawing	SR	Experienced workers to be deployed.
P.04	ANTI WEED TREATMENT							
P.04A	Anti-weed treatment materials	R	-	A	Each Lot of supply	Owner's Tech. Specifications & Drawing	SR	- BIFPCL / OE approved source & Agency - Review of MTC
P.04B	Execution of treatment	P	As required	B	Random check for each treatment	Drawing	SR	
Q	**ROAD WORKS**							
Q.01	CONSTRUCTION OF SUB-GRADE AND EARTHEN/HARD SHOULDERS							
Q.01A	Modified proctor Test	T	As required	A	As Per Annex-II	Annex -II, Owner's Tech. Specifications & Drawing	SR / Lab Report	
Q.01B	Moisture content of fill before compaction	T	As required	A	As Per Annex-II	Annex -II, Owner's Tech. Specifications & Drawing	SR / Lab Report	
Q.01C	Dry density by core cutter method ---- OR---- Dry density in place by sand displacement method	T	As required	A	As Per Annex-II	Annex -II, Owner's Tech. Specifications & Drawing	SR / Lab Report	
Q.01D	CBR Test	T	As required	A	As Per Annex-II	Annex -II, Owner's Tech. Specifications & Drawing	SR / Lab Report	
Q.01E	Grade Line and cross section	P & M	As required	B	One in every 500 SQM area	Owner's Tech. Specifications & Drawing	SR	
Q.02	WATER BOUND MACADAM (NON-BITUMINOUS) FOR BASE COURSE AND SUB-BASE COURSE							
Q.02A	Aggregate Impact value	T	Aggregate Impact value Test Apparatus	A	One test per 200 m3 of Test aggregate	AASHTO Guide for Design of Pavement Structure / Owner's Technical Specifications	SR / Lab Report	

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BHARAT HEAVY ELECTRICALS LIMITED
PS:ER, KOLKATA

FIELD QUALITY PLAN
FOR
CIVIL WORKS
(STATEMENT OF CHECKS)

FQP NO.: MAITREE-00-U-QA-300001-PSE
BHEL Doc. No. : QPE-MTE-660-CL-01
REV.NO.: 2
SHEET 16 / 19 SHEETS

SYSTEM: CIVIL WORKS | SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK) | AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Q.02B	Grading	T	Set of AASHTO Sieves	B	One test per 100 m3 of aggregate	AASHTO Guide for Design of Pavement Structure / Owner's Technical Specifications	SR / Lab Report	
Q.02C	Flakiness index and elongation index	T	Flakiness test gauge	B	One test per 200m3 of aggregate	-do-	SR / Lab Report	
Q.02D	Atterberg Limits of binding material	T	Atterberg limits determination apparatus	A	One test per 25m3 of binding material	-do-	SR / Lab Report	
Q.02E	Atterberg Limits of portion of aggregate passing 425 micron sieve	T	Atterberg limits determination apparatus	A	One test per 100m3 of aggregate	-do-	SR / Lab Report	
Q.02F	Camber, surface, slope	T	As required / agreed	B	One in every 500 m2 area	Drawing	SR / Lab Report	
Q.03	BITUMINOUS MACADAM FOR BASE AND BINDER COURSE							
Q.03A	Quality of binder	T / MTC △1	Penetrometer with St. needle	A	No. of samples per Lot & tests as per AASHTO Guideline as applicable	AASHTO Guide for Design of Pavement Structure / Owner's Technical Specifications	SR / Lab Report	
Q.03B	Aggregate Impact Value / Los angeles abrasion value	T	Aggregate Impact Value Test apparatus	A	Once per source	-do-	SR / Lab Report	
Q.03C	Flakiness Index and elongation index of aggregates	T	Flakiness test gauge	B	One test per 50 cum of aggregate	-do-	SR / Lab Report	
Q.03D	Stripping value of aggregate (Immersion tray test)	T	As required / agreed	B	Initially one set of 3 representative specimen per source, and on every change of source.	-do-	SR / Lab Report	

APPROVED
Checked and Approved.

Date: 28-Nov-2017

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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **CIVIL WORKS** (STATEMENT OF CHECKS)	FQP NO.: MAITREE-00-U-QA-300001-PSE BHEL Doc. No. : QPE-MTE-660-CL-01 REV.NO.: 2 SHEET 17 / 19 SHEETS
SYSTEM: CIVIL WORKS	SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK)	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Q.03E	Water sensitivity of mix	T	As required / agreed	A	Initially one set of 3 representative specimen per source, and on every change of source.	-do-	SR / Lab Report	
Q.03F	Grading of aggregates	T	Set of AASHTO Sieves	B	Two test per day per plant both on individual constituents and mixed aggregate from dryer	-do-	SR / Lab Report	
Q.03G	Water absorption of aggregate	T	As required / agreed	A	Initially one set of 3 representative specimen per source, and on every change of source.	-do-	SR / Lab Report	
Q.03H	Soundness (Magnesium and Sodium Sulphate)	T	As required as per IS:2386	A	Once per source by each method and on every change of source	-do-	SR / Lab Report	
Q.03I	Percentage of fractured faces	T	As required / agreed	B	When gravel is used one test per 50m3 of aggregates	-do-	SR / Lab Report	
Q.03J	Binder content and aggregate grading	T	Bitumen extractor	A	Periodic, subject to a min of two tests per day per plant	-do-	SR / Lab Report	
Q.03K	Control of Temperature of binder and aggregate for mixing and of the mix at the time of laying and rolling	T	Thermometer	B	At regular close intervals	-do-	SR / Lab Report	
Q.03L	Rate of spread of mixed materials	T	As required / agreed	B	Regular control through checks of layer thickness	-do-	SR / Lab Report	
Q.03M	Density of compacted Layer	T	As required / agreed	A	One test per 250 m2 of area	-do-	SR / Lab Report	
Q.04	BITUMINOUS SURFACING - OPEN GRADED PREMIX CARPET AND SEAL COAT							
Q.04A	Quality of binder	T / MTC △1	Penetrometer with St. needle	A	No. of samples per Lot & tests as per AASHTO Guideline as applicable	AASHTO Guide for Design of Pavement Structure / Owner's Technical Specifications	SR / Lab Report	

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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **CIVIL WORKS** (STATEMENT OF CHECKS)	FQP NO.: MAITREE-00-U-QA-300001-PSE BHEL Doc. No. : QPE-MTE-660-CL-01 REV.NO.: 2 SHEET 18 / 19 SHEETS
SYSTEM: CIVIL WORKS	SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK)	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Q.04B	Aggregate Impact Value / Los angeles abrasion value	T	Aggregate Impact Value Test apparatus	A	Once per source	-do-	SR / Lab Report	
Q.04C	Flakiness Index and elongation index of aggregates	T	Flakiness test gauge	B	One test per 50 cum of aggregate	-do-	SR / Lab Report	
Q.04D	Stripping value of aggregate (Immersion tray test)	T	As required	B	Initially one set of 3 representative specimen per source, and on every change of source.	-do-	SR / Lab Report	
Q.04E	Water absorption test	T	As required	A	Initially one set of 3 representative specimen per source, and on every change of source.	-do-	SR / Lab Report	
Q.04F	Water sensitivity of mix	T	As required	A	Initially one set of 3 representative specimen per source, and on every change of source.	-do-	SR / Lab Report	
Q.04G	Grading of aggregates	T	Set of Sieves	B	One test per 25 m3 of aggregates	-do-	SR / Lab Report	
Q.04H	Soundness (Magnesium and Sodium Sulphate)	T	As required	A	Once per source by each method and on every change of source	-do-	SR / Lab Report	
Q.04I	Polished stone value	T	As required as per BS:812(Part 114)	B	as per BS:812(Part 114)	BS:812(Part 114)	SR / Lab Report	
Q.04J	Temperature of binder at application	M	Thermometer	B	At regular close intervals	AASHTO Guide for Design of Pavement Structure / Owner's Technical Specifications	SR / Lab Report	
Q.04K	Binder content	T	Bitumen extractor	A	One test per 500 cum& not less than two tests per day	-do-	SR / Lab Report	

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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **CIVIL WORKS** (STATEMENT OF CHECKS)	FQP NO.: MAITREE-00-U-QA-300001-PSE BHEL Doc. No. : QPE-MTE-660-CL-01 REV.NO.: 2 SHEET 19 / 19 SHEETS
SYSTEM: CIVIL WORKS	SUB-SYSTEM: CIVIL WORKS (EXCEPT PILING WORK)	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Q.04L	Rate of spread of materials	T	As required	B	One test per 500 cum and not less than 2 tests per day	AASHTO Guide for Design of Pavement Structure / Owner's Technical Specifications	SR / Lab Report	
Q.04M	Percentage of fractured faces	T	As required	A	When gravel is used one test per 50cum of aggregates	-do-	SR / Lab Report	
Q.05	TACK COAT/ PRIME COAT/ FOG COAT							
Q.05A	Quality of binder	T / MTC △1	Penetrometer with Standard needle	A	No. of samples per Lot & tests as per AASHTO Guideline as applicable	AASHTO Guide for Design of Pavement Structure / Owner's Technical Specifications	SR / Lab Report	
Q.05B	Temperature of binder at application	M	Thermometer	B	At regular close intervals	-do-	SR / Lab Report	
Q.05C	Rate of spread of binder	T	As required	B	One test per 500 m3 and not less than 2 tests per day	-do-	SR / Lab Report	
Q.06	RCC PAVEMENTS : Concrete - Material, Mix design, Trial Mixes, Production, Transportation, Placement, Compaction, Curing, Test on green concrete, Test on hardened concrete etc.	Refer clause no. C, D & E of this FQP for concrete Works						
Q.07	ALIGNMENT, LEVEL, SURFACE REGULARITY AND RECTIFICATION							
Q.07A	Horizontal alignment, Surface levels and Surface regularity	V & M	As required	B	Drawing	Owner's Tech. Specifications & Drawing	SR / Lab Report	
Q.07B	Rectification	V	As required	B	Each rectification	Owner's Tech. Specifications & Drawing	SR / Lab Report	

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Frequency of testing the aggregates shall be at least as follows:

Test Type	**Coarse Aggregate**	**Fine Aggregate**	**Remarks**
Grading of each aggregate	Daily	Daily	Should be as per the requirement of design mix, subject to variation within the limit as specified in BS EN 12620:2002+A1:2008 OR ASTM C 33-16E1
Grading of combined aggregates	Daily	Daily	
Specific gravity	7 days	7 days	
Magnesium sulphate soundness	30 days	-	
Clay, silt and dust content	Daily	Daily	
Shape (elongation and flakiness)	Twice a week	-	
Los Angeles abrasion	Initially only & on change of source	Initially only & on change of source	
Moisture content	2 days	Daily	
Drying shrinkage	Initially only & on change of source	Initially only & on change of source	
Organic impurities	30 days	30 days	

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Frequency of Sampling & Testing of Soil and Sand for Backfilling & Grading:

SL No.	Nature of Test / Characteristics		Method of Test	No. of samples & Frequency of Test	Remarks
I	**Suitability of Fill Materials**				
	(a)	Grain size Analysis	ASTM D 6913-04(2009)E1	Once per each type of source or change of source	Test for soil and sand
	(b)	Liquid limit and Plastic Limit	ASTM D 4318-10E1	Once per each type of source or change of source	Test for soil
	(c)	Shrinkage Limit	ASTM D4943-08	Once per each type of source or change of source	The frequency of Test shall be increased depending on type of soil.
	(d)	Free swell Index	ASTM D4546 - 14		
	(e)	Chemical Analysis		Once per each type of source or change of source	Test for soil and sand
		i) Organic matter	ASTM D 2974-14		
		ii) Calcium Carbonate	ASTM D 4373-14		
		iii) PH	ASTM D 4972-13		
		iv)Total soluble sulphate	ASTM C 1580-15		
II.	**Standard Proctor Test**		ASTM D 698-12E2	One in every 5000m^3 for each type, each layer and each source of fill materials △1	Test for soil for determining optimum moisture content, Dry Density etc.
III	**Moisture content of Fill before compaction**		ASTM D 2216-10 OR ASTM D 4944-11	One in every 5000m^3 for each type, each layer and each source of fill materials △1	Test for soil

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SL No.	Nature of Test / Characteristics	Method of Test	No. of samples & Frequency of Test	Remarks
IV.	**Modified Proctor Test**	ASTM D 1557-12E1	One in every 2000m^3 for each type, each layer and each source of fill materials	Test for soil
V	**Degree of compaction of fill**			
	a) Dry density by core cutter method OR b) Dry density inplace by sand displacement methods	a) ASTM D 2937-17 b) ASTM D 1556M -15E1	I. For foundation filling one for every ten foundations for each compacted layer for location of important and heavily loaded foundations. II. For grading & area filling, one for every 5000 m^2 area for each compacted layer. (1) III. For road work: One in every 500 m^2 area for each compacted layer. * One Test consists of 3 nos sample.	Test for soil
	c) Relative density Index	ASTM D 4253 and D 4254	-do-	Test for sand
	d) Dry Density by proctor needle-penetration.	ASTM D 698-12E2	Random checks to be carried out for each compacted layer in addition to tests mentioned under V (a) above.	Test for soil.
	e) Permeability Test.	ASTM D2434	Random checks	Test for soil
	f) CBR	ASTM D1883	One in every 5000m^3 for each type and each source of fill materials or every 1000m linear length of road, whichever earlier	For Road Subbase course only

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Frequency of Checks on Formwork:

Nature of Test / Characteristics	Method of Test	No. of samples & Frequency of Test	Remarks
a) Staging (Durability, strength & soundness of staging, joints. adequacy of its foundation and specific level).	Visual / Measurement	Each member / structure	Any staging intended for use shall be approved by the BHEL Engineer & BIFPCL/OE for its durability and strength.
			After erection of staging, BHEL Engineer & BIFPCL/OE shall check the soundness of the staging as a whole, its joints, adequacy of its foundation and the specific levels.
b) Shuttering			
i) Materials (as per ACI 347R or equivalent European standard)	Visual	Random	Forms shall be constructed from waterproof plywood. Plywood lining for forms shall be of timber, which is resin bonded and water repellent Form work materials shall be strictly as per specifications and approval of the BHEL & BIFPCL/OE. Materials for form work shall be unwrapped, thoroughly clean and without broken or damaged edges.
ii) Joints	Visual	Random	Joints shall be leak proof to avoid loss of liquid.
iii) Dimensions and plumb	Physical. measurement	Each member and before every lift.	Tolerances as per Specifications.

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RECORD OF QUALITY CHECKS

SHEET NO. OF FQP	CHECK NO.	RESULTS ACHIEVED OK / NOT OK	DRAWING / DOCUMENT REFERENCE	FORMAT OF RECORD	INSPECTED BY SIGN. & DATE	CLEARED BY SIGN. & DATE	REMARKS

Note : Any protocol made is to be numbered & mentioned in "Format of Record" column.

		SYSTEM	SUB-SYSTEM	AREA	FQP. NO.: QPE-MTE-660-CL-01
PROJECT					REV. NO. : 2
UNIT NO.					LOG SHEET NO. L-00
RATING					PAGE 1 OF 1

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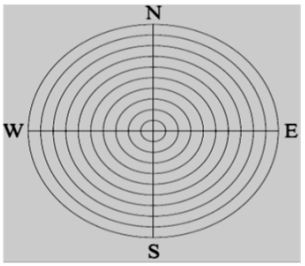
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	DATE OF INSPECTION		TIME	
	DRAWING / DOC. REF.			

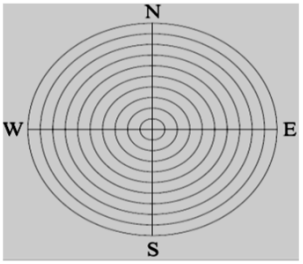
DAILY MEASUREMENT OF VERTICALITY OF CHIMNEY

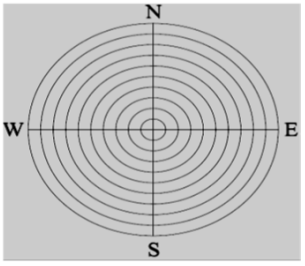
ELEVATION : SHUTTER LEVEL …… / CONCRETE LEVEL ……

INNER RADIUS (AS PER DRAWING) …… SHELL THICKNESS (AS PER DRAWING) ……

YOKE NO	INNER RADIUS	THICKNESS OF SHELL	DEVIATION (W.R.T. DRG.) OF RADIUS / WALL	YOKE NO	INNER RADIUS	THICKNESS OF SHELL	DEVIATION (W.R.T. DRG.) OF RADIUS / WALL	VERTICALITY / TWIST MEASUREMENT
1				29				CENTRE
2				30				
3				31				
4				32				
5				33				
6				34				
7				35				
8				36				
9				37				
10				38				TWIST (T1)
11				39				
12				40				
13				41				
14				42				
15				43				
16				44				
17				45				
18				46				
19				47				
20				48				TWIST (T2)
21				49				
22				50				
23				51				
24				52				
25				53				
26				54				
27				55				
28				56				





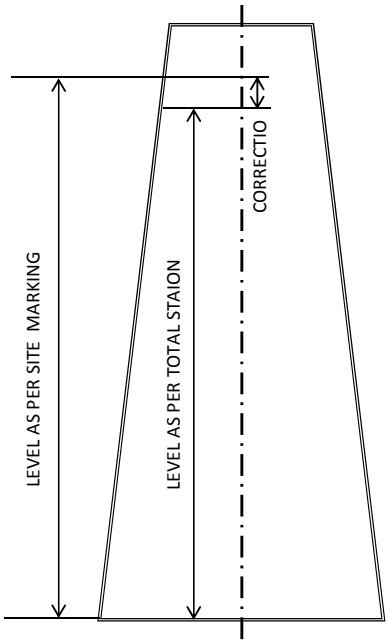


			NAME	SIG. / DATE	FQP NO. : QPE:RKL:250:CL:01
PROJECT		CHECKED BY			REV. NO. : A
UNIT NO.		ACCEPTED BY			LOG SHEET NO. L-01
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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PSER	INSTRUMENT REG. NO.			
	DATE OF INSPECTION		TIME	
	DRAWING / DOC. REF.			

PERIODICAL CORRECTION OF LEVEL OF CHIMNEY



MASUREMENT AT YOKE NO. : ……..

BENCH MARK 1 (STATION POINT) :		**BENCH MARK 2 (BACK SIGHT POINT) :**	
S		S	
E		E	
RL		RL	

MACHINE RL (L_M) : ……

TARGET LEVEL ON YOKE NO. …….. AS PER SITE MARKING (L_T) : ……..

RL OF TARGET ON YOKE NO. …….. AS PER TS READING (L_R) : ……..

ACTUAL RL OF TARGET ($L_A = L_R - L_M$) *: ……

. ˙ . CORRECTION OF HEIGHT ($L_A - L_T$) : ……

* ACTUAL RL TO BE TRANSFERRED IN OTHER YOKES WITH WATER LEVEN

			NAME	SIG. / DATE	FQP NO. : QPE-MTE-660-CL-01
PROJECT		CHECKED BY			REV. NO. : A
UNIT NO.		ACCEPTED BY			LOG SHEET NO. L-02
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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PSER	INSTRUMENT REG. NO./TAG NO.		
	DATE OF INSPECTION		
	DRAWING / DOCUMENT REF.		

PROTOCOL

			NAME	SIGNATURE & DATE	FQP. NO.: QPE-MTE-660-CL-01
PROJECT		INSPECTED BY			REV.NO.: 2
UNIT NO.		CLEARED BY			PROTOCOL
RATING		CUSTOMER			PAGE:

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Date: 24-Jan-2018

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FIELD QUALITY PLAN
FOR
STRUCTURAL WORKS

2X660 MW MAITREE SUPER THERMAL POWER PROJECT

BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED

OWNER'S ENGINEER

FICHTNER

Fichtner GmbH & Co. KG, Germany

BIFPCL DOC. NO. : MAITREE-00-U-QA-300002-PSE, REV. NO. : 2

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR - EASTERN REGION
KOLKATA – 700091

BHEL DOC. NO. : QPE-MTE-660-CL-03
REV No.: 2

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Date: 24-Jan-2018

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FIELD QUALITY PLAN
FOR
STRUCTURAL WORKS

2X660 MW MAITREE SUPER THERMAL POWER PROJECT

BIFPCL DOC. NO. : MAITREE-00-U-QA-300002-PSE, REV. NO. : 2

PREPARED BY	BHEL. PSER KOL-91 QUALITY DEPT. DE/ QLY, BHEL, PSER	APPROVED BY	HEAD / QLY, BHEL, PSER
FQP NO.		**QPE-MTE-660-CL-03**	
ORIGINAL DATE OF ISSUE		21/11/2017	
REVISION NO. & DATE		2, Dt. 24/01/2018	
COPY NO.			
ISSUED TO			
DATE OF ISSUE			
PURPOSE :			
ISSUED BY (SIGNATURE & DESIGNATION)		DE/ QLY, BHEL, PSER	

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR - EASTERN REGION
KOLKATA – 700091

APPROVED
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Date: 24-Jan-2018

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FIELD QUALITY PLAN FOR STRUCTURAL WORKS

FQP NO.: MAITREE-00-U-QA-300002-PSE
BHEL Doc. No. : QPE-MTE-660-CL-03

REV No.: 2

SHEET 1 / 1 SHEETS

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3.0	Authorization for checks and nonconformity disposition	01
4.0	Statement of Checks	14
5.0	Annex - A	04
6.0	Annex - B	01
7.0	Annex - C	04
8.0	Log Sheets (L-00 TO L-12)	17

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PSER	FIELD QUALITY PLAN FOR STRUCTURAL WORKS	FQP NO.: MAITREE-00-U-QA-300002-PSE BHEL Doc. No. : QPE-MTE-660-CL-03
		REV No.: 2
		SHEET 1 / 1 SHEETS

STATUS OF REVISIONS

SL. NO.	REFERENCE OF SHEETS REVISED	REVISION NO. & DATE	REMARKS
01	All	0, Dated 21/11/2017	Document prepared as per Technical Specifications of BIFPCL
02	None	1, Dated 01/12/2017	Document resubmitted
03	Sheet 1, 2, 4, 5 & 14 of Statement of Checks.	2, Dated 24/01/2018	Document revised as per BIFPCL/OE's comments dated 23/01/2018

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PSER

AUTHORISATION FOR DIFFERENT CATEGORY OF CONSTRUCTION/ ERECTION CHECKS & NONCONFORMITY DISPOSITION

Category of Check	Inspection Authority	Witness Authority	Nonconformity (if any) Disposition Authority	Accepting Authority
'A' (Customer Hold Point)	BHEL Engineer	OWNER / CONSULTANT	BHEL ENGG Centre/ Head (Quality): BHEL PS-ER	OWNER / CONSULTANT
'B' (Formal intimation shall be forwarded by BHEL. Check shall commence at notified time whether parties show-up or not)	BHEL Engineer	OWNER / CONSULTANT	BHEL ENGG Centre/ Head (Quality): BHEL PS-ER	OWNER / CONSULTANT
'C'	BHEL Engineer	BHEL Engineer	BHEL ENGG Centre/ Head (Quality): BHEL PS-ER	BHEL HOS

Abbreviations used:

HOS – Head of Section

Note:

1. Nonconformity Disposition authority for all categories of checks shall be as under:

   Product nonconformities: BHEL Engineering Centre.

   Process/System nonconformities: Head (Quality): BHEL, PS ER.

2. Wherever log sheet is not called for, suitable record shall be maintained in protocol / Site register.

3. In case of nonconformity, accepting authority will consider the solution for the nonconformity as proposed by the Nonconformity Disposition Authority before acceptance, and such solution shall be reflected in the log sheets/protocols.

4. Owner's Engineer is authorized to carry out surveillance in any of B & C category of checks at his discretion.

5. Concerned agencies shall ensure that MMRs having valid calibration are only used for measurements.

6. Quantum of check shall be 100% for all characteristics unless otherwise mentioned specifically in Field Quality Plan/ reference documents.

7. Only authorised persons with proper safety gears to enter construction area.

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PSER	FIELD QUALITY PLAN FOR STRUCTURAL WORKS	FQP NO.: MAITREE-00-U-QA-300002-PSE BHEL Doc. No. : QPE-MTE-660-CL-03
		REV No.: 2
		SHEET 01 / 14 SHEETS

STATEMENT OF CHECKS

Capacity / Type :	660MW
System :	CIVIL WORKS
Sub-system :	STRUCTURAL WORKS
Area :	CONSTRUCTION

NOTES :

1. As an evidence of having carried out the work satisfactorily, a general purpose log sheet, L-00 shall be maintained for all the checks.
2. Checks for Structures for conventional heat generation (including coal bunker) is covered under document number MAITREE-00-UH-QA-300006-PSE
3. Abbreviations used:

   R – Record Verification
   V – Visual Check
   P – Physical Check
   M – Measurement
   T – Test
   MTC – Manufacturers Test Certificate
   SR – Site Register
4. Latest revision of Standards & Specification shall apply.
5. Materials shall be procured in compliance to Functional Technical Specifications & BIFPCL / OE approval.
6. Welding shall be carried out by Qualified Welders, with traceable WPQ, in line with approved WPS and Qualified PQR, as per ASME Section IX
7. Only approved welding consumables shall be used, as per Approved Welding Consumable list.
8. Procedure shall be established and followed, for Procurement, Storage, Issue and Control of Welding Consumables.
9. NDT shall be carried out by Qualified Personnel with compliance to Approved NDT procedures and Acceptance Norms, as per ASME Section V.
10. The Agency carrying out RT shall be approved by Local Authorities.
11. Field Radiography shall be carried out in compliance with Local Statutory requirements and safety precautions by Approved Agency.
12. Radiography Source handling and control procedure shall be established and complied.
13. Preheating and Post Weld Heat treatment shall be in compliance with Approved Procedures.
14. Gauges and measuring Instruments, with valid calibration only shall be used

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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **STRUCTURAL STEEL WORKS** (STATEMENT OF CHECKS)	BIFPCL Doc. No.: MAITREE-00-U-QA-300002-PSE BHEL Doc. No. : QPE-MTE-660-CL-03 REV.NO.: 2 SHEET 02 / 14 SHEETS
SYSTEM: CIVIL & STRCUTURAL WORKS	SUB-SYSTEM: STRUCTURAL STEEL WORKS	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1.00	**GENERAL REQUIREMENTS**							
1.01	Ensure availability of requisite equipment in good working condition well before commencement of concerned activity. All MMRs in the field shall be calibrated before commencement of tests and then at interval as per manufacturer's recommendations and as per direction of BIFPCL / OE.	P & R	-	A	Once prior to start of work and thereof monthly OR immediately after an Instrument Damaging incident 2	- Technical Specifications & Drawing -The calibration certificate shall specify the fitness of the MMRs within the limit of tolerance for use.	SR	-Functioning of MMRs in proper working condition to be verified on monthly basis. -calibration of MMRs shall be done by approved lab and the report shall be submitted to BIFPCL/ OE. - Wherever practical, a label shall be affixed on the Instrument, indicating the validity of Calibration 2
1.02	Ensure availability of approved drawings	R	-	A	100% for each structure before start of activity	List of Latest Revision of Approved Drawings and Owner's Technical Specifications 2	SR	
2.00	**Structural Steel Raw Material for Site Fabricated Items (if any)**							
2.01	Ensure that the raw materials (including Stainless steel) is as per the specification and from BIFPCL / OE approved sources. Review MTC for the followings - a) Mechanical/Physical properties b) Chemical properties	R / T	-	A	each lot of each section	SA/IS 2062 & AISI/SAE409 or any other grade mentioned in approved drawing	MTC	In absence of correlation, tests may be done
2.02	UT report on all plates >40mm thickness In case of unavailibility of report test shall be carried out on the materials as per specification.	R / T	-	A		ASTM A 435/A 435M-17 2	TC	In absence of correlation, tests to be done. UT to be carried out by Qualified NDT Personnel 2
3.00	**Receipt, Storage & Preservation of Raw Steel, Fabricated Structures & BOIs**							
3.01	Check the availability of the following: a) Shipping List (SL) b) Packing Slip (PS) / Loading Advice Slip (LAS) / Lorry Receipts (LR) / Bill of Lading (BL) c) MDCC (Material Despatch Clearance Certificate)	V & R	-	C	100%	-	-	
3.02	Verify the components / items received for the following. - a) Work order no./ Package No. / Bill of Lading b) Drawing No. & part No.	V & R	-	C	100%	Shiping List / Packing Slip / MDCC & Drawing	Stock Register	
3.03	Check the components / items on receipt for the following: a) Packing condition b) Physical damage c) Shortage/ Excess of components	V	-	C	100%	SL / PS / BL & Drawing	SR	

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SYSTEM: CIVIL & STRCUTURAL WORKS	SUB-SYSTEM: STRUCTURAL STEEL WORKS	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
3.04	Ensure non-conforming & rejected components are identified and stored separately and reported to Manufacturer	V & R	-	C	100%	SL / PS / BL & Drawing	MDR (Material Discrepancy Report)	
3.05	Ensure control of receipt & issue of all components	V & R	-	C	100%	SL / PS / BL	Stock Register	
3.06	Ensure storage of materials as per requirements with easy traceability.	V & R	-	C	100%	Annex-B	SR	
3.07	Ensure 'shelf life' of materials are displayed, wherever found necessary and stored separately with expiry date clearly visible.	V & R	-	C	100%	Annex-B	SR	
3.08	Ensure preservation of materials as per requirement	V & R	-	C	As per Annex-B	Annex-B	SR	
3.09	Periodic inspection of stored items for their condition & preservation.	V & R	-	C	As per Annex-B	Annex-B	SR	
3.10	Ensure that customer supplied materials (if any) are identified, stored separately and record maintained.	V & R	-	B	100%	Technical Specifications	SR	
4.00	**Marking, Cutting & Fit-up for Site Fabrication (if any)**							
4.01	Ensure that the marking are done as per the requirement	V	-	C	100%	Construction drawings & Class 1 Functional manufacturing tolerances of Annex D of BS EN 1090-2: 2008+A1:2011	SR	
4.02	Check that the marking are done by punching at convenient intervals	V	-	C	100%		SR	
4.03	Ensure that the raw materials are cut by using suitable method	V	-	C	100%		SR	
4.04	Ensure that the cut edges are properly cleared/dressed before taking up fabrication	V	-	C	100%		SR	
4.05	Check that the raw materials after cutting are identified with part number.	V	-	B	100%		SR	
4.06	Ensure that forming is done using proper tooling & free from damages (if applicable)	M	Measuring tape, gauge	B	100%		SR	
4.07	Ensure proper fit up before welding	M	Measuring Tape	B	100%		SR	

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BHARAT HEAVY ELECTRICALS LIMITED
PS:ER, KOLKATA

FIELD QUALITY PLAN
FOR
STRUCTURAL STEEL WORKS
(STATEMENT OF CHECKS)

BIFPCL Doc. No.: MAITREE-00-U-QA-300002-PSE
BHEL Doc. No. : QPE-MTE-660-CL-03
REV.NO.: 2
SHEET 04 / 14 SHEETS

SYSTEM: CIVIL & STRCUTURAL WORKS | SUB-SYSTEM: STRUCTURAL STEEL WORKS | AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
5.00	**Pre-welding Requirements (Fabrication & Erection)**							
5.01	Availability of correct WPS	V	-	A	100%	Drawing & AWS D1.1M-2015	WPS	
5.02	Review of MTC of welding electrodes	R	-	A	100%	Relevant AWS specifications as per applicable WPS	SR	- BIFPCL/ OE approved welding consumables -The copy of MTCs to be jointly reviewed & signed by BHEL & BIFPCL/OE and record to be maintained in Site Register
5.03	Welders' / Welding Operators' performance qualification.	V & T	-	A	100%	WPS & AWS D1.1M-2015	WPR	Welders shall be assigned Identification for traceability 2
5.04	Adoption of correct procedure, approved electrodes and methods.	V & R	-	B	100%	WPS & Drawing / EWS	SR	
5.05	Review of qualification of NDT inspectors	R	-	A	100%	Level-II or above of ASNT NDT Certification or equivalent	-	
5.06	Storage , Baking ,drying and Control of Electrodes, including return of excess drawn (as applicable) 2	V & R	-	B	Random in each shift	Recommendations of electrode manufacturer and BHEL Welding Consumable Control procedure 2	SR	
6.00	**Field Welding**							
6.01	Ensure pre heating is carried out wherever applicable. (using appropriate method)	V	Thermal chalk / Non contact thermometer	B	100%	WPS and Construction drawings	SR	
6.02	Ensure that the interpass temperature is maintained during the welding. (if required)	V	Thermal chalk / Non contact thermometer	C	100%	WPS and Construction drawings	SR	
6.01	Ensure proper sequence of welding.	V	-	C	100%	Construction drawings	SR	
6.02	Check finish & size of welding	V & M	Weld gauge	B	100%	Construction drawings	SR	
6.03	Check that the temporary attachment welded are removed and ground & touched-up.	V	-	B	100%	Construction drawing & Approved painting scheme	SR	
6.04	Check and ensure that the overlap/excess weld metal is removed by grinding and touched-up.	V	-	C	100%	Construction drawing & Approved painting scheme	SR	

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1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
6.07	Post Weld Heat Treatment (PWHT), if required	V	Thermo-couple with time-temp. recorder	A	100%	WPS and Construction drawings	SR / CHART	
6.05	Check the measurement of parts after welding for the correctness of dimension & matching. (applicable for fabrication only)	V	Measuring Tape	B	100%	Construction drawings	SR	
6.06	Storage & Preservation of fabricated structures	V	As required	C	As per Annex-B	Annex-B	SR	
7.00	**NDT and Destructive Testings on Field Welds**							
7.01	Fillet Welds							
7.01A	Ensure correct size, profile with smooth transition into parent metal	V & M	weld gauge	B	100%	Construction Drawing	SR	
7.01B	DPT	T	Approved brand of Penetrant, Developer	B	5% of weld length with min. 300mm at each member	AWS D1.1M-2015	SR	- ensure DPT consumables from approved source - NDT to be carried out by Qualified NDT Personnel (2)
7.02	Groove Welds							
7.02A	Ensure correct size, profile	V	Visual	B	100%	Construction drawing, AWS D1.1M-2015	SR	
7.02B	DPT	T	Approved brand of Penetrant, Developer	B	100% on root run after back gouging	AWS D1.1M-2015	SR	(2) NDT to be carried out by Qualified NDT Personnel
7.02C	Ultra Sonic Testing (other than coal bunkers & hoppers)	T	UT M/C	A	10% weld length on full penetration joint	AWS D1.1M-2015	IR	(2) NDT to be carried out by Qualified NDT Personnel
7.02D	Radiography Testing (Except coal bunkers & hoppers)	T	RT Source	A	10% RT weld length of each welder on butt welds, except for crane girders and coal bunker	AWS D1.1M-2015	IR	The length of weld to be tested shall not be more than 0.75 x focal distance. The width of the Radiographic film shall be width of the welded joint plus 20 mm on either side of the weld. NDT to be carried out by Qualified NDT Personnel (2)

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SYSTEM: CIVIL & STRCUTURAL WORKS	SUB-SYSTEM: STRUCTURAL STEEL WORKS	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
8.00	**Corrosion Protection (after fabrication) - Surface preparation & Primer Coating**							
8.01	Painting material	R	-	A	Each batch of delivery	- BIFPCL / OE approved list of manufacturers - BIFPCL / OE approved Painting Schedule / scheme	SR / MTC	- BIFPCL / OE Approved source - Mfr. TC shall be co-related with the consignment received
8.02	Surface Preparation (for site fabricated items only)	V & M	as agreed	B	Each erection mark	BIFPCL / OE approved Painting Schedule / scheme	SR	
8.03	Primer Thickness & acceptance of the surface (for site fabricated items only)	V & M	Paint DFT gauge	B	Each erection mark	BIFPCL / OE approved Painting Schedule / scheme	JOINT PROTOCOL	
9.00	**Checks for Permanent bolts, Nuts & Washer and checks for bolting**							
9.01	Ensure materials are procured from BIFPCL / OE approved source	R	Review of Invoice copy	A	Once in each lot of supply	BIFPCL / OE approved list of manufacturers	SR	In case of bolts supplied by BHEL manufacturing units, only BIFPCL/OE issued MDCC shall be reviewed
9.02	Check that Manufacturer's Test Certificate available for fastener materials and review physical & chemical properties	R	Review of MTC	A	Once in each lot of supply	ASTM F 3125M-15A or equivalent Euro Norm, as specified in drawing	SR	
9.03	Inspection of non-preloaded bolts							
9.03A	Each fastener of the bolt assembly (bolt, nut & washer) shall be physically checked for markings, appearance and freeness of nut	P	-	C	100%	Any nut and bolt assembly where the nut does not run freely shall be discarded.	SR	
9.03B	Identification of assembly bolt lot locations and Check for dia. of bolt & number of bolt assembly in the joint	V	-	C	100%	Drawing	SR	
9.03C	Check the contact surfaces before assembly	V	-	C	100% for each joint	No loose rust, oil, grease	SR	
9.03D	Inspection of snug tightened bolt assemblies	P	As required	B	Random 10%	EN 1090-2	JOINT PROTOCOL	

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SYSTEM: CIVIL & STRCUTURAL WORKS	SUB-SYSTEM: STRUCTURAL STEEL WORKS	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
9.04	Inspection of Pre-loaded (HSFG) Bolted Joint							
9.04A	Each fastener of the bolt assembly (bolt, nut & washer) shall be physically checked for markings, appearance and freeness of nut	P	-	C	100%	Annex-C	SR	Any nut and bolt assembly where the nut does not run freely shall be discarded.
9.04B	Identification of assembly bolt lot locations and Check for dia. of bolt & number of bolt assembly in the joint	V	-	C	100%	Drawing & Annex-C	SR	
9.04C	Check the contact surfaces before assembly	V	-	C	100% for each joint	Annex-C	SR	
9.04D	Inspection of snug tightened bolt assemblies	P	As required	C	As per Annex-C	Annex-C	SR	Bolt assemblies to be tightened as per the guidelies in Annex-C
9.04E	Check the tightness of bolt assemblies	T	Torque Wrench as specified in Annex-C	A	As per Annex-C	Annex-C	JOINT PROTOCOL	
10.00	**Column Assembly Checks**							
10.01	Check that column pieces are free from any loose rust / scale, mud & oil	V		C	100%		SR	
10.02	Check individual column pieces for identification. Match mark column no., length, camber, sweep & condition of the column pieces.	V & M	Piano wire, Measuring Tape	B	100%	Approved Drawing & Annexure-A	L-06	
10.03	Ensure columns are assembled as per match marks and centre line already punched on the column pieces and respective splice plates wherever applicable.	V	-	B	100%	Approved Drawing & Annexure-A	L-06	1. Interchanging of column pieces and turning of column by 180 degree is not permitted. 2. Splice plates are to be positioned as per shop match marks and placing them upside down turning by 180 degree to be totally avoided.

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1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
10.04	Check camber, sweep, match mark and total length after assembly of columns.	M	Piano wire, Measuring Tape	A	100%	Approved Drawing & Annexure-A	L-07	
10.05	Ensure welding / bolting of all asembled items	shall be done as per welding checks in Sl No. 5 to 7 or bolting checks in Sl. No. 9, as the case may be						
11.00	**ROOF TRUSS / ROOF BEAM ASSEMBLY CHECKS**							
11.01	Ensure roof trusses / beams are pre-assembled as per match mark and C.G line punched on top and bottom angles.	V		B	100%	Approved Drawing & Annexure-A	SR	
11.02	Check the following							
11.02A	Camber	M	Measuring Tape	B	100%	Approved Drawing & Annexure-A	L-08	
11.02B	Sweep	M	Measuring Tape	B	100%	Approved Drawing & Annexure-A	L-08	
11.02C	Slope (if applicable as per drawing)	M	Measuring Tape / Waterlevel	B	100%	Approved Drawing & Annexure-A	L-08	
11.02D	Alignment of CG line punch mark and the match mark given on the top & bottom, permitted deviation in C.G line matching is ±5 mm)	M	Measuring Tape	B	100%	Approved Drawing & Annexure-A	SR	
11.02E	Total length of assembled roof truss/ beam between faces of end gusset plates at top & bottom.	M	Measuring Tape	B	100%	Approved Drawing & Annexure-A	L-08	
11.02F	End plates are aligned and in one plane on both the ends.	M	Measuring Tape	B	100%	Approved Drawing & Annexure-A	SR	
11.03	Ensure welding / bolting of all asembled items	shall be done as per welding checks in Sl No. 5 to 7 or bolting checks in Sl. No. 9, as the case may be						
12.00	**ASSEMBLY CHECKS FOR SPACE FRAME STRUCTURES (VIZ. COAL CONVEYOR GALLERIES, PIPE / CABLE RACKS ETC.)**							
12.01	Ensure Pre-assembly as per match mark	V		C	100%	Approved Drawing	SR	
12.02	Ensure assembly of all bracings, struts beams etc. which are required for safe handling of gallery during erection	V		C	100%	Approved Drawing & Annexure-A	SR	

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SYSTEM: CIVIL & STRCUTURAL WORKS	SUB-SYSTEM: STRUCTURAL STEEL WORKS	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
12.03	Check the slope & other dimensions of the frame as per drawing	M	Measuring Tape / Waterlevel	A	100%	Approved Drawing & Annexure-A	SR	
12.04	Ensure welding / bolting of all asembled items	shall be done as per welding checks in Sl No. 5 to 7 or bolting checks in Sl. No. 9, as the case may be						
13.00	**Pre-Erection Checks**							
13.01	Ensure availability of permanent Bench Mark.	V	-	A	Before start of erection	Joint Protocol with BIFPCL / OE	JOINT PROTOCOL	Joint Protocol with BIFPCL / OE for bench mark to be made at start of erection
13.02	Check the orientation of the foundation.	V	-	B	100%	Approved Drawing & Annexure-A	SR	
13.03	Check the top level of foundation pedestals with respect to permanent benchmark.	M	Dumpy Level / Auto Level	B	100%	Approved Drawing & Annexure-A	L-02	
13.04	Check the centre to centre distance of column foundation pedestals with respect to the reference axis.	M	Measuring Tape/ TS	B	100%	Approved Drawing & Annexure-A	L-03	
13.05	Check the diagonals between column foundation pedestals.	M	Measuring Tape / Total Station	B	100%	Approved Drawing & Annexure-A	L-04	
13.06	Check the pitch distance of foundation bolts on both axis and diagonals.	M	Measuring Tape	B	100%	Approved Drawing & Annexure-A	L-05	
13.07	Check that foundation bolts are free from damages and foundation bolt pocket & shear key pocket is free from debris and foreign materials.	V	-	B	100%	Approved Drawing & Annexure-A	SR	
13.08	Check cleaning of packer plates and that they are free from undulations and burrs.	V	-	B	100%	Approved Drawing & Annexure-A	SR	
13.09	Check thickness & number of packer plates	M	Measuring Tape	B	100%	Drawing & readings in Logsheet L-02	SR	Packer plate shall be selected in such a way that number of packers is limited to 3 & bottom of base plate of columns shall be within ±5mm of true level

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BHARAT HEAVY ELECTRICALS LIMITED
PS:ER, KOLKATA

FIELD QUALITY PLAN
FOR
STRUCTURAL STEEL WORKS
(STATEMENT OF CHECKS)

BIFPCL Doc. No.: MAITREE-00-U-QA-300002-PSE
BHEL Doc. No. : QPE-MTE-660-CL-03
REV.NO.: 2
SHEET 10 / 14 SHEETS

SYSTEM: CIVIL & STRCUTURAL WORKS | SUB-SYSTEM: STRUCTURAL STEEL WORKS | AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
13.10	Check surface finish of 'seating plate' on crane girder bracket of column & crane girder bearing plate and check / ensure proper bearing	M	Surface Roughness Tester	C	100%	Drawing	SR	
14.00	**Erection Checks**							
14.01	Ensure proper orientation of column.	V	-	B	100%	Approved Drawing & approved erection procedure	SR	
14.02	Ensure that centre line of base plate coincides with foundations pedestal axis (both in X and Y axis)	V	-	B	100%	Approved Drawing & Annexure-A	SR	
14.03	Ensure first pieces of all columns are erected and aligned. ##	M	Measuring Tape & Plumb bob	A	100%	Approved Drawing & Annexure-A	SR	## only columns with 'cap plate - bearing plate' bolted joints shall be erected in pieces. Otherwise, columns shall be assembled at ground and erected in total length
14.04	Ensure the erection of horizontal beams/girders and vertical bracing	refer Sl. No. 14.14 for erection checks						
14.05	Check verticality of first piece columns after erection of the respective connecting adjacent columns.	M	Plump bob / Digital Theodolite *	A	100%	Approved Drawing & Annexure-A	SR	* for column length more than 6 mtr., only Digital Theodolite shall be used.
14.06	Ensure proper tightening of foundation bolts with lock nuts.	V		B	100%	Approved Drawing & Annexure-A	SR	
14.07	Ensure locking of all packer plates & plate washers by tack welding.	V		C	100%	Approved Drawing & Annexure-A	SR	
14.08	Ensure grouting up to the base plate bottom after ensuring verticality of columns and cure (Cube test to be carried out)	M / V	Compressive strength Testing m/c	B	100%	Approved Drawing & Annexure-A	L-09	
14.09	Ensure erection of second pieces of all columns.	V		C	100%	Approved Drawing & Annexure-A	SR	
14.10	Ensure erection & welding of interconnecting members.	refer Sl. No. 14.14 for erection checks						

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SYSTEM: CIVIL & STRCUTURAL WORKS	SUB-SYSTEM: STRUCTURAL STEEL WORKS	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
14.11	Check verticality of 1st and 2nd pieces after the erection of Connecting pieces. (only for bolted splicing) ***Note: The same method shall be followed for further pieces***	M	Plump bob / Digital Theodolite *	A	100%	Approved Drawing & Annexure-A	SR	* for column length more than 6 mtr., only Digital Theodolite shall be used.
14.12	Check the verticality of total erected column $$	M	Digital Theodolite	A	100%	Approved Drawing & Annexure-A	L-10	$$ out of plumbness of Powerhouse column axis measured at crane girder bracket level to be restricted to ±5mm
14.13	Ensure the following during the erection of roof trusses / Roof Beams							
14.13A	Proper handling to avoid damage & distortion to assembled trusses.	V	-	C	100%	Approved Drawing & approved procedure	SR	
14.13B	Alignment, Slope, level as per drawing.	M	Measuring tape, Spirit Level / Water Level	B	100%	Approved Drawing & Annexure-A	SR	Ensure erection of truss to truss connecting members including purlins for proper alignment.
14.13C	completion of all erection welds (fillet & groove) / bolting as per drawing	shall be done as per welding checks in Sl No. 5 to 7 or bolting checks in Sl. No. 9, as the case may be						
14.14	Ensure the following during the erection of beams, bracings & other members							
14.14A	Proper handling to avoid damage & distortion to assembled trusses.	V	-	C	100%	Approved Drawing & approved procedure	SR	
14.14B	Alignment, Slope, level of erected members as per drawing.	M	Spirit Level / Water Level	B	100%	Approved Drawing & Annexure-A	SR	
14.14C	completion of all erection welds (fillet & groove) / bolting as per drawing	shall be done as per welding checks in Sl No. 5 to 7 or bolting checks in Sl. No. 9, as the case may be						
14.15	Check and ensure the following during Crane girder erection wherever applicable							
14.15A	Check Bracket top level on the column are aligned with water level	M	Water Level	A	100%	Approved Drawing & Annexure-A	L-11	safe acceses / platforms to be provided at crane girder bracket level

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SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
14.15B	Check top flange level of crane girder are aligned with water level	M	Water Level	A	100%	Approved Drawing & Annexure-A	L-11	
14.15C	Check web axis of crane girder at one row of columns (e.g. A-row for Power House) and aligned	M	Measuring Tape	A	100%	Approved Drawing & Annexure-A	SR	
14.15D	Centre to Centre distance girders	M	Measuring Tape	A	100%	Approved Drawing & Annexure-A	L-12	
14.16	Check the following during the erection of Space frames (viz. coal conveyor galleries, piepe/ cable racks etc.)							
14.16A	Proper handling to avoid damage & distortion to assembled galleries	V	-	C	100%	Approved Drawing & approved procedure	SR	
14.16B	Alignment of all the frame	V & M	As required	B	100%	Approved Drawing & Annexure-A	SR	
14.16C	Slope of as per drawing.	M	Water Level	B	100%	Approved Drawing & Annexure-A	SR	
14.16D	Ensure proper connection with column / trestles	shall be done as per welding checks in Sl No. 5 to 7 or bolting checks in Sl. No. 9, as the case may be						
15.00	**Corrosion Protection (after assembly / erection) - Touch-up & Painting**							
15.01	Painting material	R	-	A	Each batch of delivery	BIFPCL / OE approved list of manufacturers & BIFPCL / OE approved Painting Schedule / scheme	SR / MTC	- BIFPCL / OE Approved source - Mfr. TC shall be co-related with the consignment received
15.02	Touch-up of primer / paint in damaged portions (if required)	V	-	B	Each erection mark	BIFPCL / OE approved Painting Schedule / scheme	SR	
15.03	Intermediate Coat Thickness (for external strcutures)	V & M	Paint DFT gauge	B	Each erection mark	BIFPCL / OE approved Painting Schedule / scheme	SR	
15.04	Acceptance of Painted surface after final panting	V & M	Paint DFT gauge	B	Each erection mark	BIFPCL / OE approved Painting Schedule / scheme	JOINT PROTOCOL	

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BHARAT HEAVY ELECTRICALS LIMITED
PS:ER, KOLKATA

FIELD QUALITY PLAN
FOR
STRUCTURAL STEEL WORKS
(STATEMENT OF CHECKS)

BIFPCL Doc. No.: MAITREE-00-U-QA-300002-PSE
BHEL Doc. No. : QPE-MTE-660-CL-03
REV.NO.: 2
SHEET 13 / 14 SHEETS

SYSTEM: CIVIL & STRCUTURAL WORKS | SUB-SYSTEM: STRUCTURAL STEEL WORKS | AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
16.00	**Galvanised Steel Items / SS Handrail Pipes**							
16.01	Ensure materials are procured from BIFPCL / OE approved source	R	Review of Invoice copy	A	Once in each lot of supply	BIFPCL / OE approved list of manufacturers	SR	In case of handrail supplied by BHEL manufacturing units, only MDCC shall be reviewed by FQA
16.02	Review of Manufacturer's Test Certificate / Inspection report	R	Review of MTC	A	Once in each lot of supply	For GI Pipes : EN 10255 :2004 & EN 10240:1998 or equivalent ASTM code or as specified in drawing For SS pipes : AISI/SAE 409 & ASTM A790/A790M-16 or equivalent European norm or as specified in drawing	SR	
16.03	Acceptance of erected handrails	V & M	As required	B	100%	Construction Drawing	SR	
16.04	Painting (if required as per approved paiting scheme)	V	-	B	100%	Approved Painting Schedule	SR	
17.00	**Galvanised Electroforged Gratings**							
17.01	Ensure materials are procured from BIFPCL / OE approved source	R	Review of Invoice	A	Once in each lot of supply	BIFPCL / OE approved list of manufacturers	SR	In case of grating is supplied by BHEL manufacturing units, only MDCC shall be reviewed by FQA
17.02	Review of Manufacturer's Test Certificate	R	Review of MTC	A	Once in each lot of supply	Approved Drawing / Datasheet & BS 4592-1	MTC	
17.02	Acceptance of erected Gratings	V & M	As required	B	100%	Construction Drawing	SR	
18.00	**Flexible Neoprene Expansion Bellow Strap**							
18.01	Ensure materials are procured from BIFPCL / OE approved source	R	Review of Invoice	A	Once in each lot of supply	BIFPCL / OE approved list of manufacturers	SR	
18.02	Review of Manufacturer's Test Certificate	R	Review of MTC	A	Once in each lot of supply	Approved Drawing & Datasheet	MTC	Mfr. TC shall be co-related with the consignment received
18.03	Acceptance of erected bellow	V & M	As required	B	100%	Construction Drawing	SR	

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BHARAT HEAVY ELECTRICALS LIMITED PS:ER, KOLKATA	FIELD QUALITY PLAN FOR **STRUCTURAL STEEL WORKS** (STATEMENT OF CHECKS)	BIFPCL Doc. No.: MAITREE-00-U-QA-300002-PSE BHEL Doc. No. : QPE-MTE-660-CL-03 REV.NO.: 2 SHEET 14 / 14 SHEETS
SYSTEM: CIVIL & STRCUTURAL WORKS	SUB-SYSTEM: STRUCTURAL STEEL WORKS	AREA: CONSTRUCTION

SL NO.	CHARACTERISTICS / ITEM	TYPE OF CHECK	INSTRUMENT	CLASS OF CHECK	QUANTUM/ FREQUENCY OF CHECK	REFERENCE DOCUMENT/ ACCEPTANCE STANDARD	FORMAT OF RECORD	REMARKS
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
19.00	**PTFE / ELASTOMERIC Bearings**							
19.01	Ensure materials are procured from BIFPCL / OE approved source	R	Review of Invoice	A	Once in each lot of supply	BIFPCL / OE approved list of manufacturers	SR	
19.02	Review of Manufacturer's Test Certificate	R	Review of MTC	A	Once in each lot of supply	Approved Drawing & Datasheet	MTC	Mfr. TC shall be co-related with the consignment received
19.03	Acceptance of erected bearing	V & M	As required	B	100%	Construction Drawing	SR	
20.00	**Stop Log Gate / Trash Rack, Lifting Beam**							
20.01	Ensure materials are procured from BIFPCL / OE approved source	R	Review of Invoice	A	Once in each lot of supply	BIFPCL / OE approved list of manufacturers	IR	
20.02	Review of Shop Inspection report & MDCC	R	Review of MTC	A	Once in each lot of supply	Approved Drawing & Datasheet	MTC / SR	
20.03	Ensure the following during the erection of the components							
20.03A	Proper handling to avoid damage & distortion	V		C	100%	Owner's Technical Specifications, Drawing	SR	
20.03B	Alignment, Slope, level of erected members as per drawing.	M	Plum bob / Spirit Level / Water Level	B	100%	Drawing & AWWA C-563	SR	
20.03C	completion of all erection welds & inspection of welding	shall be done as per checks in Sl No. 5 to 7						
20.04	Testing							
20.04A	Free movement of members under dry & under full water condition	V	-	A	100%	Owner's Technical Specifications, Drawing	JOINT PROTOCOL	
20.04B	Leakage for stop log gate	V / T	As required	A	100%	Owner's Technical Specifications, Drawing & Approved procedure △2	JOINT PROTOCOL	Leakage should not be more than 5 litres / minute / meter of length of seal under design head △2
20.04C	Operation (lifting of log gates) with lifting beam & acceptance △2	M	As required	A	100%	Approved procedure	JOINT PROTOCOL	

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ERECTION TOLERANCES FOR STEEL STRUCTURES

A. FOUNDATION DISPOSITION

Sl. No.	Description	Tolerances
A.1	Column pedestal top level (as cast) : Deviation from specified level	+ 15 mm - 20 mm
A.2	Dimension between adjacent column pedestals	1 mm per meter (limited to 5mm)
A.3	Adjacent column pedestal diagonal difference	1 mm per meter (limited to 10 mm)
A.4	Pre-set foundation bolt (where prepared for Adjustment)	
	a) Foundation bolt pitch difference	± 10mm
	b) Foundation bolt diagonal difference	± 10mm
	c) Foundation bolt protrusion above specified level [the protruding length of a vertical foundation bolt (in its best-fit position if adjustable) should be vertical to within 1 mm in 20 mm]	+ 25mm - 5mm
A.5	Foundation bolt pitch difference (where not prepared for Adjustment)	
	a) Foundation bolt pitch difference	± 3mm
	b) Foundation bolt diagonal difference	± 5mm
	c) Foundation bolt protrusion above specified level	+ 45mm - 5mm
A.6	Grouting gap	70 mm (Max.) or grout manufacturers recommendations, whichever is lower
A.7	Steel anchor plate embedded in concrete - Deviations Δx, Δy, Δz from the specified location and level:	± 10mm
* Tolerance specified under Sl. No. A.1 should be read in conjunction with A.6 & C2		

B. ASSEMBLY OF STRUCTURES (COLUMNS / GIRDERS / BEAMS)

Sl. No.	Description	Tolerances
B.1	Individual column / girder piece camber	± L/750 (limited to 10 mm)
B.2	Individual column / girder piece sweep	± L/750 (limited to 10 mm)
B.3	Total length after pre-assembly	
	a) upto and including 20 m height (H)	± 10 mm
	b) over 20 m height (H)	± 0.25(H+20) mm

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Sl. No.	Description	Tolerances
B.4	Camber for the total length of the column / girder	± L/750 (Max. 15 mm)
B.5	Sweep for the total length of column / girder	± L/750 (Max. 15 mm)
B.6	Deviation in any bearing or seating level with respect to true level.	± 5 mm
B.7	Field assembly tolerances for Lattice components & space frames	As per table D.2.10 BS EN 1090-2: 2008+A1:2011

C. ERECTED STEEL COLUMNS & OTHER MEMBERS

Sl. No.	Description	Tolerances
C.1	Deviation of column axis at the level of its base with respect to true axis:	
	i) in longitudinal direction	± 5 mm
	ii) in lateral direction	± 5 mm
C.2	Deviation in the level of bearing surface of columns (*i.e.* bottom of base plate) at foundation top with respect *to* true level	± 5 mm
C.3	Out of plumbness (verticality) of column axis from true vertical axis, as measured at column top:	
	a) For columns without any special requirements:	
	1) upto and including 30 m height	± H/1000 or ± 25 mm whichever is less
	2) over 30 m height	± H/1200 or ± 35 mm whichever is less
	b) For column with special requirements like cranes or such similar requirements: #	
	1) Upto and including 30 m height	± H/1000 or ± 20 mm whichever is less
	2) Over 30 m height	± H/1500 or ± 25 mm whichever is less
	# Inclination from column base to bearing of crane beam shall be limited to ± 10mm	
C.4	Deviation in straightness in longitudinal and transverse of column between brace levels along the height.	± H/1500 or ± 10 mm whichever is less
C.5	Distance between centres of adjacent columns at base level (where L in meters is true distance)	
	L ≤ 5m	± 5 mm
	L > 5m	± 0.2(L+30) mm or ± 10 mm whichever is less

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Sl. No.	Description	Tolerances
C.6	Deviation in any bearing or seating level with respect to true level.	± 5 mm
C.7	Deviation in difference in bearing levels of a member on adjacent pair of columns both across and along the building.	± 5 mm
C.8	Deviation from straightness of an erected beam or cantilever of length L	± L/1000 or ± 10 mm whichever is less
C.9	Deviation at mid span from intended camber of an erected beam or lattice component of length *L*:	± L/500 or ± 20 mm whichever is less
C.10	Overall length of a building : Distance between end columns in each line, at base level [L in metres]	
	For L ≤ 30 m	± 16 mm
	30 m < L < 250 m	± 0,2(L+50) mm
	L ≥ 250 m	± 0,1(L+350) mm
C.11	Location of the outer face of a perimeter column at base level, relative to the line joining the faces of the adjacent columns	± 7 mm
* Tolerance specified under Sl. No. C.3 should be read in conjunction with C.4 and Sl. No. C.1 should be read in conjunction with C.10 & C.11		

D. ERECTED CRANE GIRDER & RAIL

Sl. No.	Description	Tolerances
D.1	Shift in the centre line of crane rail with respect to centre line of web crane girder.	± {(Web thk in mm) + 2mm} / 2 or ± 5 mm whichever is less
D.2	Shift in plan of alignment of crane rail with respect to true axis of crane rail at any point,	± 10 mm
D.3	Deviation in crane track gauge with respect to the gauges	
	a) For track gauge up to and including 16 mm	± 5 mm
	b) For track gauge more than 16 m	± (5 + 0.25(S-16)) mm subject to a maximum of ±10 mm, where S in meters is true track gauge.

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Sl. No.	Description	Tolerances
D.4	Deviation in the crane rail level at any point from true level	± 10 mm
D.5	Deviation in crane girder level (T.O.S) over 2 m gauge length	± 2 mm
D.6	Relative levels of rails on the two sides of a runway: at Spacing s between centres of crane rails:	
	a) for s ≤ 10 m	± 10 mm
	b) for s > 10 m	± s / 1 000 subject to a maximum of ±20 mm
* Tolerance specified under Sl. No. D.4 should be read in conjunction with D.5 & D.6		

E. ERECTED TOWERS & MASTS

Sl. No.	Description	Tolerances
E.1	Straightness of legs and chord components: Straightness of portion (L) between joint locations.	L/1 000
E.2	Main dimensions of mast cross section and bracing:	
	Panel < 1 000 mm:	± 3 mm
	Panel ≥ 1 000 mm:	± 5 mm
E.3	Verticality of a mast: Deviation from verticality of a line between any two points on the intended vertical axis of the structure, when measured in still air	± 0,05 % or ≥ 5 mm whichever is more
E.4	Verticality of a tower: Deviation from verticality of a line between any two points on the intended vertical axis of the structure, when measured in still air	± 0,05 % or ≥ 5 mm whichever is more

NOTES –

1. Tolerance specified are as per BHEL standard practice or functional erection tolerances as per Annex D of **EN 1090-2: 2008**.

2. In case where deviations from the true positions of the structure are intimately linked with or directly influence the equipment erection, the tolerances on erected steel shall be limited to the deviations permitted by the equipment.

3. For misc. structures not specified above, erection tolerance shall be as per the guideline of Class-1 Functional erection tolerances of Annex D of EN 1090-2: 2008+A1:2011.

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STORAGE & PRESERVATION GUIDELINE

SL. NO.	COMPONENT	TYPE OF STORAGE	PRESERVATION	FREQUENCY OF CHECK	CHECK FOR	REMARKS
1	Raw Steel (including stainless steel)	Open storage	-	Once in six months	Damage	Refer point no. C in note
2	Fabricated Structural Steel Members (including stainless steel components)	Open storage	As per approved painting schedule	Once in three months	Damage, painting	Refer point no. C in note
3	Foundation bolts, insulation pins, Anchor channels, Sleeves etc.	Open storage	Temporary Rust Preventive Fluid	Once in three months	Damage, painting & protective coating of thread	
4	Galvanised gratings / pipes	Open storage	As per approved painting schedule	Once in three months	Damage and coating	
5	SS pipes	Open storage	As per approved painting schedule	Once in six months	Damage	Refer point no. C in note
6	Stop Log Gate, Trash Rack & Lifting Beams	Open storage with tarpaulin cover / canopy	As per approved painting schedule	Once in three months	Damage, painting	Refer point no. C in note
7	Permanent MS, HT / HSFG Bolts	Covered Storage	Rust Preventive Coating	Once in three months	Damage and protective coating	Rust Preventive Coating as per manufacturer's recommendations
8	PTFE / ELASTOMERIC Bearings	Covered Storage	In proper packing	Once in three months	Damage	as per manufacturer's recommendations
9	Neoprene bellow strap	Covered Storage	In proper packing	Once in three months	Damage	
10	Welding Electrodes / Consumables	Covered Storage	in sealed box / case	Once every month	Damage	as per manufacturer's recommendations
11	Paints etc.	Covered Storage	in sealed container	Once every month	Expiry date & Damage to the container	as per manufacturer's recommendations

NOTE :

A. FOR OPEN STORAGE -

1. The open yard shall be levelled, well consolidated to achieve raised ground with proper slope to drain the water connecting to storm water drain and the provision of cranable feeder roads along with access roads running all sides. The entire open yard shall be suitably divided in to number of blocks and identified using alphanumeric codes. The location sign boards for each block shall be kept and maintained for locating the components easily.
2. Components shall be stored with appropriate bottom supports like sleepers / concrete blocks to avoid direct contact with earth. The height of sleepers / concrete blocks shall be selected in such a way that stacked material do have enough / adequate clearance even during resettlement of earth / ground.
3. Bottom supports are to be suitably placed at required intervals for longer components to avoid sagging / bending.
4. Where components are to be stacked one above the other suitable sleepers / spacers shall be used in between the stacking.

B. FOR COVERED STORAGE -

1. The Covered shed can be constructed by using cold-rolled / tubular components for structure and Corrugated PPGI sheets / galvanised iron sheets for roofing. Brick walls / PPGI sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete. The shed shall be provided with proper ventilation and illumination.
2. Components shall be stacked properly taking in to consideration of handling and preservation. The identification marks shall be re-written wherever necessary for easy traceability.
3. Small components shall be stored on racks with the components identification No. written on tags.
4. In no case, components, which do not have packing, shall be placed directly on the floor.

C. Stainless Steel components shall be stored separately from carbon steel components & no cutting or gouging of carbon steel components to be done in the vicinity of SS components.

D. While stacking the components the following shall be taken into consideration:

- Adequate space to insert slings for handling and to avoid disturbance of components nearby
- Enough space for preservation
- Visibility of identification marks

E. Adequate fire fighting equipment shall be provided at strategic / easily approachable points duly maintained periodically.

F. Adequate illumination shall be provided.

G. A separate yard to be identified as "scrap yard" slightly away from main open yard to store wooden/steel scrap, which is to be disposed off. This is required to avoid mix up with erection components as well as to avoid fire hazard.

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GUIDELINE TO CARRY OUT THE TIGHTENING & INSPECTION OF PRE-LOADED BOLTS USING TORQUE METHOD AS SPECIFIED IN EN 1090-2

1. PURPOSE

The purpose of this procedure is to provide a guideline to carry out the Tightening & Inspection of Pre-loaded bolts using Torque method as specified in EN 1090-2.

2. REFERENCE

a) EN 1090-2:2008+A1:2011 (E)
b) Approved Drawings
c) Approved Field Quality Plan

3. APPARATUS

a) Calibrated bolt tension device (in accordance with EN 14399-2) with uncertainty max. ±2%, repeatability error ± 1%
b) Calibrated torque wrench (of suitable operating range) with accuracy ± 4 %, repeatability error ± 1 %. Hand or power operated wrenches may be used.

Calibration shall be carried out yearly or after any incident occurring during use (significant impact, fall, overloading etc.) and affecting the apparatus.

4. FASTENERS

a) BOLTS : shall be of property class 8.8 as per ISO 898-1 and the nominal fastener diameter used for structural bolting shall be at least M 16, unless otherwise specified in drawing. The length of protrusion shall be at least the length of one thread pitch measured from the outer face of the nut to the end of the bolt. At least four full threads (in addition to the thread run out) shall remain clear between the bearing surface of the nut and the unthreaded part of the shank. The length of bolt shall be selected accordingly.
b) NUTS : shall be of property class 8 as per ISO 898-2, unless otherwise specified in drawing. Nuts shall run freely on their respective bolt, which is easily checked during hand assembly. Any nut and bolt assembly where the nut does not run freely shall be discarded. Nuts shall be assembled so that their designation markings are visible for inspection after assembly.
c) WASHERS : shall be hardened washer as per ISO 7090, unless otherwise specified in drawing. For class 8.8 bolts, a washer shall be used under the bolt head or the nut, whichever is to be rotated. Taper washers shall be used if the surface of the constituent product is at an angle to a plane perpendicular to the bolt axis of more than:
   i) 1/20 (3°) for bolts with d ≤ 20 mm;
   ii) 1/30 (2°) for bolts with d > 20 mm.

5. PREPARATION OF CONTACT SURFACES

The following precautions shall be taken prior to assembly, unless specified otherwise in the drawing:

a) The contact surfaces shall be free from all contaminants, such as oil, dirt or paint. Burrs that would prevent solid seating of the connecting parts shall be removed;
b) Uncoated surfaces shall be freed from all films of rust and other loose material. Care shall be taken not to damage or smooth the roughened surface.

6. TIGHTENING OF PRE-LOADED BOLTS

6.1. The connected components shall be drawn together such that they achieve firm contact. All the bolts assemblies (bolt, nut & single washer as per Clause No. 4) in the subject joint shall be installed before proceeding to tightening process.

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6.2. Then each bolt assembly shall be brought at least to a snug-tight condition. The tightening process shall be carried out from bolt to bolt of the group, starting from the most rigid part of the connection and moving progressively towards the least rigid part. The most rigid part of a cover plate connection / splice plate of 'I' section is commonly in the middle of the connection bolt group. The most rigid parts of end plate connections of 'I' sections are usually beside the flanges. To achieve a uniform snug-tight condition, more than one cycle of tightening may be necessary. The term "snug-tight" can generally be taken as that achievable by the effort of one man using a normal sized spanner without an extension arm.

6.3. Then bolts shall be tightened as per Clause no. 6.4 using a torque wrench offering a suitable operating range. Hand or power operated torque wrenches, meeting the requirements specified in Clause no. 3, may be used. The tightening torque shall be applied continuously and smoothly. In this case also, the tightening process shall be carried out from bolt to bolt of the group, starting from the most rigid part of the connection and moving progressively towards the least rigid part. Delay between installation of bolt assemblies to inspection of the joint shall be minimum to avoid uncontrolled exposure (*i.e.* outdoor condition) of the bolt assemblies. If the tightening process & subsequent inspection is delayed under uncontrolled exposure conditions the performance of the lubrication may be altered and should be checked with respect to supply condition.

6.4. Tightening by the torque method comprises at least the two following steps:

a) First tightening step: the wrench shall be set to a torque value of about $0.75T_m$. This first step shall be completed for all bolts in one connection prior to commencement of the second step;

b) second tightening step: the wrench shall be set to a torque value of $1.10T_m$

Where T_m is the value of torque established by laboratory or field test as per the Clause No. 7 of this document.

6.5. If a bolt assembly has been tightened to the minimum preload and is later un-tightened, it shall be removed and the whole assembly shall be discarded. Bolt assemblies used for achieving initial fit up should not generally need to be tightened to the minimum preload or un-tightened, and would therefore still be usable in location in the final bolting up process.

7. CALIBRATION TEST FOR PRELOADED BOLTS UNDER SITE CONDITIONS

7.1. This clause elaborates a tightening test intended to represent site conditions to calibrate high-strength bolting assemblies for preloaded bolted connections. The purpose of the test is to determine the necessary torque to ensure that the minimum required preload is reliably obtained by the tightening method specified in 7.5.

7.2. The apparatus used shall be as per Clause no. 3 of this document.

7.3. Separate tests shall be carried out on representative samples of minimum **five** assemblies from each lot of fastener assemblies concerned. Test assemblies shall be chosen so that all relevant aspects of their conditions are similar.

The site conditions of fasteners, in particular the performance of the lubrication, can deteriorate if they are left exposed to outdoor conditions on site or if they are stored for a long period of time.

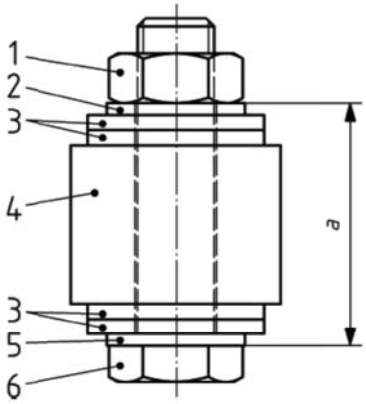
Representative assemblies shall consist of a number of bolts, nuts and washers of each inspection lot. *The assemblies used for tests shall not be re-used for supplementary tests or in the structure*.

7.4. The test set-up (see Figure 1) may include shims needed to suit the measuring device.

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Key

1	nut
2	washer under the nut when nut turned during tightening
3	shim(s)
4	bolt tension measuring device
5	chamfered washer of the assembly or chamfered shim
6	bolt head

Figure - 1

The test assemblies and shims shall be positioned such that:

- the composition of the assembly is similar to the utilisation in practice;
- a chamfered shim is placed under the bolt head;
- a hardened washer is placed under the nut when the nut will be turned during tightening.

The method used for tightening during the test shall be the same as that used on the site. Sufficient measurements shall be taken of the torque, the corresponding bolt tension (ref. 7.5). Neither the fixed part nor the washer under the turned part shall rotate during the test.

For the torque method, the test shall be terminated when any one of the following conditions is satisfied:

a) the bolt force exceeds 1.1Fp (Ref. 7.5);
b) bolt failure by fracture occurs.

7.5. Unless otherwise specified, the nominal minimum preloading force F_p shall be taken as per the table below:

Values of F_p, in [kN]

Property class	Bolt diameter in mm							
	12	16	20	22	24	27	30	36
8.8	47	88	137	170	198	257	314	458
10.9	59	110	172	212	247	321	393	572

Table – 1

7.6. The criteria for acceptance of the torque values for the torque method shall be:

$V_m \leq 0.04$ for sample size of 5

With

$$Vm = \frac{Sm}{Tm}$$

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Where –

- V_m is coefficient of variation of the T_i values
- T_i is individual value of the torque (in Nm) related to each sample assembly (i.e. T_1, T_2, etc.) to achieve the minimum pre-loading force of F_p as mentioned above.
- T_m is the mean value of T_i values
- S_m is the estimated standard deviation of the T_i value

7.7. The following minimum information shall be included in the test report:

- ✓ date of testing;
- ✓ identification number of the assembly lot or the extended assembly lot;
- ✓ number of assemblies tested;
- ✓ designation of the fasteners;
- ✓ marking of bolts, nuts and washers;
- ✓ coating or surface finish and lubrication condition; if relevant, description of alterations to the surfaces due to site exposure;
- ✓ test clamp length;
- ✓ details of the test set-up and devices used to measure tension and torque;
- ✓ remarks concerning the execution of tests (including special testing conditions and procedures such as turning the head of the bolt);
- ✓ tests results;
- ✓ specifications for the preloading of the fasteners related to the inspection lot tested;
- ✓ Calibration certificates for torque wrenches and calibrated force measuring devices.

The test report shall be signed and dated.

8. INSPECTION

8.1. All fasteners shall be procured from Customer-approved source and MTC for each lot of supply shall be reviewed & correlated with delivery challan / invoice. For fasteners supplied by other BHEL units, copy of MDCC from the Customer shall be reviewed.

8.2. Each fastener of the bolt assembly shall be physically checked for markings; appearance and freeness of nut (refer Clause no. 4).

8.3. Identification of assembly bolt lot locations shall be done as per the approved drawing.

8.4. Condition of the contact surfaces to be checked as per the requirement of clause no. 5.

8.5. Snug tightening condition of randomly selected 10% bolts for each bolt assembly group shall be verified.

8.6. For final tightness inspection, one dedicated torque wrench meeting the requirements of clause no. 3 & offering adequate range shall be used. The inspection of a bolt assembly shall be carried out by the application of a torque to the nut (or to the bolt head if specified) using the inspection torque wrench setting the torque at least equal to 1.05 times the torque value T_m (refer Clause No. 7). The inspection shall be carried out between 12 h and 72 h after final completion of tightening in the bolt subgroup concerned.

8.7. The number of bolt assemblies inspected overall in a joint shall be randomly selected 10% or 5 nos., whichever is higher and shall be marked by chalk before start of inspection. A bolting assembly for which the nut turns by more than 15° by the application of the inspecting torque is considered to be under-tightened (< 100 %) and shall be retightened up to 100 % of the required torque. Any under-tightened bolt in the selected sample shall call for rejection of the whole bolt assembly lot of the joint. If the inspection leads to a rejection, all the bolting assemblies in the bolt sub-group shall be checked and corrective actions shall be taken. Then the joint shall be offered for re-inspection.

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PSER

RECORD OF QUALITY CHECKS

SHEET NO. OF FQP	CHECK NO.	RESULTS ACHIEVED OK / NOT OK	DRAWING / DOCUMENT REFERENCE	FORMAT OF RECORD	INSPECTED BY SIGN. & DATE	CLEARED BY SIGN. & DATE	REMARKS

Note: Any protocol made is to be numbered & mentioned in "Format of Record" column.

		SYSTEM	SUB-SYSTEM	AREA	FQP. NO.: QPE-MTE-660-CL-03
PROJECT					REV. NO. : 2
UNIT NO.					LOG SHEET NO. L-00
RATING					SHEET 1 / 1 SHEETS

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PSER	INSTRUMENT REG. NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

NOT USED

			NAME	SIG. / DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			LOGSHEET NO. L-01
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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PSER	INSTRUMENT REG. NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

FOUNDATION DISPOSITION

TOP OF PEDESTALS

Elevation of top pedestal as per drawing …… mm.

All dimensions are in mm.

Column No.	Top Elevation measurement	Deviation from drawing value	Column No.	Top Elevation measurement	Deviation from drawing value

			NAME	SIG. / DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			LOGSHEET NO. L-02
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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PSER	INSTRUMENT REG. NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

DISPOSITION OF FOUNDATION

COLUMN PEDESTALS SPACING

All dimensions are in mm.

Column No.		Spacing		Column No.		Spacing	
From	To	Drawing	Actual	From	To	Drawing	Actual

			NAME	SIG. / DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			LOGSHEET NO. L-03
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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PSER	INSTRUMENT REG. NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

DISPOSITION OF FOUNDATION

DIAGONAL BETWEEN COLUMN PEDESTALS

All dimensions are in mm.

Column No.		Diagonal D1	Column No.		Diagonal D2	Difference between D1 & D2
From	To		From	To		

			NAME	SIG. / DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		ACCEPTED BY			LOGSHEET NO. L-04
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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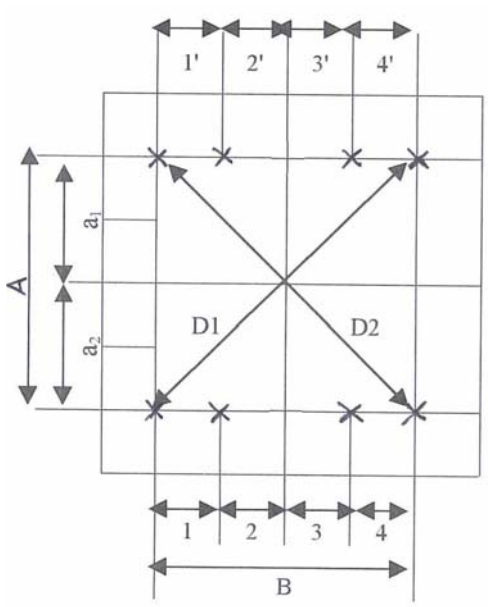
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PSER	INSTRUMENT REG. NO.				
	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

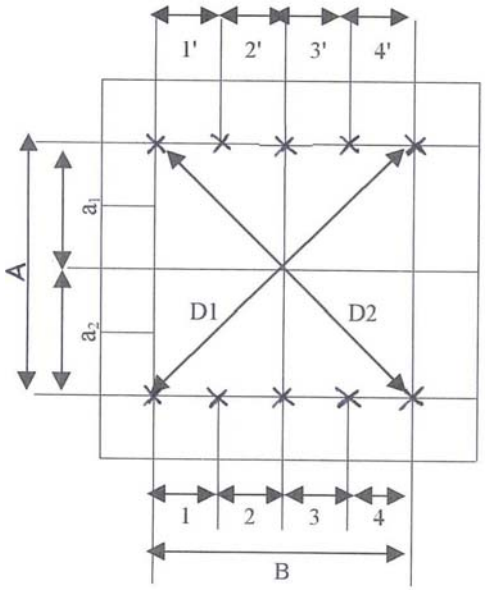
PITCH DISTANCE OF FOUNDATION BOLTS & DIAGONALS

N

TYPE -I



TYPE -II



TYPE - I

Column No.	A	B	a_1	a_2	1	2	3	4	1'	2'	3'	4'	D1	D2
As per drawing														

TYPE - II

Column No.	A	B	a_1	a_2	1	2	3	4	1'	2'	3'	4'	D1	D2
As per drawing														

			NAME	SIG. / DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		ACCEPTED BY			LOGSHEET NO. L-05
RATING		CUSTOMER			SHEET 1 / 4 SHEETS

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Date: 24-Jan-2018

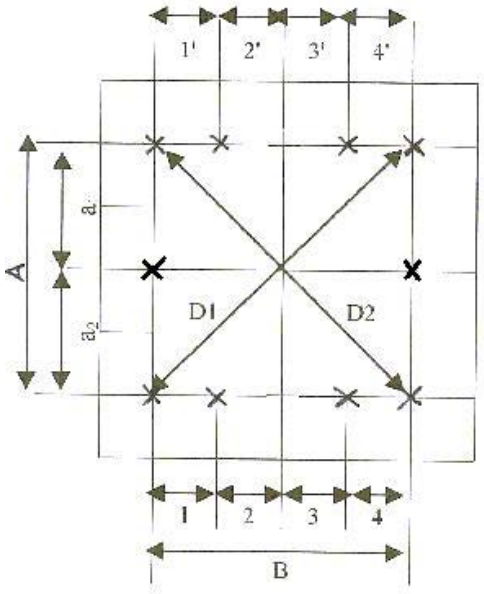
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	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

PITCH DISTANCE OF FOUNDATION BOLTS & DIAGONALS

N

TYPE - III



Column No.	A	B	a_1	a_2	1	2	3	4	1'	2'	3'	4'	D1	D2
As per drawing														

			NAME	SIG. / DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			LOGSHEET NO. L-05
RATING		CUSTOMER			SHEET 2 / 4 SHEETS

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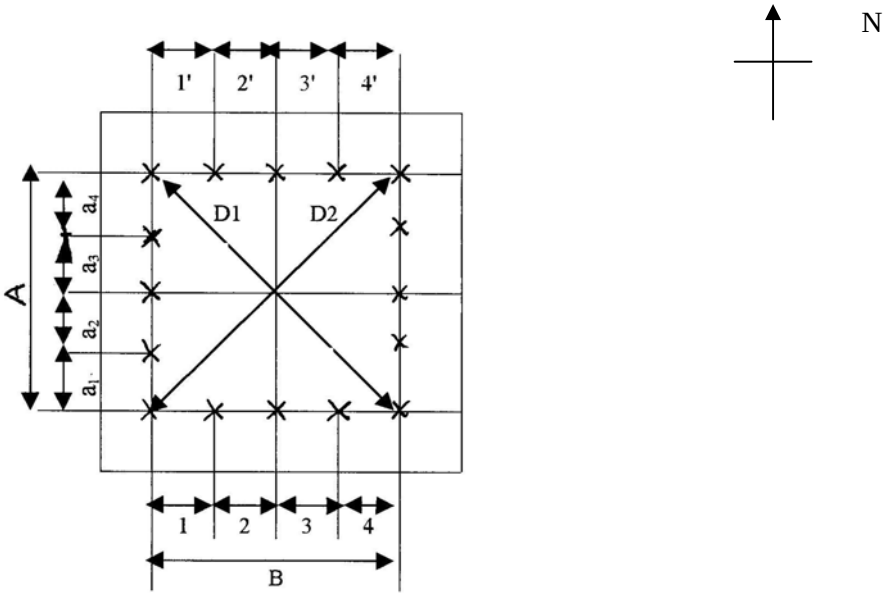
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	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

PITCH DISTANCE OF FOUNDATION BOLTS & DIAGONALS

Type IV



Type - IV

Column No.	A	B	a_1	a_2	a_3	a_4	1	2	3	4	1'	2'	3'	4'	D1	D2
As per drawing																

			NAME	SIG. / DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			LOGSHEET NO. L-05
RATING		CUSTOMER			SHEET 3 / 4 SHEETS

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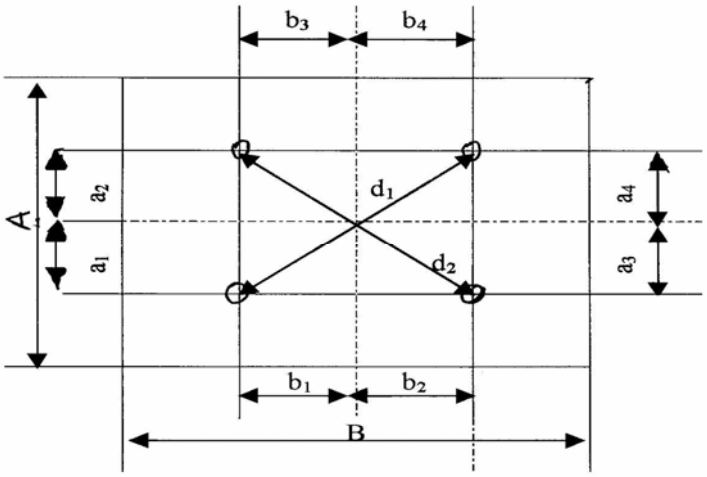
Date: 24-Jan-2018

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	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

PITCH DISTANCE OF FOUNDATION BOLTS & DIAGONALS

Type - V



Type-V

Column No.	A	B	a_1	a_2	a_3	a_4	b_1	b_2	b_3	b_4	d_1	d_2

			NAME	SIG. / DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			LOGSHEET NO. L-05
RATING		CUSTOMER			SHEET 4 / 4 SHEETS

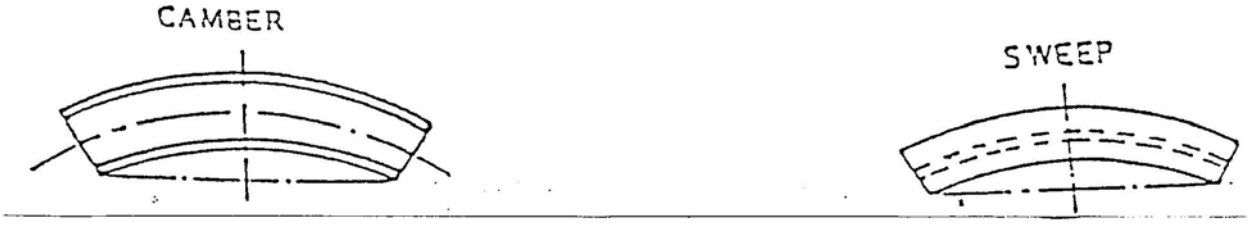
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	DATE OF INSPECTION				
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CAMBER, SWEEP AND LENGTH OF COLUMN PIECES



INDIVIDUAL PIECE TOLERANCE : 1mm / M Max. 10 mm

Column No.	Camber			Sweep			Length
Piece No.	T	M	B	T	M	B	

T – Top of the Piece M – Middle of the Piece B – Bottom of the Piece

			NAME	SIG./DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			LOG SHEET NO. L-06
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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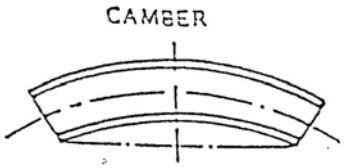
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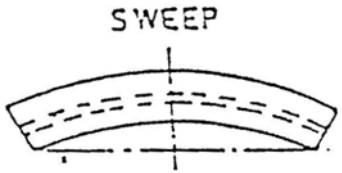
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	DATE OF INSPECTION							
PSER	DRAWING / DOCUMENT REF.							

TRIAL ASSEMBLY OF COLUMN PIECES

COLUMN NO. :

	Assembled Piece Tolerance 1 mm / M Max. 15 mm	Elevation Level From Bottom									

	Assembled Piece Tolerance 1 mm / M Max. 15 mm	Elevation Level From Bottom									

Note : Measure at every 5 Meter level. (Fix Piano wire to full length of column) Measure the reading and only deviation in "+" or "_" Values

	J1	J2	J3	J4	J5	J6
Match mark						

TOTAL LENGTH : As Per Drg. MEASURED : DIFFERENCE : TOLERANCE : ± 15 mm

			NAME	SIGNATURE / DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			LOG SHEET NO. L-07
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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Date: 24-Jan-2018

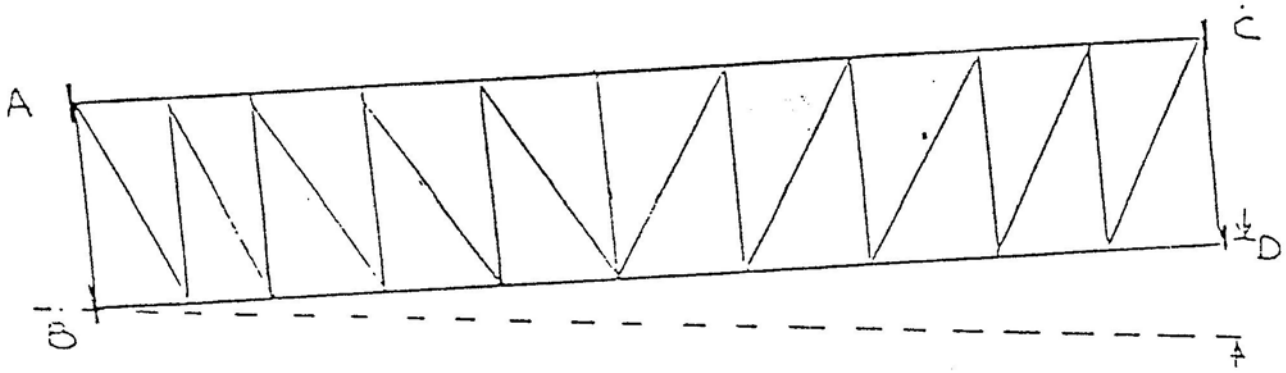
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PSER	INSTRUMENT REG. NO./TAG NO.				
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ROOF TRUSS PRE – ASSEMBLY

A & C – End plate at top angle side.

B & D – End plate at bottom angle side.



SLOPE at " D "

Slope actual	
As Per Drawing	

CAMBER AND SWEEP

LOCATION						
CHAMBER						
SWEEP						

Match Mark : Indicate OK if it is correct and if any deviation inform through SAR.

Location			
Match Mark			

TOTAL LENGTH

As Per Drawing	Measured	Difference	Tolerance
			± 5 mm

			NAME	SIG./DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			LOG SHEET NO. L-08
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

GROUTING OF COLUMN BASE

Column No.	Grouting Gap (in mm)	No. of Cubes taken	3 day strength of cube	7 day strength of cube

			NAME	SIG./DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			LOG SHEET NO. L-09
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

COLUMN VERTICALITY MEASUREMENT

(Note :To be checked with theodolite and cross checked with plumb bob.)

(All Measurements in mm)

Column No.	Inclined to wards				Column No.	Inclined towards			
Location	Left	Right	Front	Rear	Location	Left	Right	Front	Rear

(Tolerance 1 mm / Meter Max. 25 mm)

			NAME	SIG./DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			LOG SHEET NO. L-10
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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	DATE OF INSPECTION				
	DRAWING / DOCUMENT REF.				

CRANE GIRDER

Crane girder bracket top level				Crane girder top flange level			
Column No.	Level	Column No.	Level	Column No.	Level	Column No.	Level

Tolerance Max. 5 mm

All Dimension in mm.

			NAME	SIG./DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		ACCEPTED BY			LOG SHEET NO. L-11
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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	DATE OF INSPECTION				
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CRANE GIRDER CENTER TO CENTER SPACING

All dimensions in mm.

Location	Measured Length	Deviation

Location	Measured Length	Deviation

			NAME	SIG./DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			LOG SHEET NO. L-12
RATING		CUSTOMER			SHEET 1 / 1 SHEETS

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	DATE OF INSPECTION		
	DRAWING / DOCUMENT REF.		

PROTOCOL

			NAME	SIGNATURE & DATE	FQP. NO.: QPE-MTE-660-CL-03
PROJECT		INSPECTED BY			REV. NO. : 2
UNIT NO.		CLEARED BY			PROTOCOL NO.
RATING		CUSTOMER			PAGE:

भारत हेवी इलेक्ट्रिकल्स लिमिटेड

(भारत सरकार का उपक्रम)

BHARAT HEAVY ELECTRICALS LIMITED

(A Govt. of India Undertaking)

HEALTH, SAFETY AND ENVIRONMENT PLAN FOR SUB-CONTRACTORS FOR 2X660MW MAITREE SUPER THERMAL POWER PROJECT

DOCUMENT NO; HSEP:14-MAITREE: VENDOR DATE:05.05.16

Pradip Ghosh

Digitally signed by Pradip Ghosh
DN: cn=Pradip Ghosh, o=BHEL, ou=HSE-PSER, email=pradipg@bhelpser.co.in, c=IN
Date: 2017.05.06 13:31:44 +05'30'

HSE DEPARTMENT
Plot No. 9/1, Block-DJ,Sector-II, Salt Lake, Kolkata – 700 091
Phone no. 033-23398049, Web : www.jantermanter.com

SPECIAL NOTES

- **This document supersedes section-IX of SCC or any such HSE related document in the tender**

- This document is a living document and subject to changes as many times as desired by BHEL and customer, BIFCL and project consultant Fichtner GmbH. Any cost implication shall be absorbed by the contractor.
- This project is a highly eco-sensitive project. There will be regular assessment of impact of the site activities on ecology. The contractors shall be obligated to take corrective actions, if any, as advised by BHEL/ Customer/ any Statutory body.
- The contractor shall ensure that only persons with required competence and sound health are engaged at the site. No deviation shall be allowed. The person and the contractor shall be in possession of relevant documents in support of competence and health condition for producing before BHEL for verification, whenever demanded.
- It may take minimum 2 days for finishing health check-up and induction training before a gate-pass/ ID is issued. In a day, maximum 30 persons can be given induction training. Mobilization shall be planned accordingly
- Method statement and Job Safety Analysis shall be carried out for all hazardous jobs and critical lifts
- As the site is located in an area which is prone to adverse weather condition, the contractors shall have infrastructure for fast evacuation of people
- Contractor for Boiler-1, Chimney-1 and Cooling Tower-1 shall provide one double-mounted siren at a height covering a dia of about 2KM for alerting site workers in case of emergency.
- The following basic instruments shall be available with contractors HSE team if their job involves:
  - Height work: Binoculars
  - Confined space work: Oxy-meter
  - Night work: Lux meter, Torch light
  - Checking of ELCBs: ELCB tester
  - Checking of earthing: Megger

  Apart from these, DB meter, Alcohol Breath analyzer, and other HSE promotional items shall be made available by the contractors as and when demanded by BHEL.

- Well-equipped sick room shall be set up and ambulance shall be made available by specific contractors as provided for in the work order of certain packages. However, the operational expenses can be shared by those contractors who will avail services of these facilities.

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1.0 PURPOSE

1.1 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.

1.2 This document shall be followed by BHEL's subcontractors at all installation and servicing sites. In case customer specific documents are to be implemented, this document will be followed in conjunction with customer specific documents.

1.3 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 or EHSS contract requirements must be followed of which the most stringent shall apply

1.4 In case the customer has any specific requirement, the same is to be fulfilled.

1.5 We will promote and maintain a safe, healthy and environmentally compliant workplace for all employees, contractors, visitors and any others that may be affected by construction activities, and strive for a "GOAL of ZERO REPORTABLE INCIDENTS" on the project.

2.0 SCOPE

The document is applicable for installation and commissioning of 2x660MW SETS as per the relevant contractual obligations, and provides the minimum HSE requirements to be followed at the project site and labour colony. As an item of note, this HSE Plan is considered a living document and will be revised as/if necessary to ensure that contractual and regulatory compliance requirements are met during the performance of work on the project

3.0 OBJECTIVES

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

- Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
- Ensure protection of environment of the work site.
- Comply at all times with the relevant statutory and contractual HSE requirements.
- Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.
- Provide all personnel with adequate information, instruction, training and supervision.
- 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.
- Ensure that all work planning takes into account all persons that may be affected by the work.
- Ensure fitness testing of all T&Ps/Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent authority.
- Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
- Ensure continual improvements in HSE performance
- Ensure conservation of resources and reduction of wastage.

- 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 and preventive action.

3.1 Goals and Targets -

- To achieve “Zero Fatal Incident at Site”
- 100% compliance of all legal/statutory requirements related to EHS.
- 100% Health, Safety and Environmental Induction training attendance for all employees and sub-contractors.
- 100% High Risk activities to be carried out only after approved Method Satement, HIRA/JSA and Permit to Work are implemented.
- 100% PPEs compliance in high & medium risk activities.
- 100% incident reporting, recording and reviewing for corrective & preventive actions.
- A monthly review shall be scheduled and conducted to assess HSE program compliance and to close any recognized gaps to improve safety management and incident prevention.

4.0 BHEL POWER SECTORHEALTH, SAFETY & ENVIRONMENT POLICY

Power Sector HSE Policy

We, at BHEL Power Sector, reaffirm our belief that the Health and Safety of our stakeholders and conservation of Environment is of utmost importance and takes precedence in all our business decisions. In pursuit of this belief and commitment, we strive to:

- ✓ **Ensure total compliance with applicable legislation, regulations and other requirements concerning Occupational Health, Safety and Environment.**
- ✓ **Ensure continual improvement in the Occupational Health, Safety and Environment Management System performance.**
- ✓ **Enhance Occupational Health, Safety and Environment awareness amongst employees, customers and suppliers by proactive communication and training.**
- ✓ **Review periodically and improve Occupational Health, Safety and Environment Management System to ensure its continuing suitability, adequacy and effectiveness in a continuously changing business environment.**
- ✓ **Develop a culture of safety through active leadership and provide appropriate training at all levels to enable employees to fulfill their Health, Safety and Environmental obligations.**
- ✓ **Incorporate appropriate Occupational Health, Safety and Environmental criteria into business decisions for selection of plant, technology and services as well as appointment of key personnel.**
- ✓ **Ensure availability at all times of appropriate resources to fully implement the Occupational Health, Safety and Environmental policy of the company.**

This policy will be communicated to all employees and made available to interested parties.

Sd/-

Director (Power)

5.0 TERMS AND DEFINITIONS

5.1 DEFINITIONS

5.1.1 INCIDENT

Work- related event(s) in which an injury or ill health (regardless of severity) or fatality occurred, or could have occurred.

5.1.2 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".

5.1.3 MAN-HOUR 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 labours. 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.

5.1.4 FIRST AID CASES

First Aid includes:

- Visit to a physician or a licensed health care professional solely for observation or counselling
- 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)
- 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};
- Administering tetanus immunizations (other immunizations, such as Hepatitis B vaccine or rabies vaccine, are considered medical treatment);
- Cleaning, flushing or soaking wounds on the surface of the skin;
- Using wound coverings such as bandages, Band-Aids TM, gauze pads, etc.;or using butterfly bandages or Steri-StripsTM (other wound closing devices such as sutures, staples, etc., are considered medical treatment);
- Using hot or cold therapy;
- 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);
- Using temporary immobilization devices while transporting an accident victim (e.g., splints, slings, neck collars, back boards, etc.).
- Drilling of a fingernail or toenail to relieve pressure, or draining fluid from a blister;
- Using eye patches;
- Removing foreign bodies from the eye using only irrigation or a cotton swab;
- Removing splinters or foreign material from areas other than the eye by irrigation, tweezers, cotton swabs or other simple means;
- Using finger guards;

- Using massages (physical therapy or chiropractic treatment are considered medical treatment for recordkeeping purposes); or
- Drinking fluids for relief of heat stress.

No other treatments are considered first aid.

5.1.5 **INJURY OTHER THAN FIRST-AID: (As per Chapter VII, Rule 69 of Bangladesh Labour Rules, 2015)**

Notice to be given of any accident. When any accident occurs in an establishment causing loss of life or bodily injury, or an accidental explosion, ignition, outbreak of fire or irruption of water or fumes occurs, the employer shall give notice of the occurrence to the Inspector within following 3 (three) working days [:]
Provided that the factory authority shall, immediately after the occurrence of such incident, inform the matter to the Government, Fire Service, Directorate of Inspection of Factories and Establishments, Police Station, and if required, the nearby hospital or government-private medical service establishment, through telephone, mobile phone, SMS or fax, in order to take immediate necessary action to minimize potential damages or bring the situation under control.]

Fatal incident and Serious Incident:
If the victim dies in the incident, it will be treated as a fatal incident.
In this case the injured person is likely to be disable for more than 20 days to perform his duty, it will be treated as Serious Incident. In these cases, the intimation will be made as described above.

Minor Incident: (As per Chapter VII , Rule 70 of Bangladesh Labour Rules, 2015)
Where an accident mentioned above causes bodily injury resulting the compulsory absence from work of the person injured for a period exceeding 48 (forty-eight) hours, but not exceeding 20days. The management will inform the concerned statutory authority within 7 days in form-27 under rule 69/1/(A), (B) and (C) of Bangladesh Labour Rules, 2015.

6.0 HSE ORGANISATION

Number of HSE officers:

The subcontractor must deploy one HSE officer for every 500 workers or part thereof in each package. If there are more than one HSE officer, one shall be designated as head/HSE. No Of HSE stewards shall be one for every 100 workers deployed

Deployment: The subcontractor should deploy sufficient HSE officers and HSE-steward/supervisor, as per requirement given above, since initial stage and add more in proportion to the added strength in work force. Any delay in deployment of HSE Officer will attract a penalty of BNR.40,000/- per man month for the delayed period.

6.1 QUALIFICATION FOR HSE PERSONNEL

Sl.no	Designation	Minimum Qualification	Experience
1	Safety officer (Construction Agency)	Degree or Diploma in Engineering with diploma in Industrial Safety with construction safety as one of the subjects. If Degree/Diploma in safety is from India, it must be recognized by AICTE/SCTE&VT. NEBOSH IGC /IOSH diploma also acceptable	Minimum two years for degree holder and five years for diploma holder in the field of Construction of power plant/ major industries

6.2 RESPONSIBILITIES

6.2.1 **SITE IN -CHARGE OF SUBCONTRACTOR**

- Shall engage qualified safety officer(s) as per clause 6.1
- Shall adhere to the rules and regulations mentioned in this code, practice very strictly in his area of work in consultation with his concerned engineer and the safety coordinator.
- Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
- Shall not engage any employee below 18 years.
- 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.
- Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent authorities.
- Shall ensure that provisions stipulated in contract Labour Regulation Act 1970, Chapter V C.9, canteen, rest rooms/washing facilities to contracted employees at site.
- Shall adhere to the instructions laid down in Operation Control Procedures (OCPs) available with the site management.
- Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
- Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /HSE officer of BHEL.
- Shall ensure that Horseplay is strictly forbidden.
- Shall ensure that adequate illumination is arranged during night work.
- Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
- Shall ensure display of adequate signage/posters on HSE.
- Shall ensure that mobile phone is not used by workers while working.
- Shall ensure conductance of HSE audit, mock drill, medical camps, induction training and training on HSE at site.
- Shall ensure full co-operation during HQ/External /Customer HSE audits.
- Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- Shall ensure good housekeeping.
- Shall ensure adequate valid fire extinguishers are provided at the work site.
- Shall ensure availability of sufficient number of toilets /restrooms and adequate drinking water at work site and labour colony.
- Shall ensure adequate emergency preparedness.
- Shall be member of site HSE committee and attend all meetings of the committee

6.2.2 **HEALTH, SAFETY AND ENVIRONMENT OFFICER OF SUBCONTRACTOR**

- Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
- Facilitate inclusion of safety elements into Work Method Statement.
- Highlight the requirements of safety through Tool-box / other meetings.
- Help concerned HOS to prepare Job Specific instructions for critical jobs.
- Conduct investigation of all incident/dangerous occurrences & recommend appropriate safety measures.
- Advice & co-ordinate for implementation of HSE permit systems, OCPs & MPs.
- Convene HSE meeting & minute the proceeding for circulation & follow-up action.
- Plan procurement of PPE & Safety devices and inspect their healthiness.
- Report to PS Region/HQ on all matters pertaining to status of safety and promotional program at site level.
- Facilitate administration of First Aid
- Facilitate screening of workmen and safety induction.
- Conduct fire Drill and facilitate emergency preparedness
- Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
- Apprise PS– Region on safety related problems.
- Notify site personnel non-conformance to safety norms observed during site visits / site inspections.
- 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.
- To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.
- Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
- Shall work as interface between various agencies such customer, package-in-charges, subcontractors on HSE matters

7.0 PLANNING BY SUBCONTRACTOR

7.1 MOBILISATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR

- As a 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 complies with legislative and owner requirement. A documented daily prior to use inspection checklist shall be completed by the end user and periodic inspection shall be arranged by in-house competent authority for acceptance as applicable. All Tools & Plants shall be certified by a third party COMPETENT person before these are put to use as per Rule 60, 75 and schedule 3 of Bangladesh Labor Rules. As far as possible, this certification shall be made available to site HSE function by the contractor before entry into the site. The certification shall be renewed annually, otherwise, the item shall be withdrawn from the work area. The fitness of T&Ps shall be monitored by site HSE quarterly and alert/ reminder issued to the concerned agency and BHEL package in-charge.

- The machinery and equipment to be embraced for this purpose shall include but not limited to the following:

    - Mobile cranes.

- Side Booms.
- Grinding machine.
- Drilling machine.
- Air compressors.
- Welding machine.
- Generator sets.
- Dump Trucks.
- Excavators.
- Dozers
- Grit Blasting Equipment.
- Hand and power tools.

- Subcontractor 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 subcontractor 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.

7.2 MOBILISATION OF MANPOWER BY SUBCONTRACTOR

- 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-contractors to fulfill contractual as well as legislative requirement.
- Examination of medical fitness shall be conducted through qualified medical professional for all workers to be deployed (pre-employment). Post-employment medical check-up shall be done for persons engaged in hazardous jobs at a regular interval as per legislations.
- 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.
- Appropriate accommodation to be arranged for all workmen in hygienic condition.

7.3 PROVISION OF PPEs

- Personnel Protective Equipment (PPEs), in adequate numbers, will be made available at site & their regular use by all concerned will be ensured. PPE details shall be maintained as per Form-23
- The following matrix recommends usage of minimum PPEs against the respective job.

Sl. No	Type of work	PPEs
1	Concrete and asphalt mixing	Nose mask, hand glove, apron and gum boot
2	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
3	Stone/ concrete breakers	Ear muffs, safety goggles, hand gloves
4	Electrical Work	Rubber hand glove, Electrical Resistance shoes,Apron
5	Insulation Work	Respiratory mask, Hand gloves, safety goggles
6	Work at height	Double lanyard full body harness, Fall arrestor (specific cases)
7	Grit/Sand blasting	Blast suit, blast helmet, respirator, leather gloves

8	Painting	Plastic gloves, Respirators (particularly for spray painting)
9	Radiography	As per BARC guidelines

The PPEs and other related safety equipments shall conform to the relevant indian or equivalent Europeon or American standards as below:

BS EN 397-2012	Industrial Safety Helmets.
BS EN 60903:2003	Insulating material gloves for electrical purposes.
BS EN 374-3: 2003	Protective Gloves- Chemical Penetration
BS EN 388:2003	Protective Gloves- Mechanical Risks
BS EN 407: 2004	Protective Gloves- heat and fire
BS EN 420:2003	Gloves- general requirement
BS EN-20345	Industrial safety footwear
BS EN 166:2002	Eye protectors.
BS EN 352-1 & 2:2002	Ear Muff & Ear Plug
BS EN 175:1997	Eye & Face protection during welding
BS EN 361:2002	Fall Arrest Full Body Harness
BS EN 360:2002	Retractable type fall arresters
BS EN 795:2012	Lifeline System
BS EN 358;1999	Work Resistant Harness
BS EN 813:2008	Seat harness
BS EN 1498+ others	Rescue Harness+ other items of a rescue kit
BS EN 353:2002	Detachable fall arrester
BS EN 149: 2001	Filtering Half masks tp protect against particles
BS EN 471:2003	High Visibility Clothing

The list is not exhaustive. The safety officer may demand additional PPEs based on specific requirement.

- 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
- . The visitors shall also use Reflective Vests, Helmet and any other PPEs as deemed appropriate for the area of work.

Colour scheme for Helmets:

1. Workmen: Yellow
2. Safety staff: Green or white with green band
3. Electrician: Red
4. Others including visitors: White

- All the PPEs shall be checked for its quality before issue and the same shall be periodically checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be repaired/ replaced.
- The issuing agency shall maintain register for issue and receipt of PPEs.
- The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.
- The body harnesses shall be serial numbered.

  In case, contractor fails to provide PPEs in time, BHEL/Customer may provide the same and the cost as deemed appropriate by BHEL/Customer shall be debited

7.4 ARRANGEMENT OF INFRASTRUCTURE

7.4.1 DRINKING WATER

- Adequate drinking water shall be provided and maintained at suitable places at different elevations.
- Chilled water shall be made available from 1st April to 30th Sep of the year
- Container should be labeled as " Drinking Water"
- Cleaning of the storage tank shall be ensured at least once in 1 month indicating date of cleaning and next due date. 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.
- Employees should use their own cup for collecting water-no cup shall be shared
- Potability of water should be tested as per standard at least once in every quarter as per Rule 50(5) of Bangladesh Labour Rules, 2015.
- Apart from above, those who are engaged in work producing significant heat , shall be served saline water or Sarbat at the rate of 2litres perday
- Storage of drinking water shall be min 6M away from any toilet and washroom

7.4.2 WASHING FACILITIES (As per Chapter VIII, Rule 86 of Bangladesh Labour Rules, 2015)

- In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
- 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.
- 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.
- If water used for washing is not potable, it shall be marked "Do Not Drink" in English and Bangla

7.4.3 LATRINES AND URINALS (As per Chapter V, Rule 51, Schedule II of Bangladesh Labour Rules, 2015)

- Latrines and urinals shall be provided in every work place based on strength of workmen at the rate of one toilet seat and one urinal for every 50 female workmen and that for every 60 male workmen
- Urinals shall also be provided at different elevations.
- They shall be adequately illuminated and shall be maintained in a clean and hygienic condition at all times, by appointing designated person.
- Separate facilities shall be provided for the use of male and female worker if any.
- Hand-wash facility shall be provided

7.4.4 **PROVISION OF SHELTER DURING REST**

Proper Shed & Shelter shall be provided for rest during break::

7.4.5 **MEDICAL FACILITIES (Sharing with other sub-contractors at site is permitted)**

7.4.5.1 **Sick Room (As per rule 77) (As stipulated in the contract)**

- A Sick room shall be ensured/identified at site with basic facilities as per subrule 77(5) for handling medical emergencies. The sick room can be run independently or jointly developed on proportionate sharing basis with permission from BHEL. It shall be equipped with one rigid stretcher, one foldable stretcher, one rescue basket stretcher, a wheel chair, at least 2 beds with separator and all basic facilities that a doctor needs for basic health check-up and quick referral including those listed in sub-rule 77(5) of Bangladesh Labour Rules,2015
- A qualified medical professional, not less than a Degree in Medical Science (Allopathy) as recognized in Bangladesh , shall be deployed at the sick room along with sufficient support staff
- Medical waste shall be disposed as per prevailing legislation
- Ambulance, **as stipulated in the contract**, shall be made available at the site along with a trained driver and shall be equipped with at least an Oxygen cylinder along with dispensation system, first-aid box, a portable ABC type fire extinguisher.

7.4.5.2 **FIRST AIDER**

- Must have a competence certificate in First-aid issued by Bangladesh Red Cross Society/ Bangladesh St Johns Ambulance/ any other agency which is recognised by the Govt of Bangladesh
- Ensure availability of one Qualified First-aider throughout the working hours for every 150 workmen engaged as per clause 89 of Bangladesh Labour Law
- Every injury shall be treated, recorded and reported.
- Refresher course on first aid shall be conducted as necessary.
- List of Qualified first aiders and their contact numbers should be displayed at conspicuous places.

7.4.5.3 **FIRST AID BOX (as per rule 76(2) of Bangladesh Labour Rules.2015))**

- The subcontractor shall provide necessary first aid facilities. At every work place first aid facilities shall be provided and maintained.

- The first aid box shall be kept by first aider who shall always be readily available during the working hours of the work place. His name and contact no to be displayed on the box.
- 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 first aid box shall be distinctly marked with a Green Cross on white background.

- Details of contents of first aid box is given in Annexure No. 01
- Monthly inspection of First Aid Box shall be carried out by the owner as per format no. HSEP:14-F01
- The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

7.4.5.4 **HEALTH CHECK UP**

The persons engaged at the site shall undergo mandatory health checkup from a qualified doctor as per the **format no. HSEP:13-F03 and Health Record 31-A** before induction. The persons engaged in the following works shall undergo health checkup at least once in a year:

a. Height workers
b. Drivers/crane operators/riggers
c. Confined space workers
d. Shot/sand blaster
e. Welding and Gas cutting personnel

7.4.6 **PROVISION OF CANTEEN FACILITY**

- Canteen facilities shall be provided for the workmen of the project inside the project site.
- Proper cleaning and hygienic condition shall be maintained.
- Proper care should be taken to prevent biological contamination.
- Adequate drinking water should be available at canteen.
- Fire extinguisher shall be provided inside canteen.
- Regular health check-up and medication to the canteen workers shall be ensured.

7.4.7 **PROVISION OF ACCOMODATION/LABOUR COLONY**

- The subcontractor shall arrange for the accommodation of workmen at nearby houses or by making a labour colony.
- Regular housekeeping of the labour colony shall be ensured.
- Proper sanitation and hygienic conditions shall be maintained and inspected once in a month.
- Adequate number of toilet facilities with water for workers as per norms to be provided. There must be separate toilet for women workers. Drinking water and electricity to be provided at the labour colony.
- Potable water shall be tested once in six months as per IS10500.
- MSDS of LPG shall be put up prominently. This shall be included in the induction training as well.
- The labour colony shall be appropriately secure so that only authorized persons have access to it.
- First aid facility shall be provided in the labour camp under the administration of trained first aiders.
- Common kitchen facilities to be ensured and cooking inside the room to be avoided. The canteen should be maintained in hygienic condition.
- No. of occupants in room rooms to be as per the standards practice.
- Awareness training shall be organized for the workers regarding fire safety, safe use of LPG, Health & Hygiene, and electrical safety etc. on monthly basis.
- Adequate drainage and approach roads to be done.
- Perimeter fencing, security and main gate entrance shall be established and maintained.
- Monthly inspection to be done to ensure the compliance and for opportunity of improvement.
- Workers shall not be transported in open vehicles i.e. trailers, truck beds etc within project boundaries which includes the labor colony.

7.4.8 **PROVISION OF EMERGENCY VEHICLE (in addition to Ambulance)**

Generally one vehicle (4 wheeler) is identified by each major package holder (sub-agency). Minor package holders are permitted to have a tie-up with major package holder

7.4.9 **PEST CONTROL**

Regular pest control should be carried out at all offices, mainly laboratories, canteen, labour colony and stores

7.4.10 GENERAL DISCIPLINE:

Workmen under influence of liquor or drug or any other intoxication shall not be permitted to work and sent out of the work area. Workmen shall not be permitted to smoke in work area. None shall be permitted to carry any arms or firearms. The workmen shall report to work on time and follow supervisor's instruction. Use of cell phone particularly in hazardous jobs shall be discouraged like height work, crane operation etc. Horseplay, willful violation of rules shall be dealt with suitable disciplinary action including suspension and termination. They shall be subjected to physical frisking or alcohol/drug test at random by security and security shall be authorized to take appropriate disciplinary action against any delinquent employee like throwing out of the gate for the day and so on. If any such employee returns to work, he shall be put through induction training once again.

7.4.11 **SCRAPYARD**

- In consultation with customer, scrap yard shall be developed to store metal scrap, wooden scrap, waste, hazardous waste.
- Scrap/Waste shall be segregated as Bio-degradable and non-bio-degradable and stored separately.

7.4.12 **ILLUMINATION (to be reviewed)**

- Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II) or as per Bangladesh standard. Some recommended values are given below:

S. No.	Location	Illumination (Lux)
A.	**Construction Area**	
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 rough measurements etc.	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

- Lamp (hand held) shall not be powered by mains supply but either by 24V or dry cells.
- Lamps shall be protected by suitable guards where necessary to prevent danger, in case of breakage of lamp.
- Emergency lighting provision for night work shall be made to minimise danger in case of main supply failure.

If the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions issued by the authorized BHEL official, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor

8.0 HSE TRAINING& AWARENESS (Trainer, venue and infrastructure shall be decided by site HSE team headed by BHEL site HSE head). Cost shall be borne by respective contractor alone or on sharing basis on case-to-case basis.

8.1 HSE INDUCTION TRAINING

All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL /subcontractor before being assigned to work.
In-house induction training subjects shall include but not limited to:

- Briefing of the Project details.
- Safety objectives and targets.
- Site HSE rules.
- Site HSE hazards and aspects.
- First aid facility.
- Emergency Contact No.
- Incident reporting.
- Fire prevention and emergency response.
- Rules to be followed in the labour colony (if applicable)
- 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.)
- They must arrive fully dressed in safety wear & gear to attend the induction.
- Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.
- On completing attending 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.

8.2 HSE TOOLBOX TALK

- HSE tool Box talk shall be conducted by frontline foreman/supervisor of subcontractor to specific work groups prior to the start of work. The agenda shall consist of the followings:
    - Details of the job being intended for immediate execution.
    - The relevant hazards and risks involved in executing the job and their control and mitigating measures.
    - Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
    - Recent non-compliances observed.
    - Appreciation of good work done by any person.
    - Any doubt clearing session at the end.
- Record of Tool box talk shall be maintained as per format no. HSEP:14-F04

- Tool box talk to be conducted at least once a week for the specific work.

8.2.1 **PRE JOB BRIEFING**

- A separate documented daily pre job briefing must be conducted at the actual job/work site location with the supervisor and work crew, to cover working environment/conditions, safe work practices for the activities to be carried out, required PPE and review of the work package, JSA and permit requirements. Each crew member and the supervisor will sign-off on the pre job briefing form, and form will be submitted to the HSE department at the end of each shift

8.3 **TRAINING ON HEIGHT WORK**

Training on height work (3m and above from ground) shall be imparted to all workers working at height by in-house/external faculty at least twice in a year. Fall protection training must involve as much hands-on activity with the equipment as possible. The training shall include following topics:

- Fall hazards associated with the elevated work.
- Elements of the fall protection systems utilized
- Requirement for 100% tie-off when working at or above 6' or 2m.
- Body Harnesses of at least a five-point configuration shall be used in all fall arrest systems. The harness Dee-ring shall have a minimum tensile strength of 5,000 pounds (22.2 kN).
- Fall protection equipment used. Use of PPEs – Harness proper fit, storage and compulsory tie-off of body harness to a firm support/life-line or anchorage point).
- Anchorage selection used for attachment of personal fall arrest systems shall be capable of supporting at least 5,000 pounds (22.2 kN) per employee attached, determined by a competent person.
- Use of fall arrester (shock abosbing lanyard), retractable fall arrester, life line, safety nets etc.
- Safe climbing through monkey ladders.
- Maintenance and Inspection of PPEs.(Daily/periodical)-color coding
- Medical fitness requirements.
- Mock drill on rescue at height.
- Dos & Don'ts during height work.For the workers & staff passed through the vertigo test, an additional sticker for height pass to be issued. This is applicable for those who are supposed to work or inspecting in BTG area, etc.

8.4 **HSE TRAINING DURING PROJECT EXECUTION**

- Other HSE training shall be arranged by BHEL/sub-contractor as per the need of the project execution and recommendation of HSE committee of site.
- The topics of the HSE training shall be as follows but not limited to:

  - Hazards identification and risk analysis (HIRA)
  - Work Permit System
  - Incident investigation and reporting
  - Fire fighting
  - First aid
  - T & Ps fitness and operation
  - Electrical safety
  - Welding, NDE & Radiological safety
  - Storage, preservation & material handling.

- A matrix shall be maintained to keep an up-to-date record of attendance of training sessions carried out.
- Skill labour (like fitter, electrician, rigger, scaffolder, carpenter etc.) will pass through the trade test (written and practical) conducted at site by the respective engineer & EHS officer. A pass sticker of qualified person to be marked on their ID Card/Gate Pass.

8.4.1 HSE Induction for Visitors: No visitors are allowed to visit the construction site without safety induction, mandatory PPEs, and designated escort.

8.4.2 Safety Induction for all (Staff/engineers/sub-Contractors officials/supervisors): It is compulsory to provide safety induction and briefing about the site HSE management systems, requirements and individual's roles & responsibility to carry out the activities is safe manner, before deploying them.

8.5 HSE PROMOTION-SIGNAGE, POSTERS, COMPETITION, AWARDS ETC

8.5.1 **Display of HSE posters and banners**

- Site shall arrange appropriate posters, banners, slogans in local/Hindi/English languages at work place

8.5.2 **Display of HSE signage as per Safety signages will be as per BS 5378 *safety signs & Colors* and BS 5499 graphical symbols & signs)**

- Appropriate HSE signage shall be displayed at the work area to aware workmen and passersby about the work going on and do's and don'ts to be followed

8.5.3 **Competition on HSE and award**

- Site will arrange different competition (slogan, poster, essay etc.) on HSE time to time (Safety day, BHEL day, World Environment Day etc.) and winners will be suitably awarded. Monthly Safety Day shall be celebrated every month preferably on a fixed date or day at the site jointly by all the contractors as a promotional measure on cost sharing basis

9.0 HSE COMMUNICATION

9.1 INCIDENT INVESTIGATION, REPORTING AND RECORDS:

Every incident including near-misses or injury of any kind and at any level of severity shall be immediately reported by the contractor's workmen in their work area to the safety officer/ HSE coordinator, site engineer or RCM. The site HSE co-ordinator shall be the nodal person for this purpose.

For any reportable injury to any employee or to the contractor's workmen, the safety officer/ HSE-coordinator shall report the incident in incident/ incident report, to CUSTOMER

In the case of serious injury requiring hospitalization or fatality, communication shall be made to customer through telecom immediately with submission of incident report within 24 hrs and detail investigation report may be forwarded in INCIDENT INVESTIGATION REPORT FORMAT within seven days.

Investigations into all reportable incidents shall be conducted using accepted Root Cause Analysis (RCA) methodology cause and effect, 5 why's, etc, to determine the Physical, Human and Latent Root Causes for these type accident/incidents. However, it is recommended to conduct preliminary investigations into all other incidents as a proactive measure.

Every contractor shall maintain record of incidents / incidents at site, and shall be available for inspection by representatives of statutory agencies / officials visiting site from BHEL/customer The Safety Officer/ HSE coordinator shall maintain these records.

26.1 Incident Investigation Procedure:

The purpose of the investigation procedure is to find out root cause of accidents / incidents & not to find out faults, so as to avoid recurrences, in future and share lessons learned.

RCM shall constitute a committee of at-least 2 site engineers within 24 hours of such incidents. The investigation shall aim at finding out the basic unsafe acts / conditions that have caused the incidents. Immediately after all appropriate emergency measures, first aid and damage containment measures have been taken, every effort shall be made by the committee to:

- Preserve physical evidence
- Take photographs
- Take statement from incident victim(s) and eyewitnesses and anyone who may have knowledge of possible cause(s) of incidents

The committee shall also recommend corrective measures to prevent recurrence of similar incidents

25.2 Initial Incident Response:

In the event of an accident/incident, the supervisor and employees at the work site must:

- Stop work and make the work area safe (mitigate or remove the exposure to the hazard)
- Provide first aid and activate "Emergency Medical Services" and other emergency services, e.g. fire or police, as required,
- Ensure the injured worker is transported to "Emergency Medical Services" for medical attention if necessary,
- Secure the site to ensure the protection of employees and the public and to aid with the investigation,
- Report the incident immediately to the local Site In-Charge.

26.3 **Incident Investigation Report:**

The investigation committee on completion of the all investigations shall prepare and submit the report to the RCM. The report shall also include corrective measures with assigned responsibility to be taken at site to prevent similar incidents in future. The RCM shall forward the copy of the investigation report to BHEL

9.2 HSE EVENT REPORTING

- Important HSE events like HSE training, Medical camp etc. organized at site shall be reported to BHEL site management in detail with photographs for publication in different in-house magazines
- Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported as mentioned above.

10.0 OPERATIONAL CONTROL

All applicable OCPs (Operational control procedures) will be followed by subcontractor 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 subcontractor will follow this as well, within quoted rate. These OCPs (applicable ones) will be made available to subcontractor 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 subcontractor, if they so desire.

LIST OF OCPs

Safe handling of chemicals	Safety in use of cranes	Hydraulic test
Electrical safety	Storage and handling of gas cylinders	Spray insulation
Energy conservation	Manual arc welding	Trial run of rotary equipment
Safe welding and gas cutting operation	Safe use of helmets	Stress relieving
Fire safety	Good house keeping	Material preservation
Safety in use of hand tools	Working at height	Cable laying/tray work
First aid	Safe excavation	Transformer charging
Food safety at canteen	Safe filling of hydrogen in cylinder	Electrical maintenance
Illumination	Vehicle maintenance	Safe handling of battery system
Handling and erection of heavy metals	Safe radiography	Computer operation
Safe acid cleaning	Waste disposal	Storage in open yard
Safe alkali boil out	Working at night	For sanitary maintenance
Safe oil flushing	Blasting	Batching
Steam blowing	DG set	Piling rig operation
Safe working in confined area	Handling & storage of mineral wool	Gas distribution test
Safe operation of passenger lift, material hoists & cages	Drilling, reaming and grinding(machining)	Cleaning of hot well / de-aerator
Electro-resistance heating	Compressor operation	O&M of control of AC plant & system
Air compressor	Passivation	Safe Loading of Unit
Safe EDTA Cleaning	Safe Chemical cleaning of Pre boiler system	Safe Boiler Light up
Safe Rolling and Synchronization		

10.1 HSE ACTIVITIES

While planning for any activity the following documents shall be referred for infrastructural requirements to establish control measures: Only specific portion of the following documents may be shared as reference at discretion of BHEL.

1) HSE Procedure for Register of OHS Hazards and Risks
2) HSE Procedure for Register of Environmental Aspects and Impacts
3) HSE Procedure for Register of Regulations
4) Operational Control Procedures
5) HSE Procedure for Emergency Preparedness and Response Plan
6) Contract documents

10.2 WORK PERMIT SYSTEM

- The following activities shall come under Work Permit System
- a The following activities shall come under Work Permit System
  a. Height working
  b. Hot work in general and at height including handling of hazardous substance viz, Acetylene, Oxygen and LPG
  c. Confined space

d. Radiography
e. Hazardous Energy Control (lockout/tagout)
f. Excavation and Trenching
g. Heavy lifting exceeding 50Metric Tonne
h. Handling of Hazardous Substances- Diesel, Caustic Soda, Citric Acid/EDTA, Thinner, Battery Acid, Oil-based paint, Lubricants, Transformer oil.
Refer Annexure 05 for Work permit formats.

- Permit applicant shall apply for general work permit and other permits as referenced above of particular work activity at particular location before starting of the work with Method Statement and HIRA/Job Hazard Analysis.
- Permit signatory shall check that all the control measures necessary for the activity are in place and issue the permit to the permit holder.
- Permit holder shall implement and maintain all control measures during the period of permit .He will close the permit after completion of the work. The closed permit shall be archived in HSE Department of site.

10.3 SAFETY DURING WORK EXECUTION

Respective OCPS are to be followed and adherence to the same would be contractually binding

10.3.1 Power supply & upkeep of installation -

- Only persons licensed to Govt of State shall maintain and operate power installations.
- All distribution boxes shall be locked and the key controlled by site management of concerned contractor.
- Electrical appliance shall have proper earthing and for appliances equal to & more than 415V shall have two separate earthing (as per IS-3043-1987)
- All electrical supply shall be provided through ELCB of 30mA sensitivity.
- The working condition and sensitivity of ELCB shall be checked periodically.
- All fuses and fuse wires shall be of standard size and rating.
- All power supplies through cables shall be underground or overhead with height > 3mtrs.

The following guidelines are to be considered the absolute minimum requirements to be supplemented by requirements of all applicable codes and standards for such work; 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.

- 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).

- Must be visually checked before each use and periodically while in use to assure their original integrity is maintained. Cords with cuts, breaks, deep abrasions, etc. shall be taken out of service immediately. Repairs to extension cords shall only be performed by qualified/ licensed electricians.

- Must not be allowed to lie in wet or potentially wet areas.

- 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. 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. Such precautions may include halting the operation if appropriate. 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.

- Any and all underground lines that are discovered or become severed must be considered energized on both sides, and be treated accordingly.
- In general, equipment or machinery being moved or transported must maintain minimum clearances of 25 ft to all power lines.
- 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
- 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.
- 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.
- Splices in electrical cords are not permitted. Reparirs must be made at the socket connection and retain the same mechanical and dielectric condition of the original connection.
- Damaged or defective electric tools, equipment and extension cords, etc must not be used and shall be tagged out of servive, removed from the work area and taken back to stores.
- Only licensed electricians are authorized to repair and work on electrical equipment. Tampering with electric tools or equipment by others could result in termination.
- 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.
- Energized wiring in junction boxes, circuit breaker panels and similar places must be covered and locked at all times.
- Areas with live high voltage wires or terminals must be barricaded against entry and warning signs posted Danger – High Voltage and Authorized Personnel Only.
- Personnel should never work on energized equipment, deenergizing (lockout/tagout) the equipment is always the first requirement.
- The lockout and tagout procedure will be used when testing or working on, or around, energized installation.
- Working around energized equipment should never be done alone. A second electrician must always be available for assistance.
- If lockout/tagout 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/aprins, faceshields, and other protective equipment like insulated tools, blankets, mats, etc. must be used.
- 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.
- 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.

10.3.2 **Qualified and Unqualified Workers (Electrical Works):**

Basic electrical safety knowledge is a major concern. It is critical that only qualified workers be allowed to perform this work. Therefore only those persons that are both qualified and authorized may install, fabricate, repair, test, calibrate or modify electrical or electronic wiring, devices, parts, systems or equipment.

Qualified Person:
One who is trained and wiremen licensed to Govt as per Rule 58(9) of Bangladesh Labor Rules and familiar with the construction, operation and safety hazards of the equipment upon which they are permitted to work.

- 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.
- 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:
    - Qualified persons must be capable of working safely on energized circuits;
    - Must be familiar with the proper use of special precautionary techniques and procdures bases on equipment and exposure; and
    - Must be familiar with required personal protective equipment, insulating and shielding materials, and insulated tools.
- 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.
- 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 no their limitation and stop work if not qualified on what equipment they were to work on.
- 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.

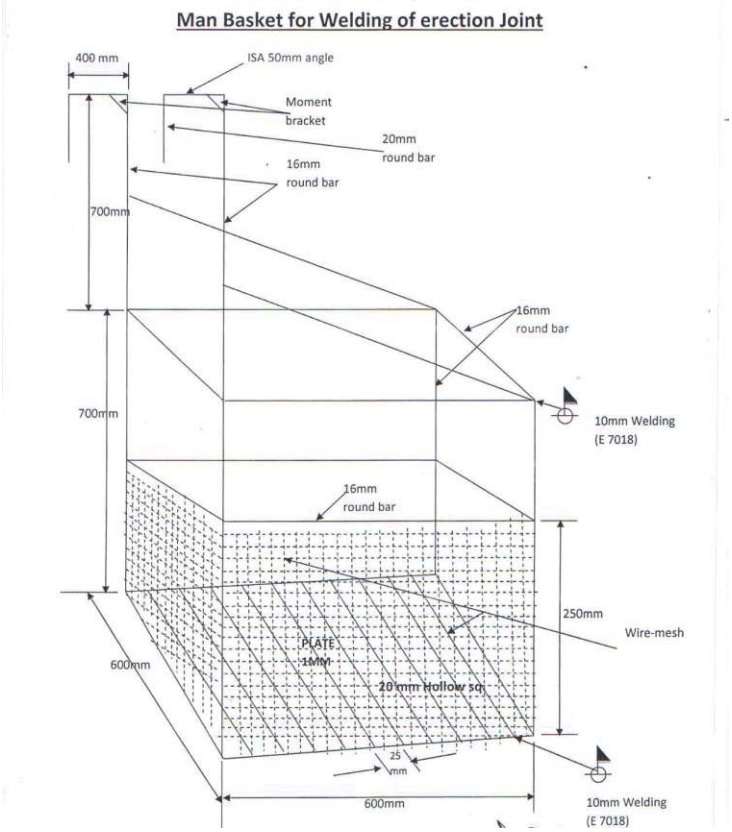
11.0 Lifting Operations:

All the cranes and lifting tools & tackles shall be inspected on daily basis and as well as formal monthly by expert and as per the law third party for annual certification. These shall be tested and certificates of fitness shall be obtained from 3rd party govt approved competent agency before deploying at site and later periodically (As per Rule 60 and 75, Schedule 3 of Bangladesh Labour Rules). 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 operators cabin of all the lifting equipment. The record shall be maintained in Form-24

The manufacturer's instruction for maintenance shall also be followed. All safety measures shall be followed. All tools tackles, lifting appliances; material-handling equipment etc used by the contractor shall be of safe design and construction. The operators, slingers and signalers shall be qualified as per IS 13367 (part-1):2003 "Safe use of cranes- code of practices". There shall be a person responsible for co-ordination

11.1 Personnel Lifts (Man-Basket): (To be treated as a T&P item)

A Personnel Man-Basket permit shall be completed prior to lifiting any people, along with a rigging plan. Man-basket shall be used where access through ladders or scaffolding is not feasible. 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. 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%. It shall have a door with double latches and shall open inside. Anchor points shall be identified within the man-basket. The man-basket shall be thoroughly inspected and load tested and a trial run perfomed without personnel before being put to job. It shall be treated as a lifting tool and shall undergo same certification cycle and inspection as other lifting equipments. An additional sling of required lifting capcity shall be fixed the the man-basket main lifting point and attached to the the crane above the ball or block.While lifting man-basket, the crane shall maintain a uniform speed of lift without any swing. 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. 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.



11.2 CRANES AND HOISTING EQUIPMENTS:

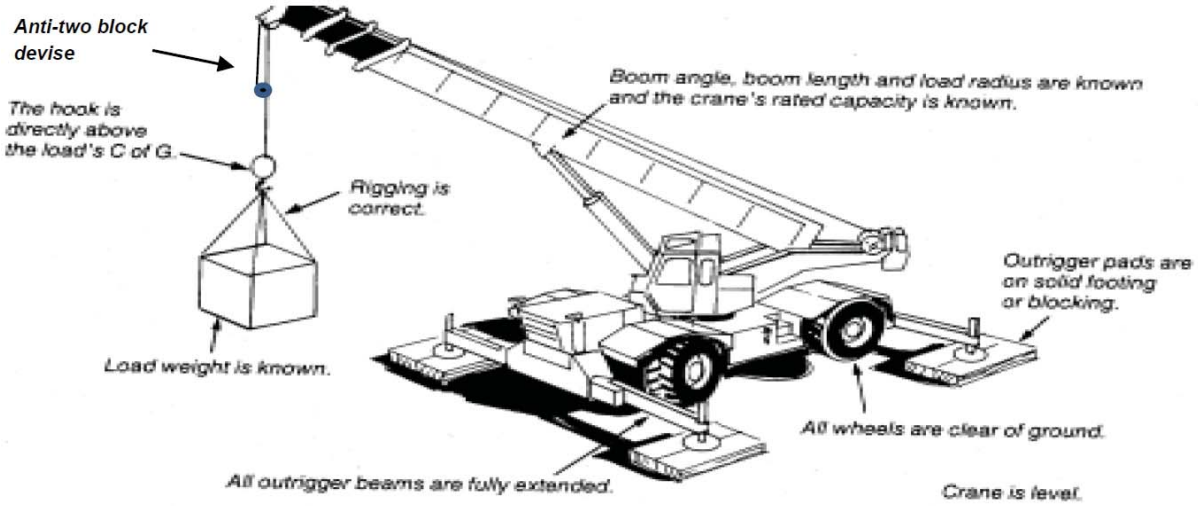
This procedure provides the guidelines to ensure proper rigging and lifting activities are accomplished safely and in accordance with applicable specifications, codes, and regulations.

- 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.
- Cranes shall have an Anti Two-block safety device installed
- All mobile cranes shall have overload and backup alarms
- Load angle indicators and limit switch

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).

- No part of the lifting equipment or its load shall be within the distance as specified in the Indian Electricity Act from an energised power line
- 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.
- Make certain that the rigging personnel, material, and equipment have the necessary capabilities for the job and are in safe condition.

- 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.
- Mats/Pads must be used on all lifting equipment, equipped with out riggers.
- Pick and carry must have the load secured to the rig in front.
- Proper crane setup:



11..2.1 Safe Rigging Practices:

- Review the planned operation and requirements with the operator and rigging crew.
- Ensure a pre-lift meeting is conducted with crane operator, tagline operator, signal personnel, and Safety Manager.
- 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.
- Clear the lift area of all unnecessary personnel.

11.2.2 The following are rules for safe rigging:

- Use loops, thimbles and corner pads to prevent damage to slings when used around corners or on cutting edges.
- 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.
- Slings must not be pulled from between or under loads with load resting on the sling.
- Keep all rope away from flame cutting or welding operations.
- Never use rope as sling material.
- Never wrap a wire rope completely around a hook.
- Do not bend wire rope near any attached fitting.

- 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.
- When using 3 and 4 legged sling configurations, any two legs must be capable of supporting the entire load.
- 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.
- 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.
- Properly rig all loads to prevent dislodgment of any part.
- Use guide ropes or tag lines to prevent the rotation or uncontrolled motion of the load when necessary.
- 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.
- 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.
- 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.
- Multiple part lines must not be twisted around each other.
- The hook must be brought over the center of gravity of load before the lift is started.
- 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.
- Keep hands away from pinch points as the slack is being taken up.
- Leather gloves are recommended when handling wire rope.
- Avoid impact loading caused by sudden jerking when lifting or lowering. Lift the load gradually until the slack is eliminated.
- Never ride on a load that is suspended.
- Avoid allowing the load to be carried over the heads of any personnel.
- 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.
- Never leave a load suspended unless emergency evacuation is required.
- Never make temporary repairs to sling.
- The capacity of a sling is determined by its angle, construction, type of hitch and size.
- Never lift loads with one leg of a multi-leg sling until the unused legs are made secure.
- Never point load a hook unless it is especially designed and rated for such use.
- Make certain that the load is broken free before lifting and that all legs are taking the load.
- When using two or more slings on a load make certain all slings are made from the same materials.
- Lower the loads on to adequate blocking to prevent damage to the slings.
- Materials and equipment being hoisted must be loaded and secured to prevent any movement which could create a hazard in transit.
- The weight of the hook, load block and any material handling devices must be included when determining crane capacity.
- Operator must have clear sight of loads being picked up or put down by crane. Tag lines will be used to control the loads. Loads must not be touched by hand while placing/ moving.

11.2.3 Synthetic Slings
The following are rules for safe use of synthetic slings:

- Synthetic slings must be marked to show the rated capacity for each type of hitch and type of web material.
- 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.

11.2.3.1 Synthetic web slings must be removed from service and destroyed if any of the following conditions are present:

- Acid or caustic burns
- Melting or charring of any part of the sling surface
- Snags, punctures tears or cuts
- Broken stitches
- Distortion of fittings
- Synthetic web slings of polyester or nylon must not be used at or come in contact with temperatures in excess of 82°C
- Polypropylene web slings must not be used at or come in contact with temperatures in excess of 93°C
- Insulated hooks must be tested yearly to insure insulation integrity to at least manufacturer's specifications.

11.2.4 Wire Rope Slings must be removed from service and destroyed if any of the following conditions are present:

- 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.
- Wear or scraping of one-third the original diameter of outside wires.
- Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure such as:
- Evidence of heat damage.
- End attachments that are cracked, deformed worn.
- Corrosion of the rope or end attachments.

11.2.5 Metal mesh slings must be immediately removed from service if any of the following conditions are present:

- A broken weld or broken brazed joint along the sling edge.
- Reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion.
- Lack of flexibility due to distortion or corrosion.
- Synthetic web slings must be removed from service and destroyed if any of the following conditions are present:
- Acid or caustic burns
- Melting or charring of any part of the sling service
- Snags, punctures, tears or cuts
- Broken stitches
- Distortion of fittings

11.2.6 Requirements of Plate Clamps:

- The rated load of the plate clamp must be marked on the main structure.
- Care must be taken to make certain the load is correctly distributed for the plate clamp being used.
- Do not allow load or plate clamp to come into contact with any obstruction.
- The plate clamp must not be used for side pulls or sliding the load.
- When lifting stainless steel or special alloys, ensure plate clamp is designed for use on the specific metal.

11.2.7 Crane operators must follow the followings:

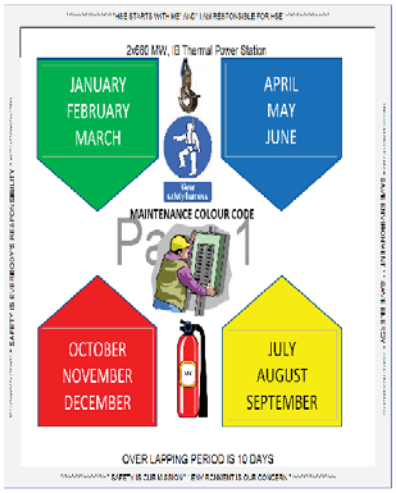
- Pass an annual Operator's Physical examination
- Carry a valid experience certificate from the previous employers

11.2.8 Colour 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

- The cycle of colors shall be Quarterly. The color code tape / Sticker shall be clearly visible to designate the period for which the inspections and tests were conducted.
- Following the initial inspection the equipment must be color-coded quarterly as per color-coding instructions that will be issued by the CONTRACTOR.
- Fire extinguisher with the current month color-coding inspection sticker must be provided and secured in the platform.
- All slings shall be regularly inspected in accordance with the requirement of the project for frequent and periodic inspections and removed from the job site if they fail to meet the minimum requirements of the project.
- The CONTRACTOR'S SFO 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.
- 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.



12.0 **Fire prevention, protection & preparedness -**

The Fire Prevention, Protection and Prepardness Program is an integral part of the overall HSE Program. Effort and consideration must be given to safety, life and potential for delays in construction schedules and plant startup, as well as protection of property on a given project.

The purpose of which is to prevent -

- Inception of fire
- Loss of life or personal injury
- Loss of Property
- Interruption of operations

Site-in-charge / Safety Officer will make periodical review of the site Fire Protection, Prevention Preparedness Programme, Site conditions and available fire protection equipment. It is very imperative that the Sub-contractors along with BHEL to establish good contact with Local fire station for availability of Fire tender in case of emergencies, in additionan to their own fire equipment.

Fire Protection, Prevention and Prepardness Inspections - The Contractor /Sub-Contractor will be required to make frequent fire prevention inspections of his work site and operating facilities. Deficiencies will be corrected at once.

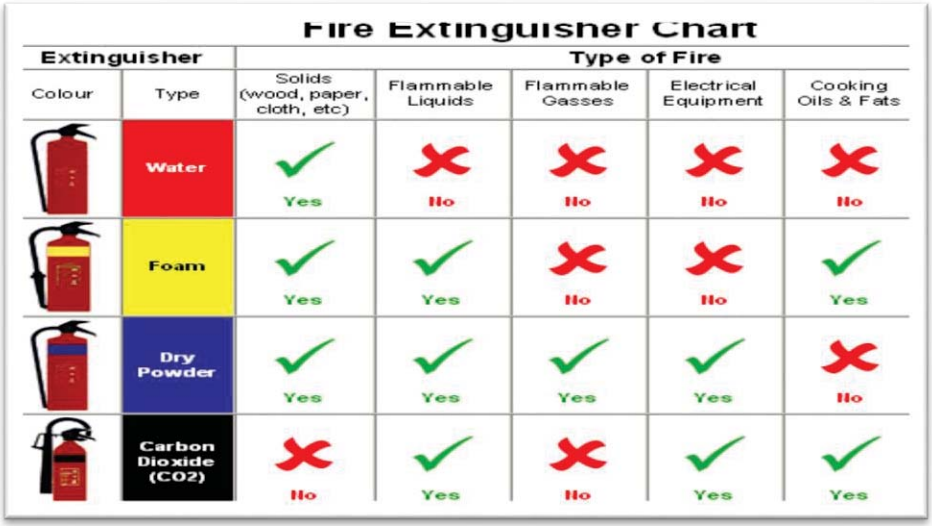
- Area where Hot work activities are carried out (Gas cutting / Welding/ any other spark producing work) above a working spot, a GI / fire-resistant non-asbestos sheet or suitable material shall be placed to prevent the fall of hot sparks. A bucket of water shall be kept nearby while doing hot work

- Hot work shall be preferably carried out in a designated area with a standing Hot Work Permit, to be renewed monthly. The designated area shall have fire extinguishers.

- Any hot work outside designated area shall require a Hot Work permit and fire watch.

No flammable material shall be stored within 35 feet from any fire load.

- Necessary fire extinguishers shall be kept at accessible area as per the chart below:
- The record of Fire safety training and Fire drill shall be maintained in Form-22 and 22(A)



- Emergency telephone number to be displayed at all conspicuous places.

General flammable material storage requirements:

- All flammable material shall be stored in deigned areas and/or in flammable storage cabinets, as necessary.
- Fire extinguishers shall be located near by and have unobstructed access.

13.0 RADIOGRAPHY: Wherever the process requires examination by radiography,

- BHEL /contractor shall use approved radiography contractors for the work on site.
- Site radiography shall be carried out after advance notification to the HSE officer and client personnel. All radiography on the site shall be subject to receipt of client/BHEL work permit and shall normally be performed outside of normal working hours. No ionising radiation sources shall be left unsupervised whilst on site.
- A minimum of 2 qualified persons from the radiography contractor are required for each activity involving ionising radiation. Adequate warning signs shall be posted on barriers and the work area shall be marked off at a safe distance with tape or hard barricades prior to starting radiography by concerned job sub-contractor.
- All personal executing radiography operations shall carry calibrated radiation monitoring devices at all times.
- The storage of radioactive sources on the site is prohibited, they shall be present only for the time required to complete the work. Whilst not in use, radiation sources and their container shall be secured in a safe location with adequate warning signs displayed as per AERB guidelines.

14.0 Confined Space Entry:

A confined space must have an opening of minimum dimension of 40.65cm X 30.65cm if shape is rectangular or oval and dia of 40.65cm if shape is round.

A hazard assessment must be completed prior to any entry into a confined space. The hazard assessment must identify the sequence of work to be performed in the confined space, the specific hazards known or anticipated, and the control measures to be implemented to eliminate or reduce each of the hazards to an acceptable level. No entry must be permitted until the hazard assessment has been reviewed and discussed by all persons engaged in the activity. Personnel who enter confined spaces must be trained per role e.g. entrant (worker), confined space supervior & attendant, and must be informed of known or potential hazards associated with the confined spaces to be entered. Number of persons entering shall be kept at minimum. All confined spaces must be inventoried at site and kept on file. Confined spaces must be posted at the entrance with similar type wording “DANAGER - Do Not Enter – Confined Space - Permit Required”.



Once a hazard assessment is completed the Contractors/Subcontractors requirements are:

- All confined space activities must be reviewed with the Contractor’s Safety Manager prior to commencement of the work. Confined space permits are required as part of the entry process.
- Prior to entering the confined space, the area must be completely controlled to prevent the entry of any unauthorized individual, hazardous substances, or materials, which would threaten the safety of the entrants and the stability of the space. All energy sources, including stored or residual energy, must be isolated and/or blanked, and locked out.
- All shall be given a pep-talk by the concerned supervisor giving details of the jobs to be performed, hazards and risks associated and mitigation measures. The persons shall be provided with all necessary PPEs including respiratory masks, if necessary.
- The confined space must be monitored prior to one entering the identified area. Then periodic atmospheric testing must take place throughout the entry, especially after breaks or work interruptions during the entry. Continuous monitoring is preferable, and may be necessary in certain situations. Monitoring results must be documented on the entry permit with the initials of the individual conducting the testing.
- Contractors/Subcontractors must complete a Confined Space Permit before permitting workers to enter the space. This document must be reviewed and approved via a signature by the entry supervisor. The content of the completed permit must be reviewed with the entrants before entering the space and posted at the confined space enertance.
- A proper and accessible means of exit and exit shall be ensured before entry.
- The space shall be illuminated with 24V lamps only
- All gas cylinders/welding machines shall be preferably kept outside the confined space. Even cutting torches/ electrode holders shall be kept outside, when not in use, if possible.
- All electrical equipments shall be connected to ELCB
- The confined space must have an attendant monitoring the activities within the space. This individual must be in constant communication with work crew inside the space. The attendant must know who is inside the space, that must

be documented. The attendant must not have any other responsibilities than monitoring the space. He/she may not enter the space to perform rescue unless relieved of the duties as an attendant.

- Adequate ventilation must be provided to establish and maintain a stable atmospheric environment. Air circulation shall be ensured. Fumes/dusts generated inside shall be extracted. Ventilation systems must be designed for use in confined spaces.
- Any space 5' or more in depth must have a mechanical retrieval system. This system must be designed for the retrieval of human, and must not be used for equipment purposes. Workers inside the space must wear full body harnesses, and must be connected to the retrieval system.
- Rescue procedures must be established prior to any entry. The local fire department must be contracted prior to entry if they will be the primary source of rescue.
- All individuals involved in the confined space activities must be trained, including hands-on experience with the safety equipment involved. Documentation of the required training must be available prior to the start of any confined space work activities.
- The confined space shall be cleared off all cables, machines, cylinders, materials at the end of the day's work as far as possible.

Once the confined space work has been completed, the entry permit must be cancelled. A copy of the cancelled permit must be given to the HSE Manager

15.0 Welding and Gas Cutting Operations

- 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 taken 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.

- Appropriate fire-fighting equipment is to be available in close proximity of any welding and gas cutting operations at all times.

- 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.

- Proper ventilation is required for any welding or torch operations performed in a confined space.

- 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.

- 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.

- 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.

- 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.

- Arc welding power supply cable shall be of proper rating and material, e.g. copper.
- 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.
- 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.
- Valve caps shall be in place when cylinders are not in use. Valve caps shall never be used for lifting the cylinder vertically.
- 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.
- Cylinders being transported by a powered vehicle shall be secured in an upright position. Gas cylinders are not allowed to be used in man-basket when occupied.
- Cylinders containing oxygen or fuel gasses shall not be taken into confined spaces.
- Oxygen cylinders shall be stored a minimum of (6) meters from fuel gas cylinders or shall have an approved firewall between them.
- Torches shall only be lit by approved strikers; never with matches, cigarette lighters, or hot work.
- 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 even MS Sheet. If such can not be provided, the passage of falling sparks or molten slag shall be barricaded till ground floor and any cable/ tubes/ any other objects interfering in the passage shall either be removed or covered with Fire-resistant sheet or M S Sheet.

16.0 COMPRESSED GAS :

- 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.
- Compressed gas cylinders shall be secured in an upright position with chain or other appropriate means.
- All cylinders shall be kept at a safe distance from welding or cutting operations or shielded from safe.
- All cylinders shall be placed where they cannot become part of the electrical circuit.
- Oxygen and acetylene shall not be stored together.
- Oxygen and fuel gas regulators, hoses and associated equipment shall not be altered and shall be in proper working order while in use.
- 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.

17.0 **WORK AT HEIGHT:** All work at height above 3meter 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 and subsequently BHEL shall follow the checklist religiously by physically verifying the condition of the work area before recommending for approval.

Whenever a fall hazard or other exposure exists for working at heights more than 3m, 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). A personnel fall protection system must include:

- The only permissible personal fall arrest system is an industry approved safety harness. Employees can use positioning belts with two-D ring attachment points as long as they are used in conjunction with a safety harness. Safety harnesses must be secured to an overhead object of substantial capacity capable of supporting five thousand pounds. In order to accomplish this and ensure 100% protection, the worker may need to use two lanyards. The primary lanyard is never unhooked until the secondary lanyard is secure.

- 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. 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. 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.

Minimum Requirements:

Prior to the start of work at elevation, the HSE Manager involved with the work must meet with 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 Manager.

The procedures for the safety response to identified fall hazards developed and resuce plans by must be reviewed with all individuals exposed to the hazards.

The HSE Manager must establish an inspection process of fall protection systems. Some equipment requires documented inspections by its manufacture on a regular schedule. This 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.

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.

Aerial lifting devices, excluding scissors lifts require the use of full body harnesses and lanyards in any elevated position.

All lifelines in general are to be made of min 8mm dia steel rope and tied to columns with 3 clamps at each end. Wherever columns are not available to tie the lifelines, the vertical posts are to be provided after carrying out drop-

load test initially.

18.0 SCAFFOLDS: (As per IS 3696 or any international standard)

The safe and efficient erection, use, dismantling, and storage of scaffolds, ladders and elevated work platforms are considered important objectives in maintaining a safe work environment. This procedure provides the guidelines for erection, use, dismantlement, and storage of scaffolding and elevated work platforms.

There is no such thing as a temporary scaffold. All scaffolds must be erected and maintained to conformed standard. The Scaffold Tagging defines satisfactory, incomplete or defective scaffolds.

Management must ensure or have each worker who performs work while on a scaffold trained by a person qualified in the subject matter to recognize the hazards associated with the type of scaffold being used and to understand the procedures to control or minimize those hazards.

All employees must be competent for the type of scaffolding work they are undertaking and should have received appropriate training relevant to the system they are working on.

- All scaffolds shall be erected / dismantled by scaffolding crew under direct supervision of **competent scaffolding supervisors.**

- 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. Bambo scaffolding is not permitted for use on site.

- Guard rails and toe boards shall be installed on all open sides and ends of platforms more than (2) meters above ground or floor

Scaffold planks must be at least 5 cm x 25 cm (2” x 10”) full thickness lumber scaffold grade or better.

- Scaffold planks shall not span distances greater than 2.5 meters (8 feet).

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.

- All scaffolding must be a minimum of two planks wide. No one may work from a single plank.

- Scaffold planks must be inspected before use. Planks that have been damaged must be removed from the site.
- Access ladders must be provided for each scaffold. Climbing the end frames is prohibited unless the design incorporates an approved ladder.
- Adequate mudsills or other rigid footing capable of withstanding the maximum intended load must be provided.
- 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.
- Do not overload scaffolds. Material should be brought up as needed. Scaffolding must not be loaded in

excess of its rated capacity.

- Barrels, boxes, kegs, blocks or similar unstable object must never be used as work platforms or to support scaffold.
- 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.
- Employees exposed to overhead hazards while working on a scaffold will be protected by 5 cm (2") thick planks.
- 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.
- The platform should have permanent hand rail and mid rail with Toe board without fail.

- 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.

- 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. 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.

Suspension Scaffold

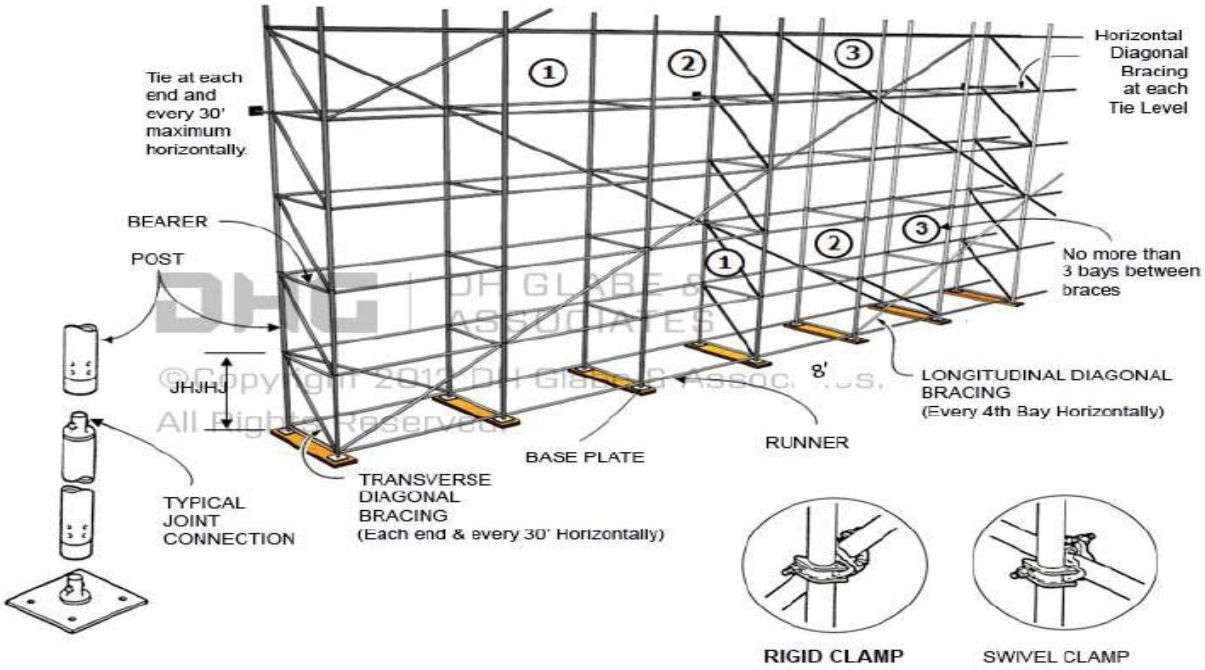
- Suspended scaffolds are platforms suspended by ropes, or other non-rigid means, from an overhead structure.
- Requirements for use are to be preapproved by HSE Head, under a specific Permit to Work.

Rolling Scaffolds

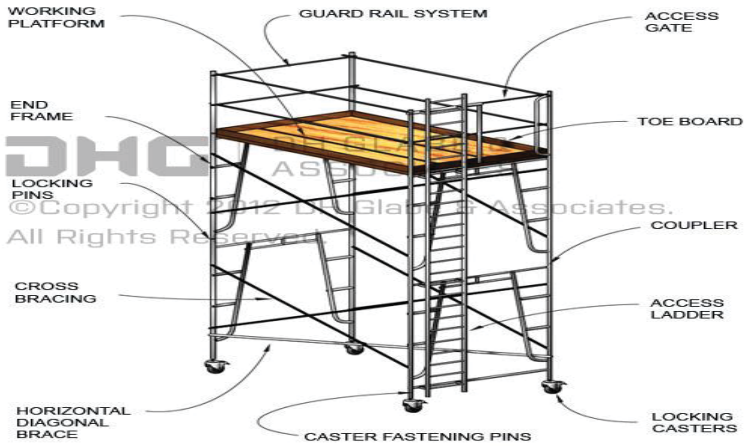
- The height of rolling scaffolds shall not exceed three times the minimum base dimension.
- The minimum base dimension of rolling scaffold will be 1.25 meters (4 feet).
- Adequate help must be provided when moving a rolling scaffold.
- Secure or remove all loose materials, equipment and tools before moving a rolling scaffold.
- 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.

Typical Scaffold Designs

Tube & Coupler Scaffold –



Rolling Scaffold –



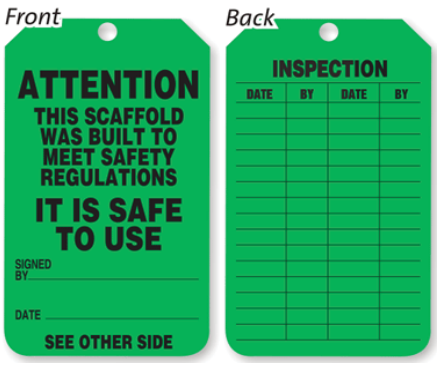
Scaffold Tagging:

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 errection.

Examples of scaffold tags:





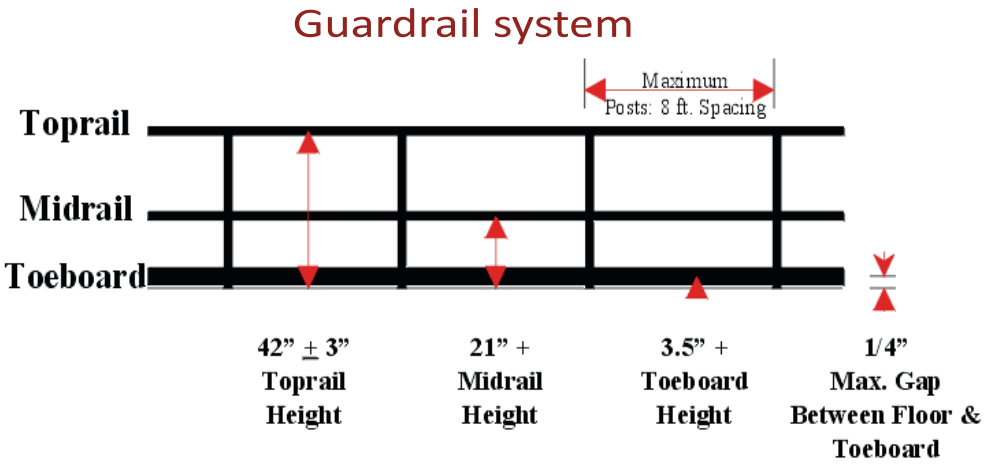
18.1SAFE USE OF LADDERS.

- ❖ Fall protection is required when working on a ladder above 2 meters and when climbing above nearby guardrails.
- ❖ Ladders must be inspected prior to use and by a competent person quarterly, with documentation.
- ❖ Use portable ladders for height up to 4 M only
- ❖ Provide fixed ladders for height above 4 M
- ❖ Place the ladder at an angle of 75 degrees (approx) from the horizontal (1:4)
- ❖ Extend ladder at least 1 M above the top landing
- ❖ Secure top and bottom of the ladder firmly to prevent displacement- anti skid lining at the bottom
- ❖ Ensure that the width of the ladder is not less than 300 mm and distance between rungs is not more than 300 mm
- ❖ 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
- ❖ 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, loose or rough soil
- ❖ Do not use ladders of conducting material near power lines, and only use ladders near powerline or other energize system with exposed parts if they are confirmed locked-out and de-energized.

- ❖ Stand no higher than the fourth rung from the top for carrying out any job standing on a ladder.
- ❖ Never reach out from a ladder to perform work where your belt buckle protrude past the ladder rung.
- ❖ Always face the ladder while climbing up or down
- ❖ 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.
- ❖ Avoid climbing up or down a ladder while carrying anything in hands. Lift tools, equipment and materials with a rope.
- ❖ Work from portable and extension ladders near guarrail where fall expouse exisit 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.

18.2 Precautions against the fall of materials and persons and collapse of structures

- ❖ 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.
- ❖ Guardrails (including scaffolding) erected over/adjacent working areas must have the guardrails screened (opening < 0.5), to prevent material from falling outsite the platform/decking.
- ❖ Guardrails must be able to withstand a 200 pound force exerted in any one direction.
- ❖ 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.
- ❖ All openings through which workers are liable to fall should be kept effectively covered or fenced and indicated in the most appropriate manner.
- ❖ As far as practicable, guard-rails and toe-boards in accordance with Indian laws and regulations as depicted below:



- 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.

  The monkey ladders shall have sufficient fall arrestors. Adequate lifelines of 8mm steel wire rope shall be provided across the work area.

  The HSE officer shall recommend appropriate PPEs after analysing hazards and risks involved.

18.3 **Safety Nets:**

- All safety net systems shall meet the requirements of Indian Standard (IS: 5175)
- Safety net mesh openings shall have a maximum size of 6 inches x 6 inches and be secured at each crossing to prevent elongation of the opening. All nets must meet IS: 5175 standard.
- Safety nets must be installed with sufficient clearance to prevent contact with the surface or structures under them
- Safety nets shall be installed as close as possible to the working level but in no case more than 25 feet below the working level.
- The safety nets shall extend out at least 8 ft. from the side of the open edge.
- Material, equipment and other items that fall into the net are to be promptly removed.
- Safety nets are to be inspected before use and then daily for wear or damage caused by falling materials.
- Safety net installation shall be inspected by a competent person.
- Safety nets must be installed below the working decks of the super structure for protection from falls of personnel and material.
- Safety nets and safety net installations must be drop-tested at the jobsite:
  - After initial installation and before being used.
  - Whenever relocated.
  - After major repair.
  - At 6-month intervals if left in one place.
- The drop test consists of a 400 pound bag of sand 28-32 inches in diameter dropped into the net from the highest surface at which employees are exposed to fall hazards, but not from less than than 42 inches above that level.
- When the employer can demonstrate that it is unreasonable to perform the drop-test described above, the employer or a designated competent person shall certify that the net and net installation have sufficient clearance and impact absorption by preparing a certification record prior to the net being used as a fall protection system. The certification must include:
  - Identification of the net and net installation.
  - Date that it was determined that the net and net installation were in compliance.
  - Signature of the person making the determination and certification.

19.0 SAFETY IN JETTY CONSTRUCTION:

A jetty is to be constructed close to the power plant site over a river. The construction activity involves deployment of cranes and other lifting appliances – a few may be mounted on vessels.
Prior to taking up job at the identified space, a HIRA shall be prepared and corrective measures shall be prepared by an expert group. This shall be shared with the subcontractor/gang to be deployed for the job through meeting/TBM as well as proper documentations.

- The safety rules as described in clause 12.0 shall be followed for all safety appliances. However, the operators shall be certified specifically for operating the lifting appliances mounted on the vessels by the owner of the vessels or the lifting supervisor of the agency.
- The lifting appliances on vessels shall be fixed and securely anchored
- Lifting appliances/ mobile plant shall be kept away from dangerous locations such as openings, edges close to water.
- The operation zone shall be clearly demarcated and properly fenced off.

19.1 SAFE USE OF LIFE JACKETS AND BUOYANCY AIDS:

- Lifejackets/buoyancy aids should be provided to and worn by workers with risk of falling into water.
- Lifejackets/buoyancy aids should conform to BS EN ISO 12402-1, 2, 3 or 4, or other equivalent international standards according to working conditions
- Lifejackets should be thoroughly checked by the user before each use.







Efficient state: Green

Maintenance Record

- A lifebuoy with sufficient lifeline (not less than 30 meters) shall be provided and the locations of the lifebuoys shall be at less than 50 metre intervals along the edges of places where work is being carried out overside or in exposed position on vessels where there is a reasonably foreseeable risk of falling or being washed overboard. To avoid any delays to rescue operations, lifebuoys shall be tightly tied to the posts.



- The lifejacket/ buoyancy aid shall preferably be provided w or a self-activating light (for night work) in order to aid locating the wearer and facilitating rescue.
- The lifejackets /buoyancy aids shall be inspected and checked periodically by a competent person.



- The life jackets/ buoyancy aids shall be properly maintained in a good serviceable condition according to the manufacturer's instructions.
- All inflatable life jackets shall be serviced by an authorized person/agent at least once a year.

19.2 WORKING AT HEIGHT

- Suitable guard-rails and toe-boards shall be installed at edges. Openings shall be properly covered where persons are liable to fall from height, to land surfaces or into water.
- Suitable working platforms, with suitable guard-rails and toe-boards, shall be provided for work at height. Safe means of access and egress shall be provided for the working platform.
- Safety harnesses with continuous and effective anchorage system shall be provided when it is impracticable to provide a suitable working platform, access and egress and safe place of work.
- Access and egress shall be sufficiently illuminated and free from any obstructions, openings, projections in order to avoid any slip, trip and fall.

20.0 NIGHT SHIFT OPERATION:

Night shift operation shall be avoided to the extent possible, so shall be any complicated or heavy job. However, prior administrative approval shall be obtained from BHEL for such operation. The following shall be ensured:

i. Adequate illumination along access, work area and egress

ii. Supervision
iii. Issue of strict instruction to workmen not to stray away from the work area and earmarked approach
iv. Non-deployment of women workforce
v. Non-deployment of fatigued workforce
vi. Vacating the area immediately on completion of the job
vii. informing first-aid facility and ambulance in advance

21.0 CONTROL OF MOVEMENTS AND USE OF HAZARDOUS SUBSTANCES AND CHEMICALS:

- The hazardous substances and chemicals shall be stored in a cool, well ventilated, dry and covered space with restricted entry only
- The loading, unloading, issue and use of these materials shall be strictly in accordance with the Material Safety Data Sheet (MSDS) and under strict supervision. Every supply shall accompany a MSDS as per standard purchase order clause.
- The site HSE team shall maintain MSDS of all these items and the same shall be shared with the stores or the user as and when required.
- Each container shall be labeled.
- The stores shall check the expiry date of perishable chemicals while receiving and store in such a fashion so as to follow First-in-first-out queue.
- There shall be enough space for movement of material and people in the stores.
- Containment shall be provided so as to arrest spillage from spreading.
- There shall be sufficient fire extinguishers and sand buckets in the stores and at point of use. In case of any spillage, dry sand shall be put on the spill and soaked sand shall be disposed as per the procedure for hazardous waste.
- There shall be provision of water preferably flowing one and a face shower at stores and point of use
- The persons handling these items shall strictly wear appropriate PPEs like leather gloves, apron, shield etc

22.0 CHEMICAL CLEANING: The chemicals have to be handled as instructed in MSDS. Only authorized person(s) shall be engaged for this job under strict supervision. The waste chemicals shall be drained out to a suitable storage provision and disposed off as per the relevant procedure. The area shall be barricaded while carrying out cleaning operation so as to prevent any unauthorized entry. Once the operation is completed, the surplus material along with the containers shall be returned to stores or scrap yard, as the case may be. The users shall use all appropriate PPEs and shall have water and sand for handling any incidental spillage or splash etc. The area shall be left completely clean before removing barricades.

22.1 PAINTING

Requirements provide a detailed procedure to be implemented by all concerned employees and sub-contractors involved in painting activities.

Significant Environmental Hazards:

- Chemical hazard due to inhalation of lead fumes (lead containing paint)
- Chemical hazard due to inhalation of VOC's from paining operations
- VOC's from painting and coating operation
- Disposal of paints and coats drums

Control Procedure for Painting:

- Chemical products used in painting and coating operation shall have proper MSDS sheet in place. Whenever any doubt arise with respect to handling and safety point of view it should be accessed to all concerned.
- Toxic substances and hazards relate the toxic chemicals shall be indentified.
- Proper PPE shall be used including plastic gloves appropriate overall etc.,
- Arrangement for cleaning of spillage shall be ensured

- In case of nauseating feeling by any one immediate action shall be taken
- Only trained workers shall be allowed and proper training should be imparted to the works.
- Exposure limits of the toxic substances shall be checked before starting the work and nobody shall be allowed to carry the work beyond the permissible limit.
- Ventilation or exhaust facility shall be provided at place where painting and coating operations are carried out.
- Overalls shall be supplied by the contractors/subcontractors to the workmen and adequate facilities shall be provided to enable the painters to wash at the cessation of work.
- Smoking, open flames or sources of ignition shall not be allowed in places where paints and other flammable substances are stored.
- A caution board in national /regional language “smoking strictly prohibited” shall be displayed in the vicinity.
- Suitable fire extinguishers/sand buckets shall be kept available at places where flammable paints are stored, handled or used.
- In case of indoor painting or painting in confined spaces, exhaust ventilating shall be provided. If adequate ventilation is not provided a proper respirator shall be provided and used by persons who are trainined and fit tested.
- The VOC’s from painting and coating operations shall not exceed the permissible level of CPCB/ SPCB norms. The paints and coats must be selected as per the guidelines.
- Workers shall thoroughly wash their hands and feet before leaving the work.

23.0 SAFETY IN THE USE OF HAND TOOLS AND POWER-OPERATED TOOLS

23.1 General provisions

i. All hands and power tools and similar equipment, shall be maintained in safe condition.
ii. When power operated tools are designed to accommodate guards, they shall be equipped
iii. with such guards, when in use;
iv. Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains and other reciprocating, rotating or moving parts of the equipment shall be similarly guarded;
v. 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, vapours, or gases shall be provided with the particular personal protective equipment necessary to protect them from the hazards;
vi. 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.
vii. 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.

23.2 Hand Tools

i. The contractor shall not issue or permit the use of unsafe hand tools;
ii. Wrenches including adjustable pipe end and socket wrenches shall not be used when saws are sprung to the point that slippage occurs;
iii. Impact tools such as drift pins, wedges and chisels shall be kept free of mushroomed heads;
iv. The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight on the tools.

23.3 Power operated tools

i. Electric power operated tools shall be either of the approved double-insulated type or shall be grounded;
ii. The use of electric cords for hoisting or lowering loads shall not be permitted;

iii. Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming incidentally disconnected;
iv. Safety clips or retainers shall be securely installed or maintained on pneumatic impact (percussion) tools to prevent attachments from being incidentally expelled;
v. 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;
vi. 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;
vii. The manufacturer's safe operating for hoses, pipes, valves, filters and other fittings shall not be exceeded;
viii. Only personnel who has been trained in the operation of the particular tool shall be allowed to operate power-actuated tools;
ix. 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;
x. 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;
xi. 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;
xii. Loaded tools shall not be left unattended;
xiii. 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;
xiv. Driving into materials that can be easily penetrated shall be avoided unless backed by a
xv. substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side;
xvi. No fastener shall be driven into a palled area caused by an unsatisfactory fastening;
xvii. Only non-sparking tools shall be used in an explosive or flammable atmosphere;
xviii. All tools shall be used with the correct shield, guard or attachment as recommended by thee manufacturer.

23.4 Abrasive wheels and tools

i. All grinding machines shall be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation;
ii. Grinding machines shall be equipped with suitable safety guards;
iii. 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;
iv. 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;
v. Cup type wheels used for external grinding shall be protected by either revolving cup guard or a band type guard;
vi. 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;
vii. Portable abrasive wheel used for internal grinding shall be provided with suitable safety flanges;
viii. When safety flanges are required, they shall be used only with wheels designed to fit the
ix. 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;

x. All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that they are free from cracks or defects;

xi. 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;

xii. All employees using abrasive wheels shall be protected by suitable eye protection equipment.

23.5 Woodworking tools

i. All fixed power driven woodworking tools shall be provided with a disconnect switch that can either be locked or tagged in the **off-position**;

ii. 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 retensioned for a different speed, the marking shall be corrected to show the new speed;

iii. 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;

iv. 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.

23.6 Defective tools to be tagged out for maintenance, as ***DEFECTIVE, DO NOT USE***, and sent to tool/store room for repair or to be discarded.

24.0 START UP, COMMISSIONING AND TESTING:

There are various activities involved prior to commissioning- the major ones are -Hydraulic Test, Steam Blowing, Charging of transformers, Boiler Light Up, Rolling and Synchronisation and Full loading of unit.

These activities shall be personally supervised by the site executive along with the commissioning engineer. The readiness of upstream and downstream system shall be ensured before taking up. These shall be handled strictly by the authorised 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. Entry of persons to the area of activity shall be suitably restricted and the emergency functions like Ambulance, first aid centre and Fire station shall be intimated about the plan well in advance. Tag-in/ Tag-out shall be in place while charging transformer and whenever necessary. Electricians with valid wiremen license only shall be permitted to work on power lines.
The area and the passage shall be adequately illuminated.

25.0 **DEMOLITION WORK**

Before any demolition work is commenced and also during the process of the work the following shall be ensured:

- All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- 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.
- 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.

26.0 **EXCAVATION**

Wherever there is 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. All safety precautions shall be taken for foundation and other excavation marks as per IS-3764. Any excavation above 2m shall be considered as hazardous job.

27.0 ENVIRONMENTAL CONTROL

Environment protection has always been given prime importance by BHEL. Environmental damage is a major concern of the principal contractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life. Chlorofluorocarbons such as carbon tetrachloride and trichloroethylene shall not be used. Waste disposal shall be done in accordance with the guidelines laid down in the project specification.

Any chemical including solvents and paints, required for construction shall be stored in designated bonded areas around the site as per MSDS.

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. BHEL shall use appropriate MSDS for clean-up technique

All contractors shall be responsible for the cleanliness of their own areas and must not pollute the ground, air and water.

BHEL shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the contractor anticipates the generation of excessive noise levels from his operations the contractor shall inform to Construction manager of BHEL accordingly so that reasonable &practicable precautions can be taken to protect other persons who may be affected.

27.1 **Water Supply and Wastewater Discharge Requirement**

- Source of water is provided by client from the existing system.
- Wastage of water to be controlled by monitoring the required water for construction & domestic use and actual consumed.
- No contaminated water to be discharged in the storm water drain confirming the standard parameters before discharge. Proper approval to be taken if applicable as per Bangladesh Environmental Standards

27.2 **Storm water runoff Management**

- Expansion of existing plant, no existing drainage systems will be disturbed and damaged.
- No construction waste water to be discharged in the existing storm water drain or newly construction storm water drains.

27.3 **Noise Mitigation**

High noise is harmful to the human health and it can cause impairment if exposed for long duration at regular intervals, and also cause disruption in nearby communities.

- Noise monitoring shall be carried out in all construction locations periodically.
- Use of silent DG is allowed at site during construction.
- Low noise generation equipment's to be preferred
- Acoustic enclosure to be used in case noise level is high for particular equipment or system.
- Work areas where noise levels exceed the 85db shall be posted as hearing protection required.
- Use of PPEs / ear plug/ear muff for personnel entering into high noise area.
- Activities generation High noise will be planned in day shift.

Noise Level Chart (As per Bangladesh Environmental Standards)

Parameter	Night Noise level dBA	Daytime Noise Level dBA
At 1-meter from each piece of equipment	85	85
At Property boundary	70	70

27.4 **Air pollution Control**

- Water sprinkling on road for suppression of fugitive dust to be done regularly.
- Startup and comminsioning activities to be planned for compliance with contract, regulatory and permit requirements..(As per Bangladesh Environmental Standards)
- Required monitoring to be done in the respective work location as applicable.

27.5 **Land and Water Resource Protection**

- Only prior approved land by CUSTOMERL to be used during construction work.
- Contract clauses to be followed
- All hazardous substances will be stored with proper containment facilities to avoid any release into the water system, causing land/water contamination.

28.0 HOUSEKEEPING

- 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 subcontractor. Such cleanings has to be done by subcontractor within quoted rate, on daily basis by an identified group. 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 contractor's bill. Such decisions of BHEL shall be binding on the subcontractor
- Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis:
  - ❖ All surplus earth and debris are removed/disposed off from the working areas to identified locations.
  - ❖ Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
  - ❖ 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 location.
  - ❖ Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
  - ❖ Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
  - ❖ Labour 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.
  - ❖ Fabricated steel structures, pipes & piping materials shall be stacked properly.
  - ❖ 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.
  - ❖ Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas
  - ❖ The paint and thinner and other chemical containers (filled, partly used and empty) shall be carefully stored, used and tracked. All empty containers shall be removed after getting punctured/lid removed and deformed to the scrap yard. The partial used one shall either be returned to store or carefully kept at a corner much away from any hot work or source of fire.

29.0 WASTE MANAGEMENT

There are operations on construction projects that may create hazardous waste, which would require handling, storage, transferring, and transporting. Therefore, hazardous waste guidelines apply for Hazardous Waste Planning:

29.1 Minimum Requirements:

- Contractors must designate a Material Manager who is responsible for checking delivered materials as potential hazardous waste and informing the Contractor's Safety Manager.
- Contractors who create, may be expected to create or could accidentally create a material that could be classified to be hazardous waste must provide Disposal number (or equivalent) and other pertinent information on file.
- All hazardous waste or waste which could be considered hazardous waste, as determined by the methodology and definitions from environmental regulators must be stored and collected in special areas and properly disposed of by the Contractor.
- No waste haulers, disposers, recyclers, or scavengers will be allowed on the site without the permission of the owner. It will be the responsibility of the Contractor to provide copies of all licenses, permits, and authorizations to the.
- No waste may be removed from the site by any person without the authorization of the Contractor. No waste may be brought onto the site and disposed of using the Contractor's systems or facilities.
- Burning of waste, if not used for generating energy, shall be generally prohibited

29.2 General Requirements

- For non-hazardous waste disposal. Receptacles e.g., dumpsters, etc. must be placed around the site for collection of waste materials. No material is to be abandoned on the site.
- Dumpsters will be inspected frequently, and any potentially hazardous material or waste will be removed from the dumpster and placed in the appropriate storage area at the expense of the responsible Contractor.

29.3 Definitions

- Solid Waste - Any garbage, refuse, sludge, or any other waste material which is not an "excluded waste."
  - The following solid wastes are not hazardous wastes unless otherwise designated as such by local authorities:
  - Fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels
  - Drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas, or geothermal energy.

- Other Waste Material - Any solid, liquid, semi-solid, or contained gaseous material, resulting from industrial, commercial, mining or agricultural operations which are discarded. This is usually an incidental by-product of the operation. Discarded material must be treated as follows:
  - Disposed of, and not used, reused, reclaimed, or recycled
  - Burned or incinerated, except where the material is being burned as a fuel for the purpose of recovering usable energy
  - Physically, chemically, or biologically treated (other than burned or incinerated) in lieu of or prior to being disposed of.

- Excluded Waste - Materials that are not solid wastes. The following materials are not solid wastes for the purpose of this part:
  - Domestic sewage ("Domestic sewage" means untreated sanitary wastes that pass through a sewer system.)
  - Any mixture of domestic sewage and other wastes that passes through a sewer system to a publicly-owned treatment works for treatment
  - Industrial wastewater discharges that are point source discharges.

29.4 Treatment - Any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste to neutralize such waste, to recover energy or material resources from the waste, or to render such waste non-hazardous.

29.5 Improper Disposal - The discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into the environment.

29.6 Temporary Storage - The holding of a hazardous waste for a period less than 90 days, at the end of which the hazardous waste is properly disposed of.

29.7 **BINS AT WORK PLACE**

- Sufficient rubbish bins shall be provided close to workplaces.
- Bins should be painted yellow and numbered.
- Sufficient nos. of drip trays shall be provided to collect oil and grease.
- Sufficient qty. of broomsticks with handle shall be provided.
- Adequate strength of employees should be deployed to ensure daily monitoring and service for waste management.

29.8 **STORAGE AND COLLECTION**

- Different types of rubbish/waste should be collected and stored separately.
- Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
- Rubbish should not be left or allowed to accumulate on construction and other work places.
- Do not burn construction rubbish near working site.

29.9 **SEGREGATION**

- Earmark the scrap area for different types of waste.
- Store wastes away from building.
- Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
- Clinical and first aid waste stored and incinerated separately.

29.10 **DISPOSAL**

- Sufficient containers and scrap disposal area should be allocated.
- All scrap bin and containers should be conveniently located.

- Provide self-closing containers for flammable/spontaneously combustible material.
- Keep drainage channels free from choking.
- Make schedule for collection and disposal of waste.

29.11 **WARNING AND SIGNS**

- Appropriate sign to be displayed at scrap storage area
- No toxic, corrosive or flammable substance to be discarded into public sewage system.
- Waste disposal shall be in accordance with best practice.
- Comply with all the requirements of Pollution Control Board (PCB) for storage and disposal of hazardous waste.

30.0 **WORK VEHICLES (Limited to contractual provision)**

Work vehicle shall be as safe stable efficient and roadworthy as private vehicles on public roads. Site management shall ensure that drivers are minimum 18 years of age, physically fit, suitably qualified and trained for the equipment they are operating. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

- A high level of stability.
- Equiped with backup alarms.
- A safe means of access/egress.
- Suitable and effective service and parking brakes.
- Windscreens with wipers and external mirrors giving optimum all round visibility.
- Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
- Provision of seat belts.
- Guards on dangerous parts.
- Driver protection - to prevent injury from overturning and from falling objects/materials.
- Driver protection from adverse weather.
- No vehicle shall be parked below HT/LT power lines.
- Valid Pollution Under Control certification for all vehicles

30.1 **TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES**

- 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.
- 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.
- All overhangs shall be made clearly visible and restricted to acceptable limits
- Load shall be checked before moving off and after traveling a suitable distance.
- 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.
- Warning signs shall be displayed during transportation of material.
  All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement

31.0 EMERGENCY PREPAREDNESS AND RESPONSE Preferably to be maintained jointly by all stake-holders in the project) (A separate document titled "Emergency Preparedness and Response Plan bearing document no HSEP:EPRP:MAITREE is to be read along with this plan) Emergency preparedness and response plan requirements are to protect worker life and health, and to safeguard property used and stored on the project. This plan

is prepared in anticipation of an emergency to prevent losses to any Incident. This plan describes how the organization identifies, respond to and review emergency situations.

This plan covers fire, medical and other environmental incidents. It aims at controlling the emergency and generally mitigating the adverse effects of a major Incident. This plan is applicable to all activities carried at all BHEL project sites. Determination of hazard potential and identification and assessment of hazards is the first part in emergency planning. This requires systematic study of the site / plant to identify emergencies that can occur.

31.1 Definition:

A major emergency can be defined as an Incident that has potential to cause serious injury of loss of life. It may cause extensive property damage and adversely affect the environment as a whole.

31.2 Emergency scenarios and General Guidelines:

Various scenarios that are anticipated to cause emergency at BGRESL site are discussed in brief along with guidelines.

- Personal injuries:
  In spite of putting best efforts some technical failure or human error may lead to personal injury at site. Guidelines are given below when personnel injuries happen:
  - Contact medical center over phone/cell/radio;
  - Contact security control room over phone/cell/radio;
  - Contact HR/Admin department over phone/cell/radio;
  - Tell your location nature of injury or near miss incident;
  - Inform site safety department;
  - Provide First Aid treatment if properly trained person is available, otherwise take the injured person to Medical center if pratical; or
  - Stay with the injured person until medical assistant arrives.

- In case of fire:
  - Shout “fire fire”;
  - Inform the persons nearby. Contact Fire Center and give your location and other details as warranted and act very calmly and swiftly. Then contact security and safety department once in a safe location;
  - Try to put out the fire by using available portable fire extinguisher if trained and fire is in incipient stage only, otherwise let firefighting personnel tend to it;
  - Do not make any attempt to collect your belonging;
  - Get out and away from the area immediately and walk do not run. Follow shortest escape route and assemble at assembly point; and
  - Under no circumstance put your precious life at risk.

- Mishaps involving failures of crane, structures, equipment and vehicular incidents, etc., can also lead to an Emergency situation on construction sites. Guidelines for actions to be taken in case of such situations are as:
  - Inform immediate authority and also inform security and safety departments.
  - Try to assist in rescue personnel involved only if safe to do so;
  - Cordon off the area to prevent entry of personnel in affected area;
  - Security shall ensure movement in affected area in coordination with Section/Site In-charge.

- Fire/Security service departments responding to affected area to contain and control the situation;
- All other personnel not involved in mitigation operation shall be directed to assembly point; and
- Contractor/ sub-contractor management shall ensure that their workmen are away from emergency site, not gathering around location of emergency.

- Toxic leakage from nearby live units can also lead to emergency situation at construction site. Guidelines for actions to be taken are as:
  - Inform immediate authority and also inform security and safety departments;
  - Evacuate all the personnel from the area immediately depending upon the wind direction to safetest assembly point;
  - Call for help from fire and medical by phone/Cell/radio;
  - Arrange transport for any victims to medical Centre; and
  - Do not panic, act swiftly, do not run and proceed as per advice of emergency services.

- Bomb threat, sabotage, riot etc., also may lead to emergency situation at construction site. Such situation shall be dealt by HR/Admin and security department with the advice of Site In-charge.
  - Notification to the owner and authorizes to follow immediately.

- Natural calamities like earthquake, cyclone, and flood like situation can also lead to emergency situation at construction site. Site In-charge will act with required diligent and directive received from Concerned State Government, Corporate office and Owner.

- High Angle rescue -
  - First arrival. The first arriving HSE Officer should assume command after arriving on the scene;
  - HSE Officer should secure a witness as soon as possible after arriving on scene. This will help in identifying the problem and locating the victim;
  - Locate the victim to determine nature of injuries if any and report to Medical for response as needed.
  - Administer first aid to the victim as necessary;
  - Resuce team to use proper rescue kit / equipment to reach the victim;
  - Personnel manbasket or arial lift may be used to reach the vitim if applicable;
  - Assess the hazards. HSE Officer to identify all potential hazards and assist rescuers.
  - The HSE Officer will be responsible for securing those hazards or making all members aware of those hazards.
  - HSE Officer shall be made aware of the specific emergency action plans once the emergency response team arrives.
  - The HSE Officer shall also be responsible for assuring that all safety procedures are adhered to.

31.3 Communication system

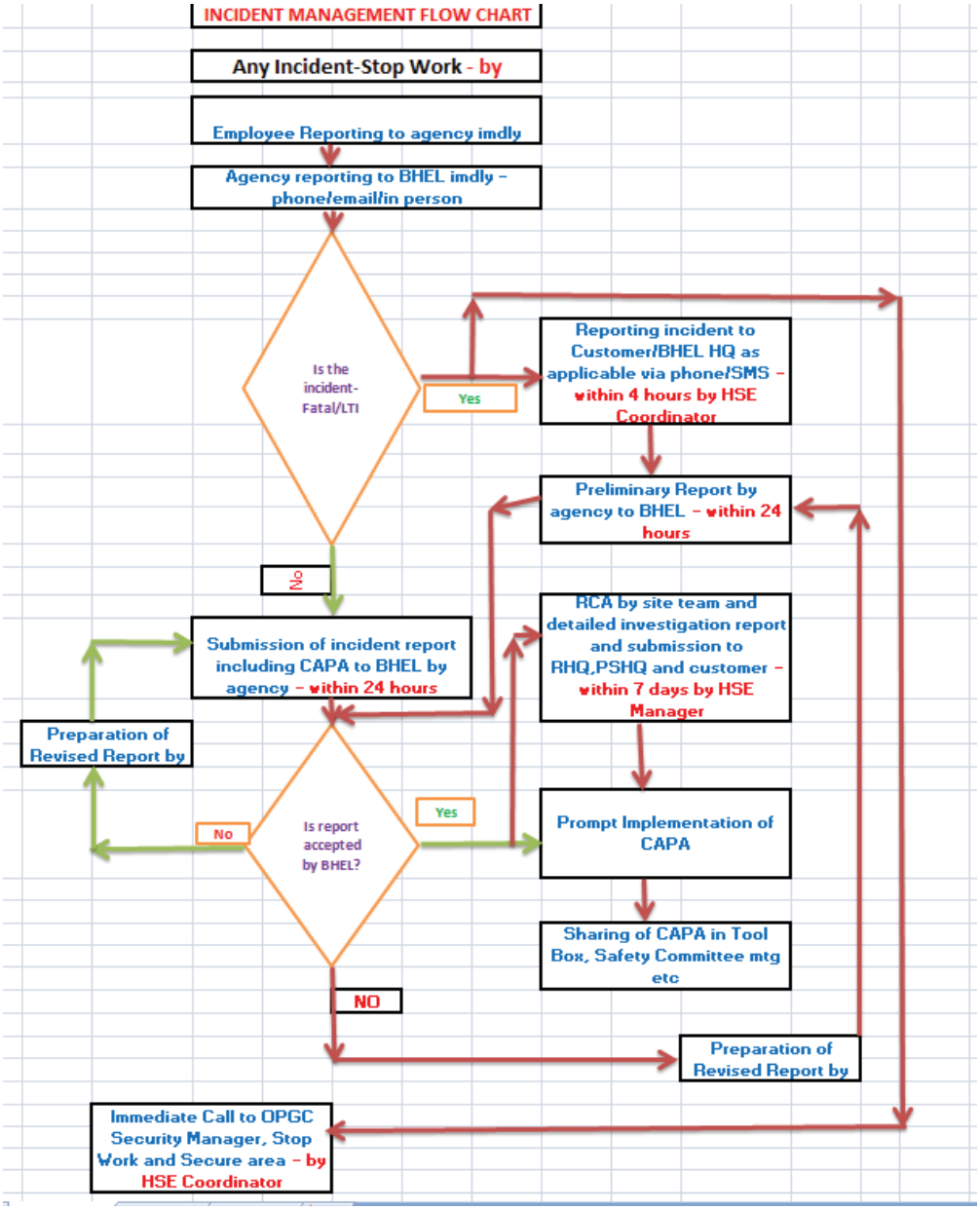
An important key to effective emergency response is an effective communication system. At BHEL, site telephone, mobile and radios will be used for communication during emergency.

- Whosoever is observing any emergency shall inform about emergency to:
  - HR/Admin department
  - HSE-Head /Officers /
  - Medical and Security department
  - Fire department,

- BHEL Site/Section In-charge

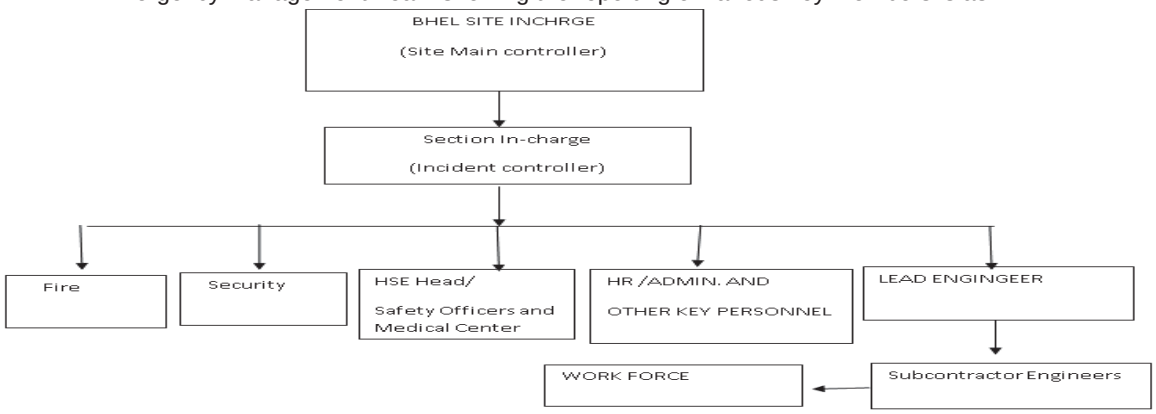
- BHEL Section In-charge will confirm the information with emergency services and also inform the Regional Manager as well as sub-contractors Site In-charge.

31.4 Communication matrix shall be as:



31.5 Emergency Organization -

An emergency organization establishment is based on nature of emergency at BHEL site. The matrix for the Emergency Management Team showing the reporting of various key members is as:



31.6 List of Key Personnel -

Sl. No.	Name	Designation	Telephone Number	Mobile number

31.7 Emergency Control Center -

For the coordination with emergency situations at BHEL site Site In-charge office shall operate as an Emergency Control Room. Site Main Controller (Site In-charge) will coordinate from this Emergency Control Room. Control Room shall be equipped with all necessary communication devises necessary to manage particular emergencys.

31.8 Emergency Drills -

The site HSE Manager and Emergency and Rescue Teams must participate in regular emergency drills of various types. The intervals between such drills must not exceed three months. The records of the drills must be prepared and kept on site for review by the Owner and site Management. The records must be reviewed during regularly scheduled project HSE Committee meetings.

- After each drill, a formal, documented debriefing must be conducted to discuss areas of improvement and an Action Plan developed with Responsible Person and Anticipated Completion Dates describing improvements to be implemented.

31.9 Roles & Responsibility -

Responsibility of Site In-charge (Site Main Controller):

- Immediately on receiving message regarding emergency will proceed to their cabin and fill their role as Main Controller and activate the Emergency Control Room and Emergency Management Team.
- Take strategic and technical decisions in line with the incident scenario to mitigate the cause of emergency.
- Provide leadership and guidance to the Emergency Management Team.
- As soon an emergency call is received they shall inform respective Section In-charge.
- Call for available resources Fire, Medical, Security as needed based on emergency situation.
- Stay in contact with Section In-charge for coordination efforts of resources and evacuation of personnel.
- Ensure head count is conducted and received.
- Notify Owner representative of situation and plan.

Responsibility of Section In-charge (Area Controller):

- If not at the location, once notified of an emergency will proceed to the area and act as an incident controller if safe or as appropriate based on the nature of emergency.
- Will be overall in-charge of the area situation in consultation with emergency responding offices and mobilized resources in coordination with Main Controller.
- Will assess the situation and take necessary action to control the emergency and give necessary instruction to site personnel as necessary and appropriate.
- Will evaluate if fire emergency and attempt to extinguish if safe and in incipient stage and assist injured as applicable.
- Shall instruct the sub-contractors and ensure that all non-essential employees are moved to safe assembly point and organize head count.
- Ensure safe exvacuation of site personnel to safe assembliy point in coordination with Main Controller.
- Shall keep in contact with Main Controller keep them informed about site situation and seek directives for mitigation of emergency.
- Communicate with shift Fire Officer of fire condition and rescue measures.
- Communicate with shift Security Officer assist in barricading the affected area.
- Communicte with shift Medical for transporting of causalities, if any.

Fire officer /shift Fire in charge:

- Respond to the emergency call with fire crew in first turn out. Report to Incident controller at site of emergency.
- Decide line of control action in consultation with Section In-charge/Incident Controller for firefighting and other control actions including evacuation of trapped personnel.
- Deploy auxiliary fire squad for assisting fire crew.
- Ensure safety of the crew members
- Keep in constant contact with Emergency Control Room and Team.

Security officer / In charge:

- Instruct and deploy security personnel at security posts/gates and around the affected area.
- Communicate with the auxiliary fire squad at emergency site immediately on receiving emergency call to ensure their mobilzation.
- Cordon off the affected area and guide traffic /emergency vehicles and manage crowd control by dispersing unnecessary persons from the area.
- Ensure vigilance at security posts /gates and be in contact with area manager and other members connected with firefighting or rescue operation.
- Mobilize for evacuation of personnel to safe locations/assemble point.

Medical Center:

- Upon receiving notification of an emergency, anticipate the casualties and prepare accordingly as per medical response plan. Inform Medical Staff and nearest Hospital in advance.
- Dispatch ambulance to incident site along with necessary staff.
- Provide medical treatment/first aid as necessary.

HR/Admin and HSE Teams:

- Coordinate with Main Controller and all other Emergency Management Team members and Government agencies as per requirement.
- Identify appropriate Assembly Points at project site, provide directions and marked areas clearly.
- Assist with arrangement of necessary PPE and use of.
- Support the Emergency Management Team as directed and/or necessary based on situation.

31.10 General Requirements:

- Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by Regional HQ
- Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its sub-contractors
- Assembly point shall be earmarked and access to the same from different location shall be shown in consultation with the owner
- Fire exit shall be identified and pathway shall be clear for emergency escape.
- Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
- Adequate number of first aid boxes shall be strategically placed at different work places to cater emergency need. Holder of the first aid box shall be identified on the box itself who will have the responsibility to maintain the same.
- First aid center shall be developed at site with trained medical personnel and ambulance
- Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
- Tie up with fire brigade shall be done in case customer is not having fire station.
- Tie up with hospital shall be done in case customer is not having hospital.
- Emergency Organization group shall be formed at site.
- Mock drill shall be conducted on different emergencies periodically (every three months) to find out gaps in emergency preparedness and taking necessary corrective action

31.11 **WEATHER SEVERITY PLAN**

A. OBJECTIVE AND SCOPE:

considering the over all monsoon and wind speed in the area the emergencies like cyclone and flood shall be considered from safety point of view during project work.

Warning/alerts issued by Bangladesh Meteorological department shall be acted upon by appropriate measures. These alerts are mostly conveyed to District Administration which in turn passes on to the owner of the project i.e. BIFPCL in this case. BIFPCL shall convey such alert to contractors. and coordinate appropriate response. Such alert is transmitted over Radio and TV channels also. However, contractors shall also remain alert to w3eather conditions and share with BHEL and fellow contractors any input received. Contractors shall actively participate in the Emergency Response activities

This safety plan provides procedure to be followed during emergency due to flood and cyclone for the period of entire project work with respect:

- To give clear guidance as to the actions that must be implemented.
- To inform employees what to do in an Emergency Scenario.
- To establish an emergency response and communications procedure.

B. RESPONSIBILITIES

RCM or his assignee shall coordinate with various departments in charge and supervisors, who will execute the alert procedures in their assigned areas. The coordination shall be in line with directives received from the Client/consultants.

C. CYCLONE

In the event of CYCLONE, alert warning is in three parts. The alert will be issued by BHEL Site Manager.

The actions required during cyclone/Rough Weather:

- Check and assist subcontractors in cleanup. Pick up all loose and unused material of respective supervisor's area
- Check tie-down arrangement is proper for all temporary structure, cranes and tall objects etc.
- Tie to secure all gas cylinders to avoid displacement and unsafe conditions which could be due to wind pressure.
- Secure portable electricity generating sets and other equipments, pumps, hoses etc.
- Make preparation for removal of water logging.
- Take review of work activity and make preparation for removal of equipments and material from all areas.
- Isolate/Turn off all electrical power from the main panel/switches. Secure and anchor panels properly.
- Recheck anchorage/tie of all temporary structures/sheds, tall objects, cranes, rigs, scaffolds etc to avoid toppling due to wind force.
- Cranes boom shall be either locked or lowered the booms as reasonably & practicably and rigs to safe position for the safety point of view.
- Group up all trash barrels, wooden pallets, forms; wooden decks etc. and anchor properly.
- Welding machines, air compressors, and such equipments are to be grouped together and secured to the stable objects. Welding leads, electrical cables, hoses are to be rolled up and secured properly.
- Set on site vehicles on high ground in the site area with brakes set firmly.
- Anchor all tanks, vessels, gas cylinders that may be moved by high wind and water.

- Evacuate job site.

D. **PERSONNEL EVACUATION**:

Personnel Evacuation will be required if predicted wind speed and storm surge heights are beyond acceptable limits as per the guidelines of BHEL management.

Special cyclone shelter shall be arranged in consultation with BHEL management. This shelter shall be equipped with first aid kit and emergency kit containing torch, sufficient batteries, jackets, emergency treatment manual. The map of escape routes and other site specific instructions of emergency situations shall be prominently displayed in the shelter.

Once the warning received from Client/Consultant, the emergency response team shall evacuate and transport all personnel involved in the project to the cyclone shelter.

Cyclone may 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”.

After the cyclone do not go outside until officially communicated about safe situation outside. Use recommended routs for returning. Do not panic or rush while returning.

Checking of gas leaks and wellbeing of electrical appliances is essential before leaving the site.

Listen to local radio for official warning and advice. The site manager shall also obtain updates from client/consultants/metrological departments and communicate to the personnel on project site.

E. MONSOON:

During monsoon following precautions needs to be considered.

- **Excavation:** Inspect all excavations and protect from collapsing or subsidence. Clear all excavated material.
- **Storm water drains:** Check all storm water drains ahead of monsoon for any blockage etc. Identify way for draining out water collected in the site. If required, temporary drains should be prepared for draining out accumulated water in site. The sufficient number of dewatering pumps should be available for the purpose and logged water shall be pumped to nearest drain by dewatering pumps.
- **Access Routes:** Identify access routes to the site in case of flood. Sand should be available to spread over slippery surface.
- **Electrical Supply:** Beforehand check earthing of electrical panels and electrical cables for joints, cracks, insulation failure etc. Keep additional stock of electrical cables and plug tops for replacement of damaged one or to energize dewatering pumps. Do not keep electrical cables/welding cables on the ground but route them above head level. Do not use welding / DB sheds as shelters. All electrical equipment shall be equipped with ELCBs/RCCBs.
- **Power Cable route demarking:** cable rout shall be demarked by either by temporary or permanent.
- **Scaffolding:** Check all scaffolds for stability after heavy rain/storm.

- **Work restrictions:** Do not perform any height work, electrical work and rigging activities during rain. Lower the crane boom to avoid striking of lightning.
- **Vehicular movement:** Instruct the vehicle operators about following safety precautions during monsoon in daily tool box meeting, Slippery surface and road conditions, Speed limit, Wind shield wiper, Fog light, break condition is proper, break light is in proper condition & functioning. Not to take vehicle in loose soil.
    - **Lightening protection:** Boiler structure shall be facilitated with thunder protecting equipment.
    - **Workmen shed construction:** workmen rest shed shall be constructed in robust way. RCC pillar shall be used instead of brick pillar. It shall be facilitated with lightning arrestor as per site resource. However if the rest room is nearby high mast light. Lighting arrestor may or may not be provided.
    - **Field Training Programme on Lightening/Thunder: Dos or Dos not.**

F. SAFETY PRECAUTIONS FOR SNAKE MENACE:

Preventive Measures –

③ Remove vegetations around the site

③ Pour Carbolic acid around site boundaries in regular intervals to keep away poisonous snakes. . In summer and rainy season, frequency will be once a month and in other seasons, it will be once a quarter. It may be noted that as the location of the project is on a sand bed, there is almost no wild growths. Hence, Snake menace may not of significant severity and scale.

Precautions to avoid snake bite –

③ Avoid stepping out in the dark, especially during monsoon without safety shoes and torch.

③ Before wearing shoes, check inside the shoes for any snake/insect hiding inside. Similarly before lifting any material with hand lying on ground for long time, look for snake/insect handling inside. Wear leather hand gloves. Always check inside gunny bags, cartons, boxes before putting your hand in side or lifting them.

③ Be aware of your surroundings at all time. Never sit or step over obstacles without looking carefully. Never go near bushes for natural calls.

③ Don't chase snakes as they become aggressive. Never try to hit a snake or try to catch it, where there is one, there are likely others.

③ Never handle a snake, even if you think it is dead.

Symptoms of Snake Bite –

③ A pair of punctured mark, severe pain, Redness & swelling around bitten area

③ Victim gets nausea, vomiting sensation, sweating, disturbed breathing and increased salivation.

Actions required in case of snake bite –

③ Reassure the victim

③ Immobilize the bitten body part without compression.

③ Get the patient to hospital as fast as safely possible

③ Tell the doctor any of the symptoms appearing on the way to the hospital.

Snakebite Emergency: DO's and DON'Ts

Do's:

③ Avoid yourself and victim from the risk of second bite.

③ Remove tight clothing, shoes, watch or ring near bitten area before swelling starts. Calm the victim. Tell victim that virtually all snakebites are successfully treated. Panic can increase the danger to the victim by inducing rapid heartbeat.

③ Clean / disinfect bite area thoroughly, apply hard direct pressure with gauze pad over bite area, soak gauze pad with Betadine if possible before application and strap pad tightly in place with adhesive tape

③ Wrap affected extremity with 2" – 3" elastic bandaging as tightly as one would for sprain, keep the affected extremity positioned at or as close to heart level as possible and immobilize affected extremity; use a splint if possible.

③ Get medical attention as soon as possible

③ Ensure the availability of anti venom serum in the hospital.

Don'ts:

③ Do not bleed the wound, cut or increase bite marks or put ice on the bite

③ Do not eat or drink anything and engage in strenuous physical activity

③ Do not apply oral suction to bite

③ Do not take alcoholic beverage or any self medication

③ Do not apply cold / hot packs or burn wound

③ Do not delay seeking medical attention

③ Do not remove dressings/elastic wrap until at hospital

G. EMERGENCY CONTACT LIST:

Following emergency contact numbers shall be available / displayed at site and updated regularly.

Emergency Contact Numbers

(Contact numbers to be filled by Site Management)

Client		
	Project Manager	
	Plant Safety Manager	
	OPGC Fire Services	
	Medical and Ambulance Services	
	ADMIN-OPGC	
	Security- OPGC	

BHEL		
	RCM	
	Safety Manager	
	HSE COORDINATOR	
	HR-ADMIN	
SUB-CONTRACTOR		
	RCM	
	Project Manager	
	Safety Manager	
	Ambulance	
	HR-ADMIN	
Emergency Services		
	Near Hospital	
	Near Fire Station	
	Ambulance Service	
	Police Station	

32.0 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 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.

32.1 DAILY HSE CHECKS

Both the Site Supervisors and safety officer of Subcontractor 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:

- Personal Safety wears & gear compliance.
- Complying with site safety rules and permit-to-work (PTW).
- Positions and postures of workers.
- Use of tools and equipment etc. by the workers.
- The inspection should 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.

32.2 INSPECTION OF PPE

- PPEs shall be inspected by HSE officer at random once in a week as per format no. HSEP:14-F06 for its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
- The applicable PPEs for carrying out particular activities are listed below.

32.3 INSPECTION OF T&Ps

- A master list of T&Ps shall be maintained by each subcontractor.
- All T&Ps being used at site shall be inspected by HSE officer once in a month as per format no. HSEP:14-F07 for its healthiness and maintenance.
- 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.
- The validity of T&P shall be monitored as per "Status of T&Ps" format no. HSEP:14-F08

32.4 INSPECTION OF CRANES AND WINCHES

- 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.
- Cranes and Winches shall be inspected by HSE officer once in a month as per format no. HSEP:14-F09 for healthiness, maintenance and validity of third party inspection.
- The date of third party inspection and next due date shall be painted on cranes and winches.
- The operators/drivers shall be authorized by sub-contractor based on their competency and experience and shall carry the I-card.

32.5 INSPECTION ON HEIGHT WORKING

- Inspection on height working shall be conducted daily by supervisors before start of work to ensure safe working condition including provision of
    - Fall arrestor
    - Lifelines
    - Safety nets
    - Fencing and barricading
    - Warning signage
    - Covering of opening
    - Proper scaffolding with access and egress.
    - Illumination
- Inspection on height working shall be conducted once in a week by HSE officer as per format no. HSEP:14-F10.

- Medical fitness of height worker shall be ensured.
- Height working shall not be allowed during adverse weather.

32.6 INSPECTION ON WELDING AND GAS CUTTING OPERATION

- Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
- Gas cylinders shall be kept upright.
- Use of Flash back arrestor shall be ensured at both ends.
- Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per format no. HSEP:14-F11.
- Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
- Availability of fire extinguisher at vicinity shall be ensured.

32.7 INSPECTION ON ELECTRICAL INSTALLATION / APPLIANCES

- Ensure proper earthing in electrical installation
- Use ELCB at electrical booth
- Electrical installation shall be properly covered at top where required
- Use appropriate PPEs while working
- Use portable electrical light < 24 V in confined space and potentially wet area.
- Monthly inspection shall be carried out as per format no. HSEP:14-F12.

32.8 INSPECTION OF ELEVATOR

- Elevators shall be inspected by concerned supervisors once in a week as per format no. HSEP:14-F13.
- All elevators shall be inspected by competent person and validity shall be ensured.
- The date of third party inspection and next due date shall be painted on elevator.

33.0 HSE PERFORMANCE EVALUATION:

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 mobilisation	7.0,7.1	10	
2	Attendance by the safety officer and site CM (as applicable) in the meeting convened by BHEL	7.2.1 and 7.2.2	5	
3	Level of compliance w.r.t decisions taken in previous meetings/audit/inspection/as reported.	32.0,35.0,36.0	5	
4	Timely submission of monthly report on safety in the prescribed format		3	
5	Timely reporting any incident including near–miss to BHEL /Customer/statutory authority(if required) and submission of investigation report of all LTIs/ Major Property Loss incident and HSE events	10.0	10	

6	Degree of PPE compliance, Fall protection arrangements and safety net coverage	8.3, 19.2,19.3	15	
7	Level of compliance w.r.t safety rules	11.0 to 26.0	25	
8	Availability of proper first-aid facility , ambulance, hygienic labour colony and other adequate labor welfare initiatives, conducting of health check-up as per BOCW requirements	8.4	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, 31.0	6	
10	Level of House-keeping, Environmental Control	27.0, 28.0, 29.0	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.

33.1 HSE PENALTIES/ REWARDS (Performance Related)

- Suitable HSE reward system shall be developed at site level to promote HSE compliance amongst workmen.
- To decide HSE reward performance towards HSE shall be evaluated for workmen and it shall be awarded regularly in public gathering.
- 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.

33.2 PENALTIES AGAINST SPECIFIC NON-COMPLIANCE WITH HSE RULES/ INCIDENTS: (To be operated in addition to any other deduction on unsatisfactory HSE performance under relevant clause in the contract)

S. No	Nature of Non - Compliance	Penalty in Rs.	Remarks
1.	Not wearing safety helmet/ safety shoes/ welding shield	250	Per lapse/ Person/ day
2.	Not wearing double lanyard full body harness while working at height (> 2 metres)or not anchoring to lifeline/ not providing fall arrestor/ safety net Using defective or non-standard or uninspected scaffolding/ scaffolding not properly supported Using defective ladders/ drums for work at height	1000	Per Person/ lapse/day or per lapse/day
3.	Not wearing gloves/ goggle/earplug/nose mask/ apron	250	Per lapse/ Person/ day
4.	Not using 24 V supply for lighting in confined spaces	500	Per occasion

5.	Improper earthing of welding & Other electrical machines and DBs/ no ELCB/ no rubber mat/ not properly covered/ person without valid wireman license/ no Tag in-Tag out	500	Per lapse/ Machine
6.	Electrical plug not used for connection/ loose insertion	200	Per connection
7.	Using damaged slings or not slinging properly/ damaged hooks/ slings without any identification mark/	1000	Per event Per T&P
8.	Use of lifting equipments including cage or man-basket without having valid Test certificate / without SLI display	5000	Per equipment
9.	Using frayed/ broken welding cables / not using double insulation electrical cable	500	Per machine
10.	Non removal of scrap from work areas and shift to scrap yard/ not providing bins/ improper house keeping	1000	Per location
11.	Lifting cylinders without cage or rolling of cylinders	500	Per occasion
12.	Gas cutting without flash back arrestor at both ends	200	Per machine
13.	Gas cutting at height without sheet below/ barricade at level below (Spark falling from height)	500	Per event
14.	Not having valid driving license for the type of vehicle/ T&P/operator identification card/ rash driving or operation/ not having safety devices like reverse horn & light/ overload switch	500	Per driver / operator
15.	Not providing proper barricades / signage/ unauthorized excavation or barricading	500	Per location per day
16.	Not keeping filled gas cylinders vertically/ mix-up of cylinders/ using broken or damaged manifold/ using domestic LPG cylinder	500	Per occasion
17.	Activity carried out without valid safety work permit	1000	Per occasion
18.	Not carrying out mandatory health check up/ not maintaining First aid box/ centre properly	1000	Per occasion
19.	Non reporting of incident in time / completion of CAPA in time	1000	Per occasion
20.	Non-display of emergency numbers/ non-availability of sufficient fire-extinguishers/ insufficient display of safety posters/ insufficient initiative for safety promotion like TBM	1000	Per occasion

- 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
- The penalty amount shall be recovered from subcontractors from the RA Bill, otherwise Final bill.
- The list of non-compliances is not exhaustive. The site CM has liberty to impose a penalty for any other non-compliance and incidents of any nature including fatality and permanent disability.

340 OTHER REQUIREMENTS

- 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 notifying the subcontractor suitably.
- 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 issued by BHEL, 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.
- 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, favorably consider to reward the subcontractor suitably for the performance.
- In case of any damage to property due to lapses by the subcontractor, BHEL shall have the right to recover the cost of such damages from the subcontractor after holding an appropriate enquiry.
- The subcontractor shall take all measures at the sites of the work to protect all persons from incidents and shall be bound to bear the expenses of defense of every suit, action or other proceeding of 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 subcontractor be paid to compromise any claim by any such person, should such claim proceeding be filed against BHEL, the subcontractor hereby agrees to indemnify BHEL against the same.
- The subcontractor 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, overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.
- The subcontractor 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 subcontractor shall adhere to such instructions.
- BHEL may prohibit the use of any construction machinery, which according to the organization is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL.

35.0 HSE AUDIT/INSPECTION

- Regular HSE Audit/inspection shall be carried out by Subcontractor as per Site HSE audit calendar.
- HSE checklist**(Annexure 02)**shall be used for carrying out audit/inspection and report shall be submitted to BHEL site mangement
- All non-conformities and observations on HSE identified during internal or external HSE audit shall be disposed off by site in a time bound manner and reported back the implementation status
- Corrective action and Preventive action on HSE issues raised by certification body issued by Regional HQs shall be implemented by site and reported to Site management.

36.0 MONTHLY HSE REVIEW MEETING

- Site shall hold HSE review meeting every month 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 and Preventive action. The agenda is given below:
  - Implementation of earlier MOM
  - HSE performance
  - HSE inspection
  - HSE audit and CAPA
  - HSE training
  - Health check-up camp
  - HSE planning for the erection and commissioning and installation activities in the coming month
  - HSE reward and promotional activities
- The meeting shall be chaired by Construction Manager, convened by HSE coordinator and attended by all HOS, Site In charge of Subcontractors and HSE officer of Subcontractors. MOM on the discussion will be circulated to the concerned for implementation.

37.0 FORMATS USED (Details available in Annexure-04) (subject to revisions any time during the contract)

SL. No.	Format Name	Format No.	Rev No.
01	Inspection of First Aid Box	HSEP:14-F01:MAITREE	00
02	Health Check Up	FORM-26	00
03	HSE Induction Training	HSEP:14-F03	00
04	Tool Box Talk	HSEP:14-F04	00
05	MONTHLY HSE REPORT AND HSE INDICES	HSEP:14-F05	00
06	Inspection of PPE	HSEP:14-F06	00

07	Inspection of T&Ps	HSEP:14-F07	00
08	Status of T&Ps	FORM-24	00
09	Inspection of Cranes and Winches	HSEP:14-F09	00
10	Inspection on Height Working	HSEP:14-F10	00
11	Inspection on Welding & Gas Cutting	HSEP:14-F11	00
12	Inspection on Electrical Installation	HSEP:14-F12	00
13	Inspection on Elevator	HSEP:14-F13	00
14	Hse Performance and Penalty	HSEP:14-F14	00
15	incident / property damage /fire incident report	HSEP:14-F15	00
16	Crane operators Identification cum Authorization	HSEP:14-F16	
17	List of T&P	FORM-24	00
18	WORK PERMIT- EXCAVATION (DEEP)	HSEP:14-F18	00
19	WORK PERMIT- RADIATION	HSEP:14-F19	00
20	WORK PERMIT- CONFINED SPACE	HSEP:14-F20	00
21	WORK PERMIT- WORK-AT-HEIGHT (ABOVE 1.8M)	HSEP:14-F21	00

36.0 ANNEXURES

ANNEXURE 01

As per Rule 76(2):

(1) The first-aid box shall be distinctively marked with a GREEN Cross and shall contain the following items, namely:

(a) For establishments in which the number of contract labour 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)	A bottle containing 100 tablets (each of 5 grains) of aspirin
(xviii)	Ointment for burns
(xix)	A bottle of suitable surgical anti-septic solution
(xx)	3 packets of ORS

(2) Adequate arrangement shall be made for immediate recoupment of the equipment when necessary.

ANNEXURE 02

HSE AUDIT/INSPECTION CHECKLIST CUM COMPLIANCE REPORT

PROJECT:_____ SUBCONTRACTOR:_____

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				
PERSONNELPROTECTIVEEQUIPTMENTS				
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 $\pm$ 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.				

Bharat Heavy Electricals Ltd **HSEP:13-F04**
Power Sector- Eastern Region **Date:**
PROJECT:_____
(TO BE SUBMITTED IN TRIPLICATES)

EXCAVATION WORK PERMIT

Sl No:

I. Name of the work:
II. Name of Contractor:
III. Exact location of work and item for excavation:
IV. Duration of work: From to
V. Type of excavation: Manual/ by Excavator
VI. Dimension of excavation:

The following items have been checked and compliance shall be ensured during the currency of the permit:

item	**Done**
1. Checked for underground pipe/power cable	
2. Proper illumination provided (for night work)	
3. Plan/drawing available and checked (sloping, shoring provided). Safety of any adjacent structure taken care of.	
4. Access/Egress ensured (in case of manual)	
5. Equipment operator skill checked	

6. Area cordoned off, signage put up	
7. Appropriate PPEs provided	

The following persons are permitted to work for the duration mentioned herein:

Date		No of persons allowed	Time Duration	
From	To		From	To

List of persons to be maintained by contractor separately

Sign of Initiator (Sub-contractor)

Sign of Recommender

Sign of Approver

Work completed/stopped/area cleared at _____on__

The permit stands closed on_____

Sign of BHEL HSE team

Bharat Heavy Electricals Ltd **HSEP:13-F05**
Power Sector- Eastern Region **Date:**
PROJECT:_____
(TO BE SUBMITTED IN TRIPLICATES)

RADIATION WORK PERMIT

Sl No:

I. Name of the work:
II. Name of Contractor:
III. Exact location of work and item for radiography:
IV. Duration of work: From to
V. Name of Radiography agency and its authorised supervisor:

The following items have been checked and compliance shall be ensured during the currency of the permit:

item	**Done**
1. Safety regulations as per BARC/AERB ensured while source in use/transit/stores	
2. Proper illumination provided	
3. Area cordoned off	
4. Appropriate PPEs provided	

The following persons are permitted to work for the duration mentioned herein:

Date		No of persons allowed	Time Duration	
From	To		From	To

List of persons to be maintained by contractor separately

Sign of Initiator (Sub-contractor)

Sign of Recommender

Sign of Approver

Work completed/stopped/area cleared at _____on__

The permit stands closed on_____

Sign of BHEL HSE team

Bharat Heavy Electricals Ltd **HSEP:13-F06**
Power Sector- Eastern Region **Date:**
PROJECT:_____
(TO BE SUBMITTED IN TRIPLICATES)

CONFINED SPACE WORK PERMIT

Sl No:

I. Name of the work:

II. Name of Contractor:

III. Exact location of work:

1. **Condition check of target space**:

Condition	**Y/N**	**NR**
8. Isolated from air/ water/ steam/ gas/ power/radiation source		
9. Thoroughly cleaned/washed		
10. Adequately cooled		
11. Proper illumination provided		
12. Manways open & ventilated		

2. **Protection measures:**

Measure	**Y/N**	**NR**
1. Handlamp is of 24V		
2. Operators wearing recommended PPEs- gloves/ clothing/ear plug/ muff/ safety harness/lifeline/ goggles /face shield		

3. Operators wearing special devices – dust/gas/airline mask, communication equipment, personal gas alarm		
4. Attendant with SCBA/Air mask		
5. Rescue equipment/ team deployed		
6. Fire fighting equipment close-by		

The following persons are permitted to enter the confined space to work for the duration mentioned herein:

Date(s)	No of persons allowed	Name of persons allowed	Duration From	Duration To

Sign of Initiator (Sub-contractor)

Sign of Recommender

Sign of Approver

Work completed/stopped/area cleared at _____on__

The permit stands closed on_____

Sign of BHEL HSE team

Bharat Heavy Electricals Ltd **HSEP:13-F07**
Power Sector- Eastern Region **Date:**
PROJECT:_____
(TO BE SUBMITTED IN TRIPLICATES)

WORK-AT-HEIGHT PERMIT

Sl No:

I. **Name of the work:**
II. **Name of Contractor:**
III. **Exact location of work:**

Sl.	Description of the point to be checked	Pl tick (√) if it is OK
1.	Whether the manpower of the Gang engaged is having adequate number and skill required for the said activity?	
2.	Whether Supervisor has been engaged for this activity?	
3.	Whether following PPEs have been provided to all workers?	
	Full body Harness, Safety Shoe, Helmet	
4.	Whether Lifelines tied with solid anchorage above 1 M level from the job?	
5.	Whether Tool-Box meeting carried out and Hazard related to the said job and safety precaution to be taken told to workers?	
6.	Whether Fall arrestor fixed where staircase is not available for access to job?	
7.	Whether Scaffold/Platform/Place for job is strong enough, has easy access and is safe for the job? Is the Space sufficient for doing work? Whether Safety Net has been fixed?	
8.	Whether all Lifting T&Ps and Tackles have valid Fitness Certificates? Whether Lubrication is Ok? Whether these are free from any defect when visually checked before use?	
9.	Pl ensure that none of the workers of the Gang has Vertigo or High or Very Low Blood Pressure. (Health register to be referred)	

The following persons are permitted to work for the duration mentioned herein:

Date		No of persons allowed	Time Duration	
From	To		From	To

List of persons to be maintained by contractor separately

Sign of Initiator (Sub-contractor)

Sign of Recommender

Sign of Approver

Work completed/stopped/area cleared at _____on__

The permit stands closed on_____

Sign of BHEL HSE team

HSEP:13-F09

BHEL

Bharat Heavy Electricals Limited
Power Sector Eastern Region

INCIDENT (PERSONAL INJURY / PROPERTY DAMAGE) REPORT

(This report is to be sent within 24 hours directly to GM/Q &S/PS-HQ, , Noida with copy to MR(HSE)/PSER in respect of all incidents in addition to immediate Fax / Telegraphic intimation of fatalities and major damages including fires.)

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 INCIDENT		7	DATE RESUMED	
8	NO. OF WORK-DAYS LOST BY VICTIM (If duty not resumed, give estimated figure)				
9	NO. OF MANHOURS 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 INCIDENT / INJURY / DAMAGE					
12	PERSON (NAME & DESIGNATION) WITH MOST CONTROL OVER AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) CAUSING INCIDENT INJURY / DAMAGE				
13	DESCRIBE CLEARLY HOW THE INCIDENT OCCURRED AND IF THE VICTIM WAS WEARING THE APPROPRIATE PPEs. (USE ADDL SHEET, IF REQUIRED).				

ANALYSIS		
14	**WHAT ACTS AND / OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS INCIDENT**	
15	**WHAT ARE THE BASIC REASON FOR THE EXISTENCE OF THESE ACTS AND / OR CONDITION ?**	
16	**WHAT CORRECTIVE ACTIONS HAVE BEEN TAKEN TO PREVENT INCIDENT RECURRENCE ?**	
	DATE :	**SIGNATURE OF SITE HSE COORDINATOR**
17	**COMMENTS OF HEAD / SOX**	
	DATE:	**SIGNATURE OF HEAD/SOX**

BHARAT HEAVY ELECTRICALS LIMITED HSEP:13-F10
POWER SECTOR: EASTERN REGION

INVESTIGATION REPORT FROM PROJECT SITE :

INCIDENT(FATAL/SERIOUS INJURY/PROPERTY DAMAGE/FIRE)

DATE :

Instructions			
This report is to be sent within seven days to GM/Q&S/PS-HQ and RHQ Safety Department, in respect of incident requiring investigation by a committee.			
Report date	**Incident Date**	**Incident Time**	**Incident Type**
Name of Site :			
Scope of work :			
Name & Designation of BHEL Package I/C			
Name of Contractor :			
Incident Location :			
Victim(s) Information			

Name	**Designation**	**Age**	**Sex**	**Address**

Witness Information	
Name	**Address**

1	**Describe, how the incident took place (Attach separate sheets, diagrams, and photographs, if possible.)**
2	**Description of Injury (Attach medical report as applicable)**
3	**Describe property and equipment damaged in the incident and extent of damage.**
4	**Describe any personal protective equipment used and other safety equipment that were in place.**

5	**Describe any perceived actual or possible safety violations in the area of incident.**

6	**Describe events and conditions immediately before the incident.**
7	**Are these conditions still in existence?**
8	**Were any unsafe actions performed by the victim or by others or were any safety rules violated that caused/ contributed to the incident.**

9	**Describe steps taken to secure the area.**

10	**Describe measures to be taken to prevent similar recurrences.**
11	**Any other information**

Prepared by			
Name	**Designation**	**Signature**	**Date**

Submitted to:

1 Construction Manager
2 RHQ: Safety Department
3 GM/Q&S/PS-HQ

POWER SECTOR

TOOL-BOX TALK

FORMAT NO: HSEP:13-F11
REV NO.: 00
PAGE NO. 01 OF 01

Name of Site :

Sub-Contractors Name :

Date : **Topic:**

Attendance Sheet

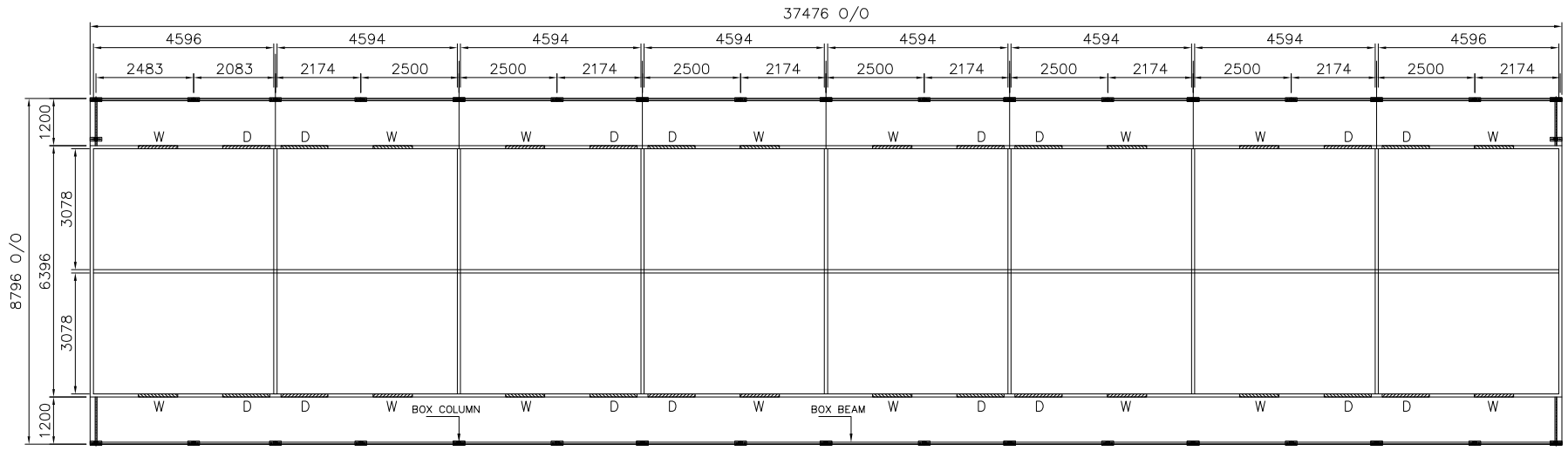
Name	Signature	Remarks

Signature of Site I/C of Subcontractor :

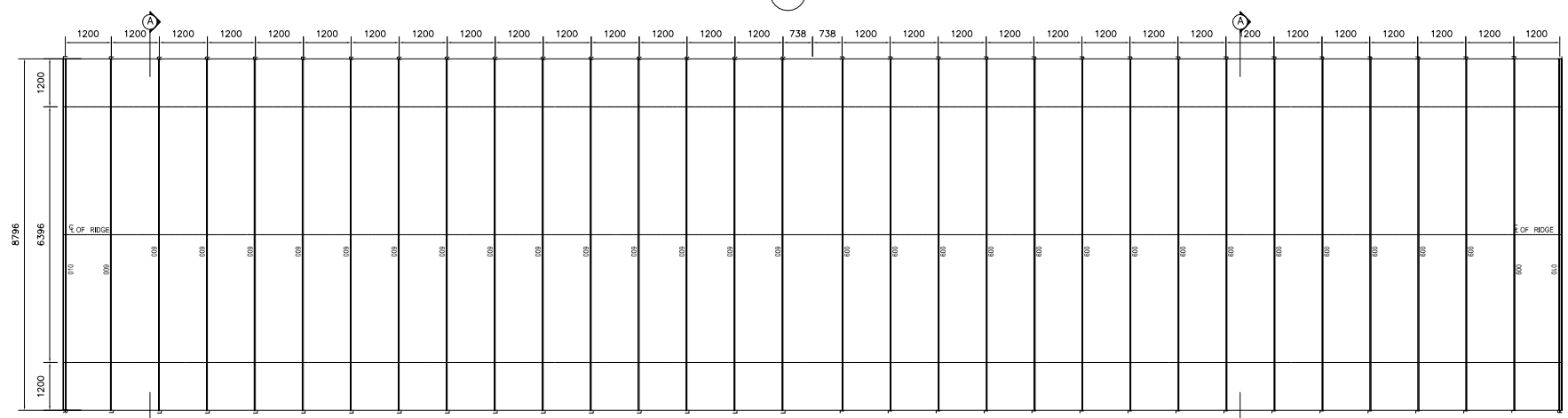
RECORD OF REVISION

CLAUSE No.	Rev No.	Brief of Revision	Date
All	00	New plan introduced	05.04.17

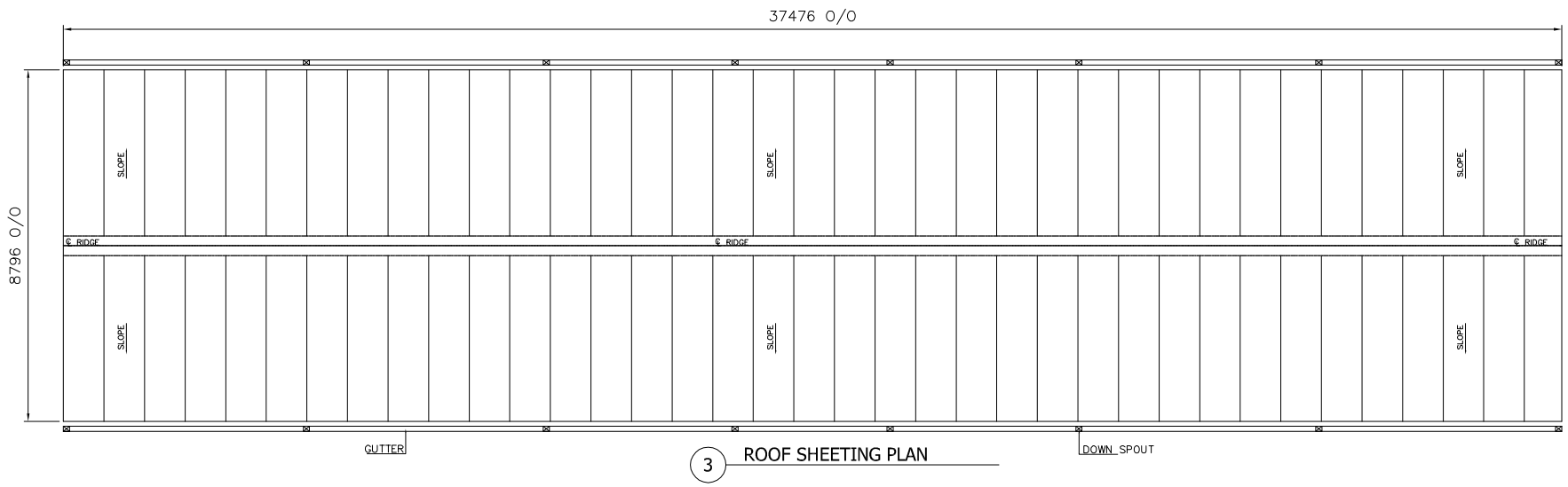
THIS DRAWING IS PURELY FOR APPROVAL PURPOSE ONLY AND NOT FOR CONSTRUCTION



1 WALL FRAME LAYOUT



2 ROOF FRAMING LAYOUT



3 ROOF SHEETING PLAN

LEGEND:

NSW – NEAR SIDE WALL ELEVATION
FAR SIDE WALL ELEVATION
LEFT END WALL ELEVATION
REW – RIGHT END WALL ELEVATION
DFO – DOOR FRAMED OPENING
RUD – ROLL UP DOOR
VFO – VENTILATOR FRAMED OPENING
WFO – WINDOW FRAMED OPENING
NBTBSL– NOT BY TBSL
RV – ROTARY VENT

NOTES:–
1. ALL DIMENSIONS ARE IN MM.

D1 : XXXX(W) X XXXX (H) (00 NOS)
D2 : XXXX(W) X XXXX (H) (00 NOS)
D : XXXX (W) X XXXX (H) (00 NOS)
EX. : XXXX(W) X XXXX (H) (00 NOS)
W : (W) X (H)

PRODUCT : PEB LITE

NOTE : FOR OTHER DETAILS REF. DESIGN DATA SHEET

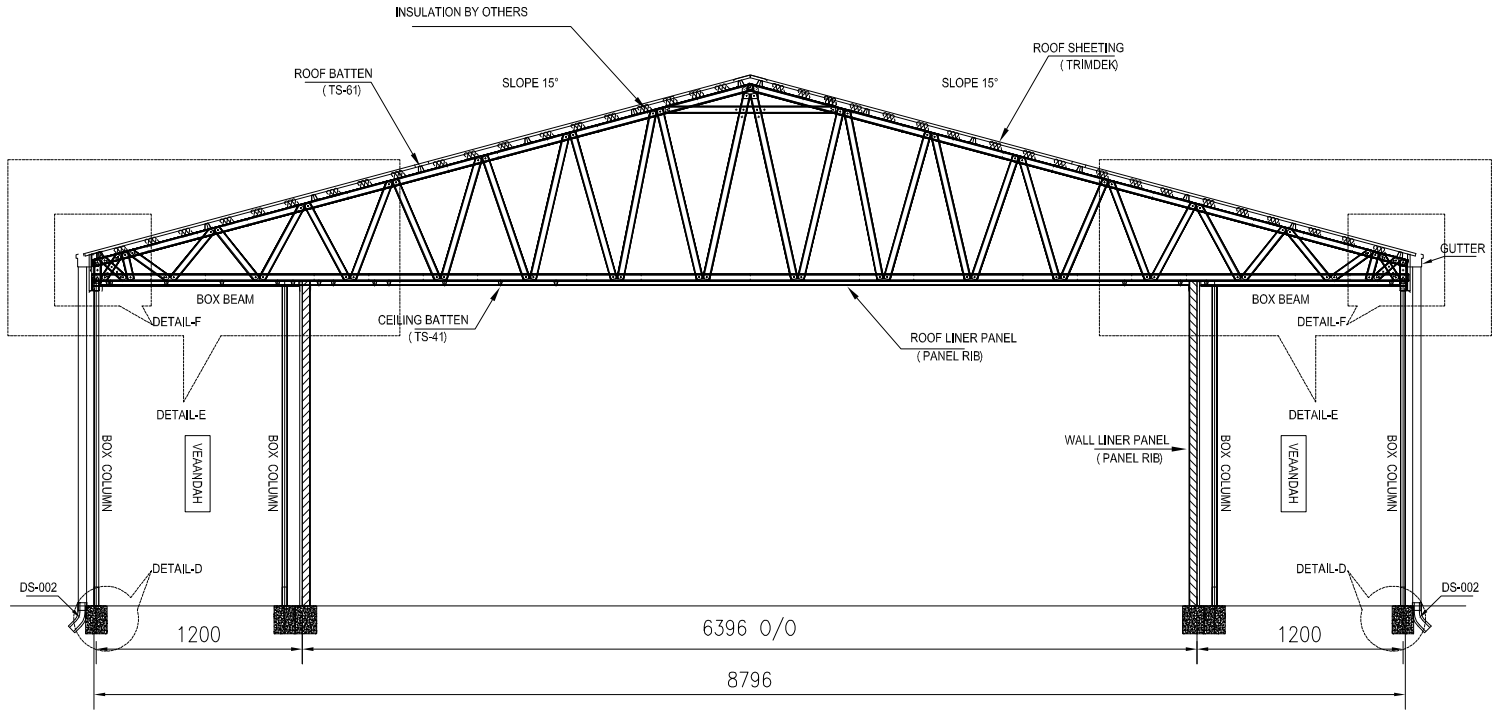
PROJECT NAME:
ROOMS for Labours-BHEL

DRAWING TITLE:
PROPOSAL DRAWING

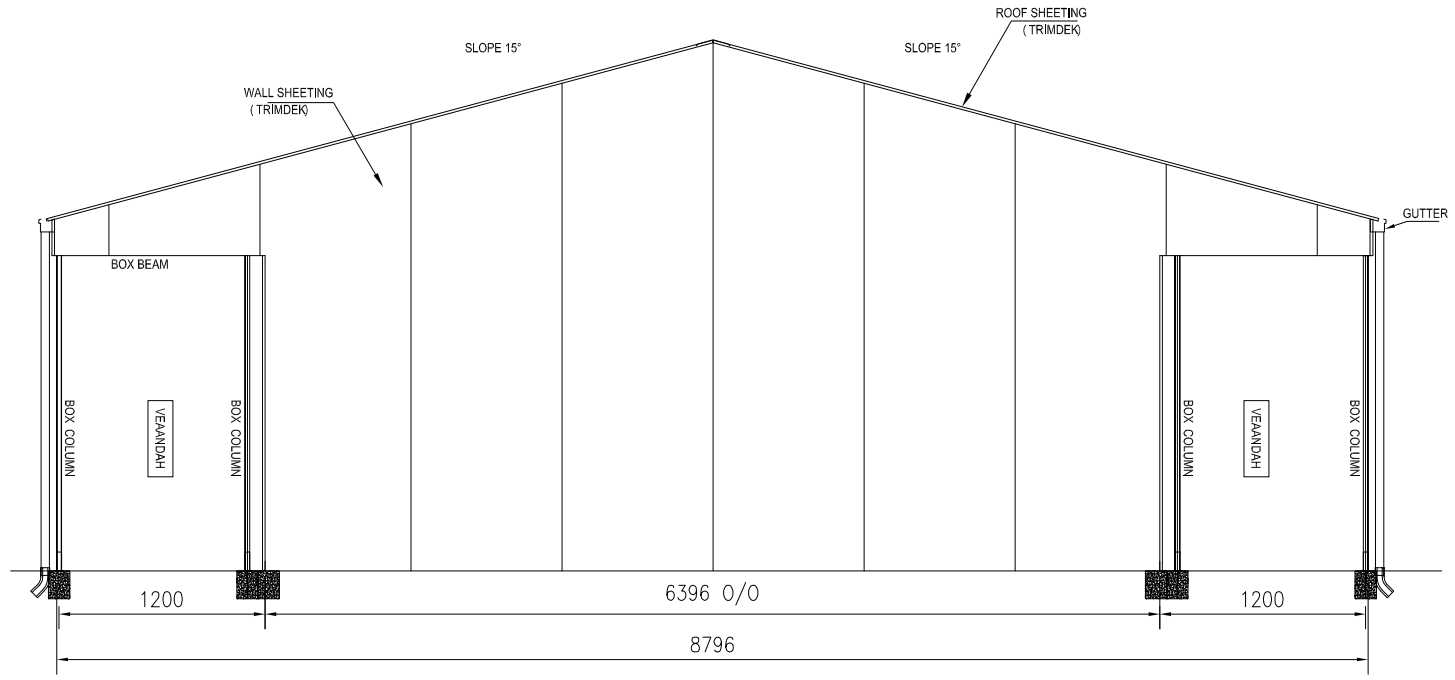
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QUOTE NO : Kolkata		REV: 0
DRG NO : E1	SCALE : NTS	
DRN : NMT	DATE : 26.04.17	
CHK : NMT	REV DATE : 00.00.00	
DSN : WAQ	SENT ON : 26.04.17	A3

TBSL/BPD–ENGG/FORM/007(R1)

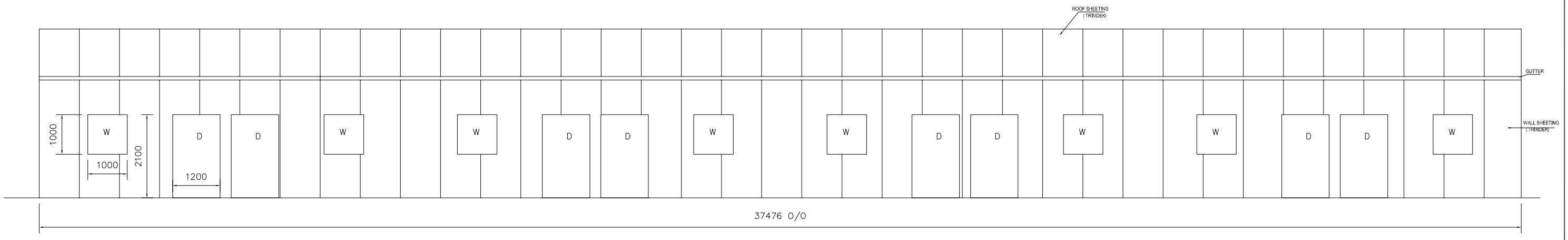
THIS DRAWING IS PURELY FOR APPROVAL PURPOSE ONLY AND NOT FOR CONSTRUCTION



4 TYPICAL CROSS SECTION A-A



5 GABLE SHEETING ELEVATION



6 SIDE WALL SHEETING ELEVATION

PRODUCT : PEB LITE

NOTE : FOR OTHER DETAILS REF. DESIGN DATA SHEET

LEGEND:
NSW – NEAR SIDE WALL ELEVATION
FSW – FAR SIDE WALL ELEVATION
LEW – LEFT END WALL ELEVATION
REW – RIGHT END WALL ELEVATION
DFO – DOOR FRAMED OPENING
RUD – ROLL UP DOOR
VFO – VENTILATOR FRAMED OPENING
WFO – WINDOW FRAMED OPENING
NBTBSL– NOT BY TBSL
RV – ROTARY VENT

NOTES:–
1. ALL DIMENSIONS ARE IN MM.

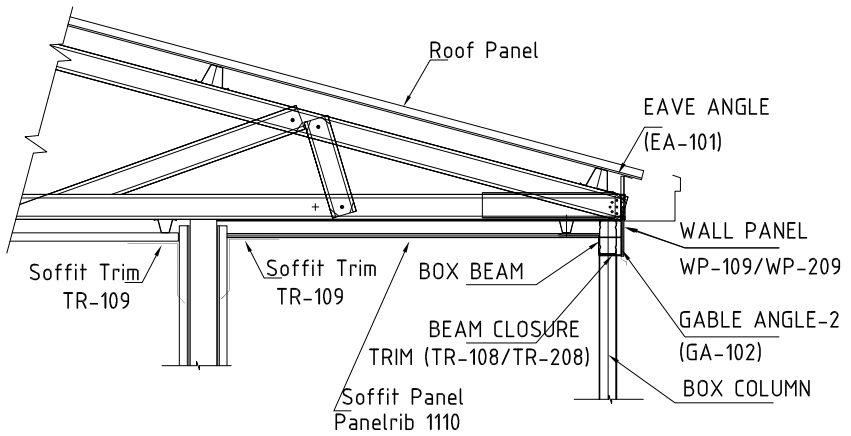
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D2 : XXXX(W) X XXXX (H) (00 NOS)
D : XXXX (W) X XXXX (H) (00 NOS)
EX. : XXXX(W) X XXXX (H) (00 NOS)
W : (W) X (H)

PROJECT NAME:
ROOMS for Labours-BHEL

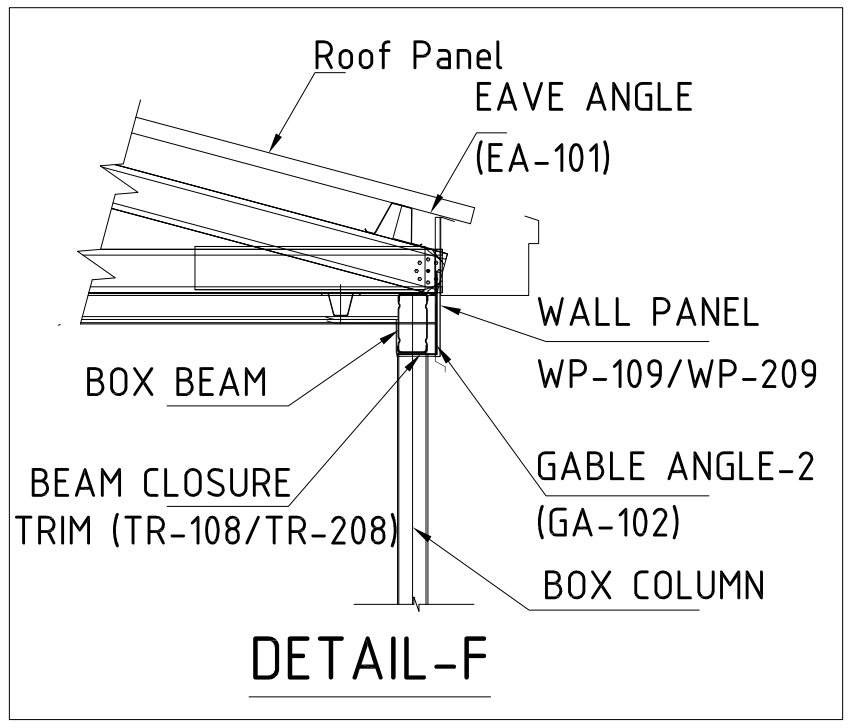
DRAWING TITLE:
PROPOSAL DRAWING

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DRN : NMT	DATE : 26.04.17	
CHK : NMT	REV DATE : 00.00.00	
DSN : WAQ	SENT ON : 26.04.17	A3

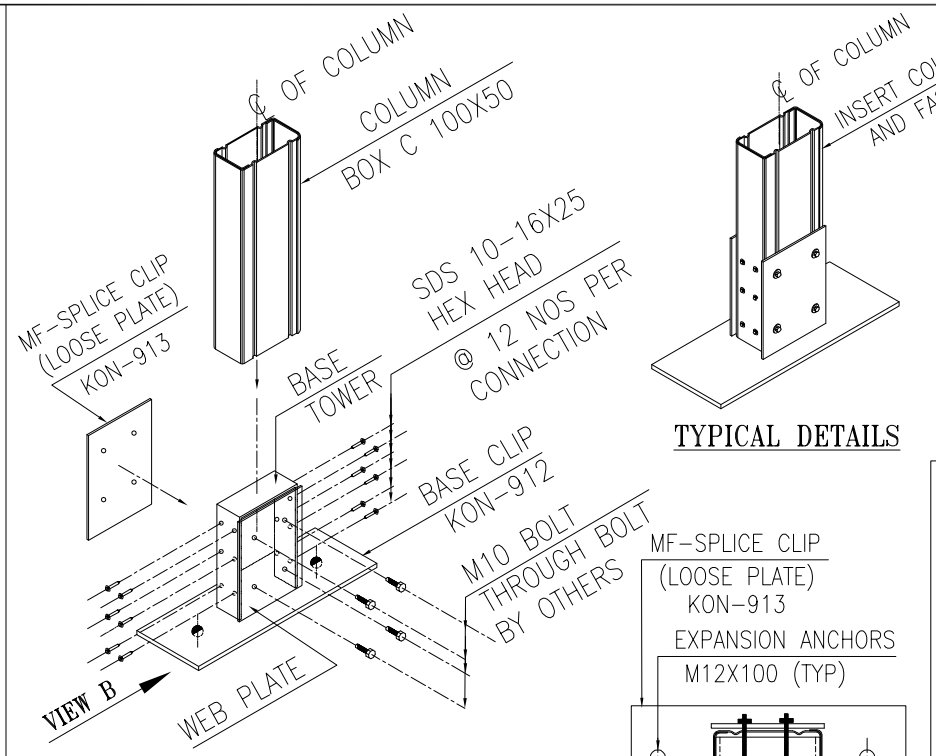
TBSL/BPD–ENGG/FORM/007(R1)



VARANDH PORTION DETAIL-DETAIL-E

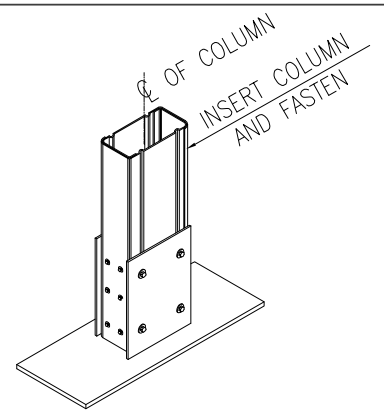


DETAIL-F

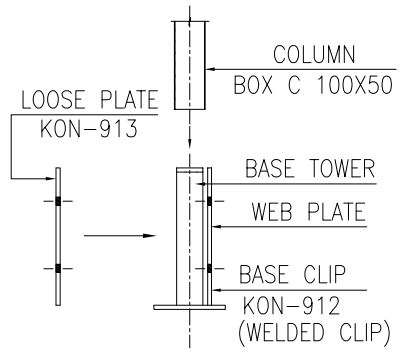


MAIN/END COLUMN BASE CLIP CONNECTION DETAILS

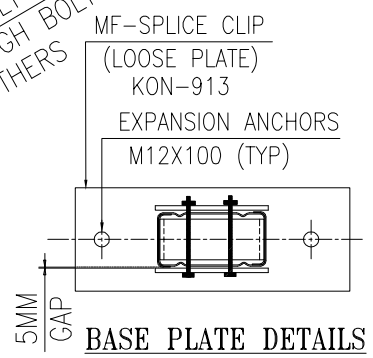
(DETAIL @ A)



TYPICAL DETAILS



VIEW @ B



BASE PLATE DETAILS

NOTES:-

STEP-1, INSERT THE COLUMN IN THE BASE TOWER

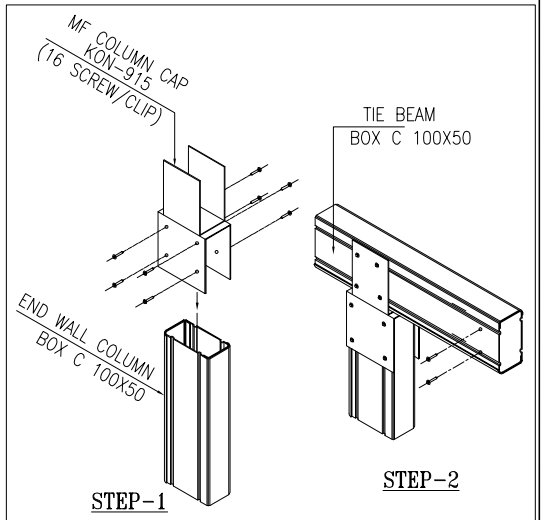
STEP-2, CHECK THE WATER LEVEL AT TOP OF THE COLUMN

STEP-3, SCREW FASTEN THE COLUMN TO BASE TOWER THROUGH FLANGE SIDE AS SHOWN

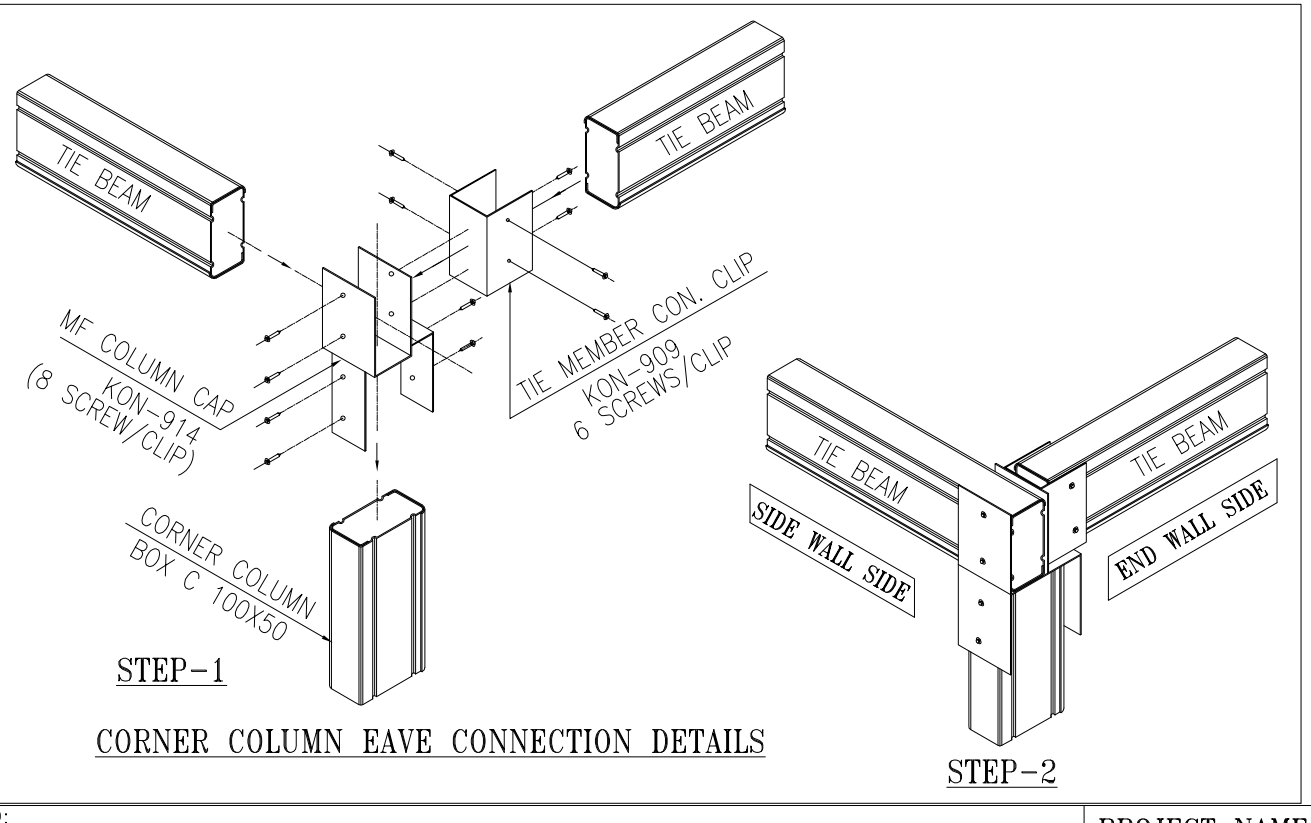
STEP-4, FIELD DRILL DIA 12MM HOLE TO COLUMN MATCHING THE WEB PLATE

STEP-5, INSERT M10 THROUGH BOLT FROM WEB PLATE AND PLACE THE LOOSE PLATE PART MARK KON-913 ON THE OTHER SIDE OF WEB PLATE AND THEN TIGHTEN THE BOLTS

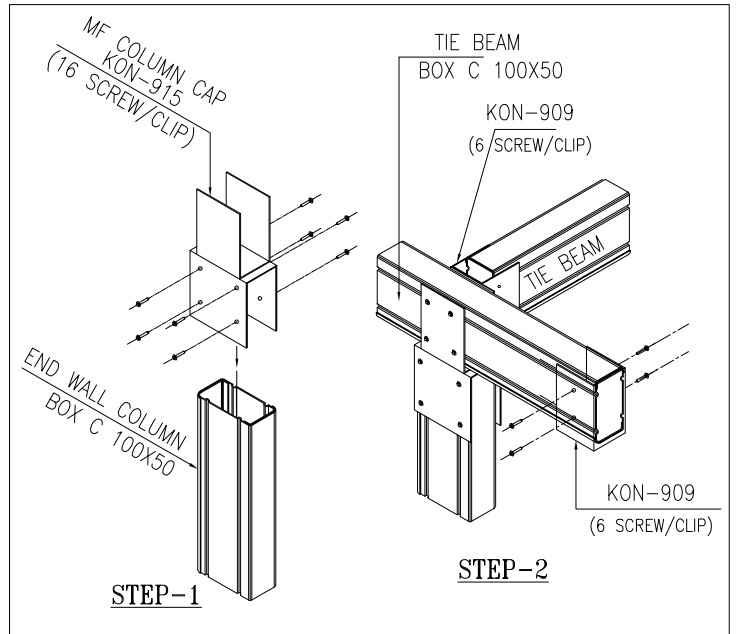
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COLUMN TO TIE BEAM CONNECTION



CORNER COLUMN EAVE CONNECTION DETAILS



COLUMN TO TIE BEAM CONNECTION

PRODUCT : PEB LITE

NOTE : FOR OTHER DETAILS REF. DESIGN DATA SHEET

LEGEND:

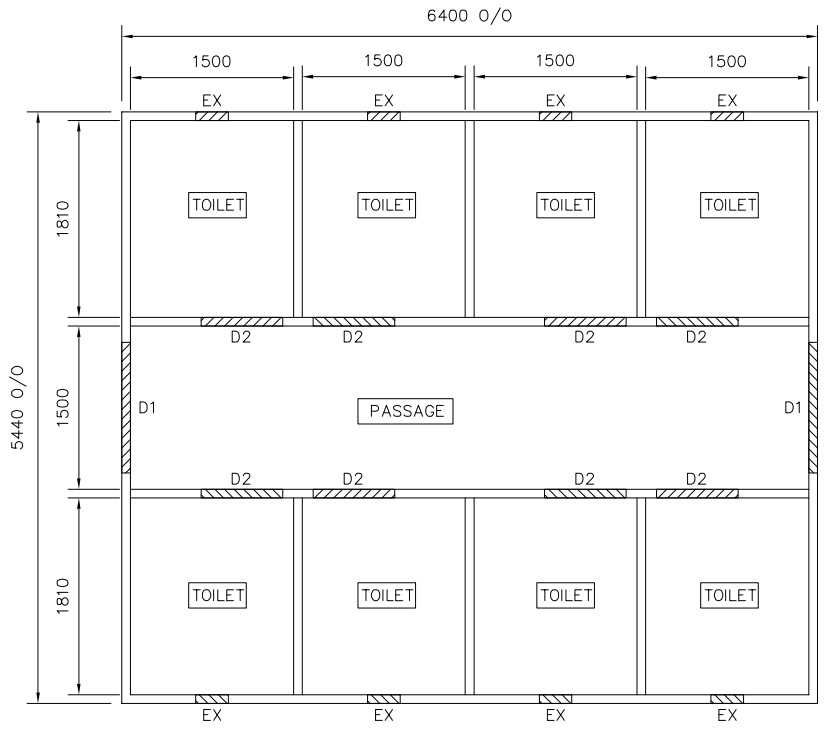
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NOTES:–
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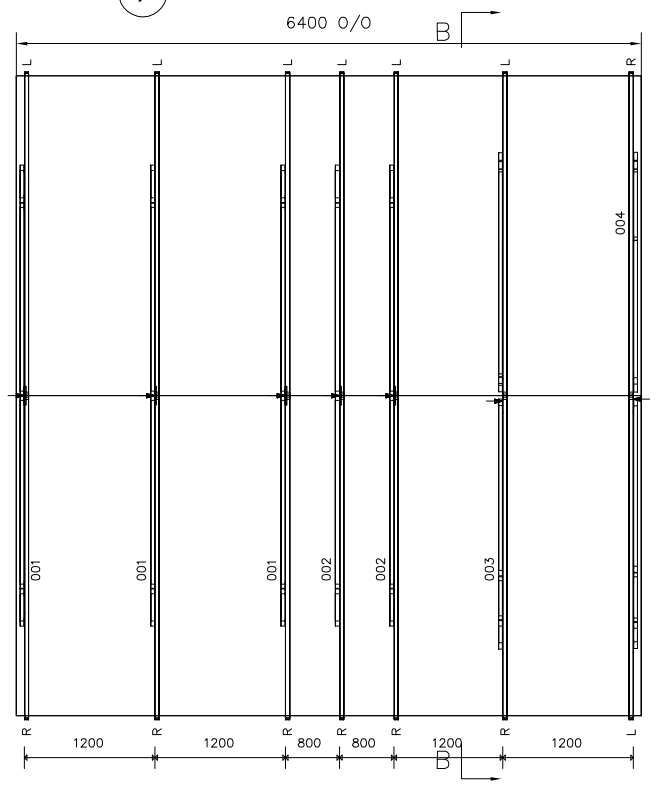
D1 : XXXX(W) X XXXX (H) (00 NOS)
D2 : XXXX(W) X XXXX (H) (00 NOS)
D : XXXX (W) X XXXX (H) (00 NOS)
EX. : XXXX (W) X XXXX (H) (00 NOS)
W : (W) X (H)

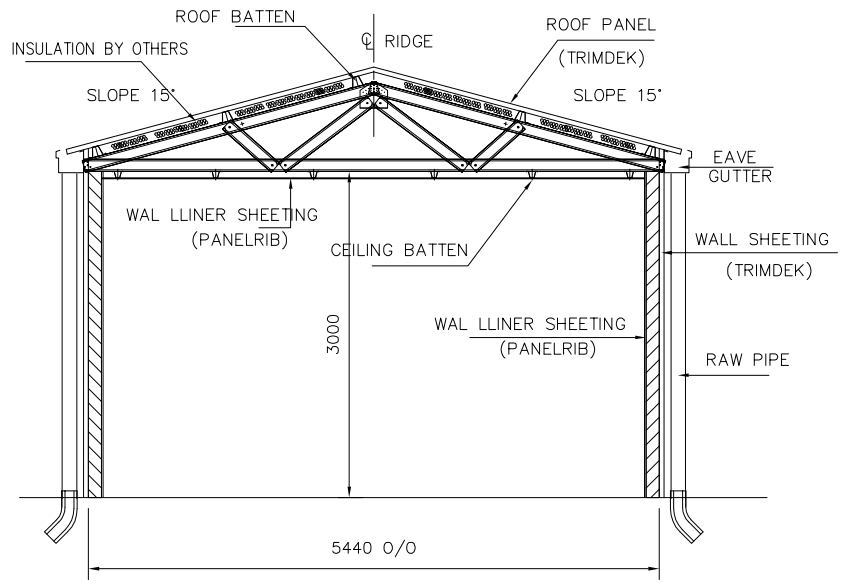
PROJECT NAME: ROOMS for Labours-BHEL	JOB SITE LOCATION : ENQ/WB/1735B	
	QUOTE NO : Kolkata	REV: 0
	DRG NO : E3	SCALE : NTS
DRAWING TITLE: PROPOSAL DRAWING	DRN : NMT	DATE : 26.04.17
	CHK : NMT	REV DATE : 00.00.00
	DSN : WAQ	SENT ON : 26.04.17 A3
		TBSL/BPD–ENGG/FORM/007(R1)

THIS DRAWING IS PURELY FOR APPROVAL PURPOSE ONLY AND NOT FOR CONSTRUCTION

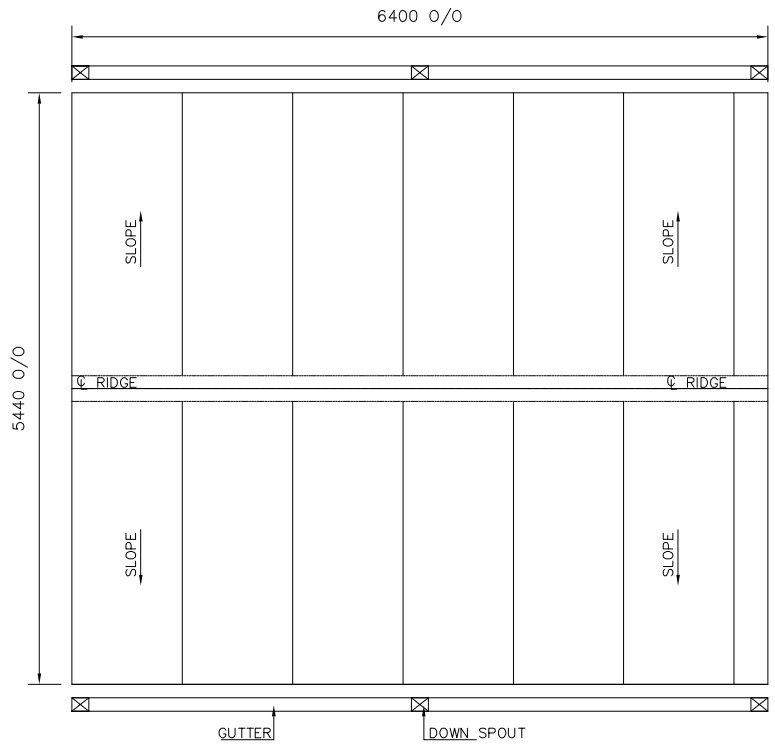


7 WALL FRAME LAYOUT

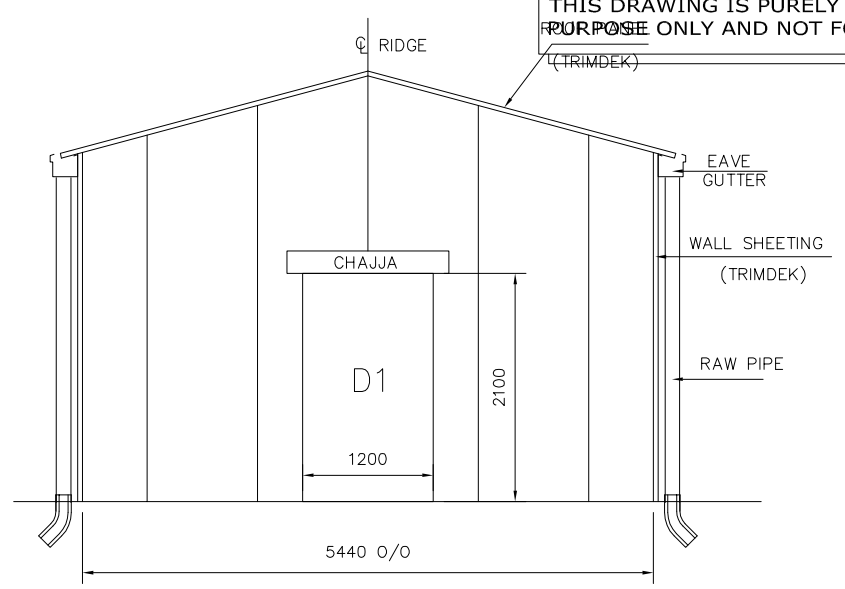




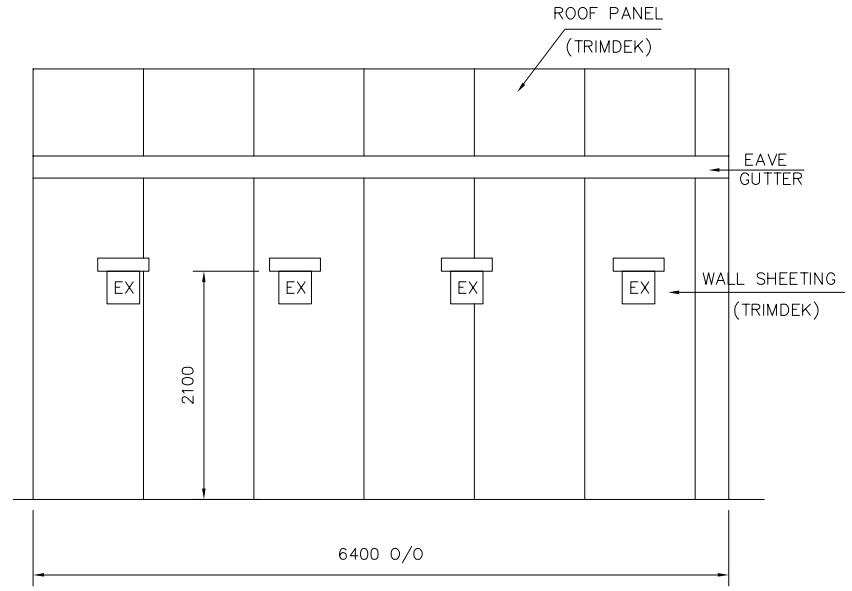
9 TYPICAL CROSS SECTION-B-B



10 ROOF SHEETING PLAN



11 GABLE SHEETING ELEVATION



12 SIDE WALL SHEETING ELEVATION

ING LAYOUT

LEGEND:
NSW – NEAR SIDE WALL ELEVATION
FSW – FAR SIDE WALL ELEVATION
LEW – LEFT END WALL ELEVATION
REW – RIGHT END WALL ELEVATION
DFO – DOOR FRAMED OPENING
RUD – ROLL UP DOOR
VFO – VENTILATOR FRAMED OPENING
WFO – WINDOW FRAMED OPENING
NBTBSL– NOT BY TBSL
RV – ROTARY VENT

NOTES:–
1. ALL DIMENSIONS ARE IN MM.

D1	:	1200(W) X	2100 (H)	(02 NOS)
D2	:	750 (W) X	2100 (H)	(08 NOS)
D	:	1200 (W) X	2100 (H)	(16 NOS)
EX.	:	300 (W) X	300 (H)	(08 NOS)
W	:	1000 (W) X	1000 (H)	(16 NOS)

PRODUCT : PEB LITE

NOTE : FOR OTHER DETAILS REF. DESIGN DATA SHEET

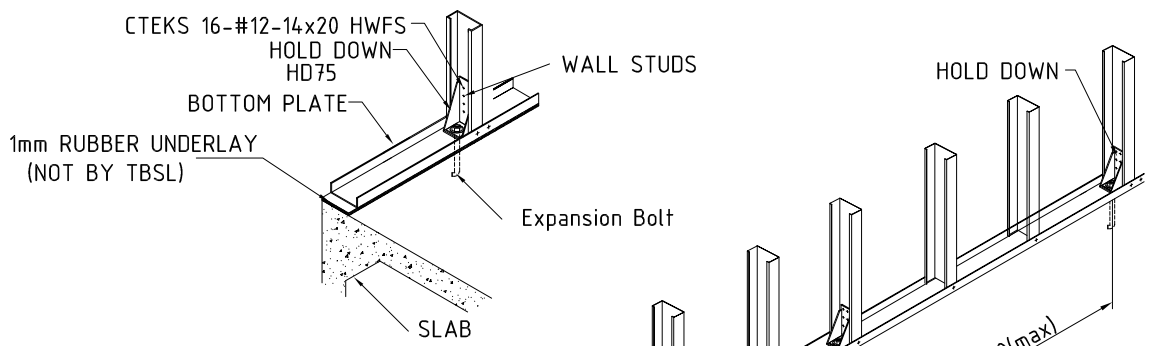
PROJECT NAME:
Toilet Block for Labours-BHEL

DRAWING TITLE:
PROPOSAL DRAWING

JOB SITE LOCATION : ENQ/WB/1735B		
QUOTE NO : Kolkata		REV: 0
DRG NO : E4	SCALE : NTS	
DRN : NMT	DATE : 26.04.17	
CHK : NMT	REV DATE : 00.00.00	
DSN : WAQ	SENT ON : 26.04.17	A3

TBSL/BPD–ENGG/FORM/007(R1)

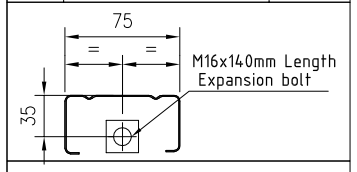
THIS DRAWING IS PURELY FOR APPROVAL PURPOSE ONLY AND NOT FOR CONSTRUCTION



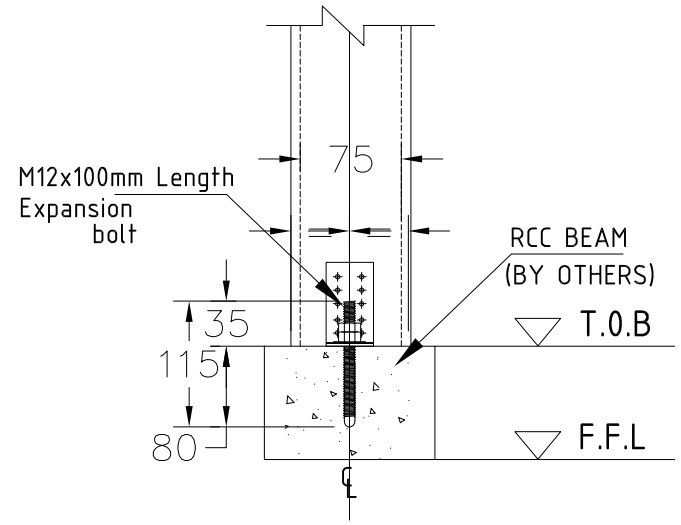
EXPANSION BOLT DETAIL

EXPANSION PLAN SKETCH

QTY.	DESCRIPTION	LENGTH
100	M16x140mm Length Expansion BOLT	140

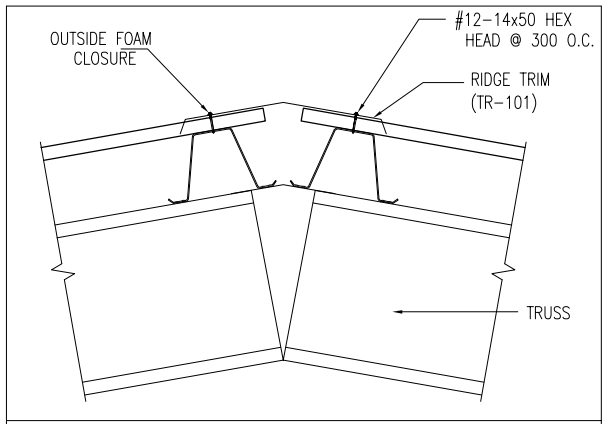


SECTION A-A

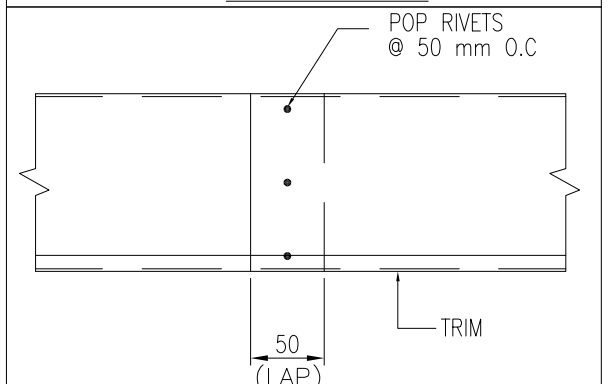


TO DESIGN RCC BEAM CONSIDERED 500 KG/M UDL

TYPICAL EXPANSION BOLT FIXING DETAILS

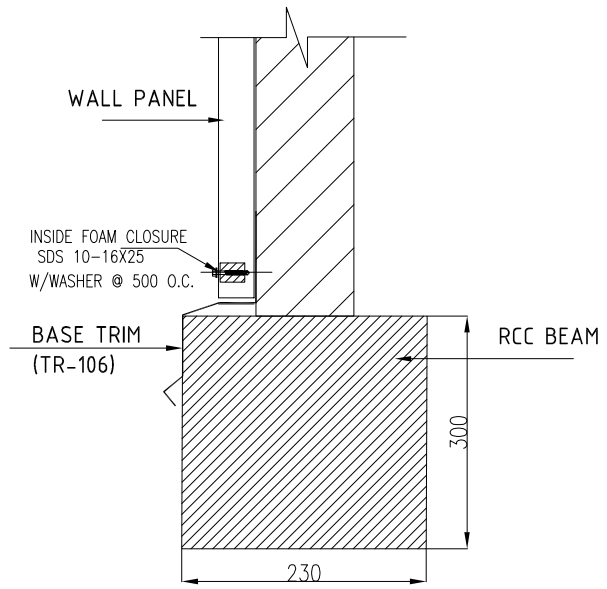


RIDGE DETAIL

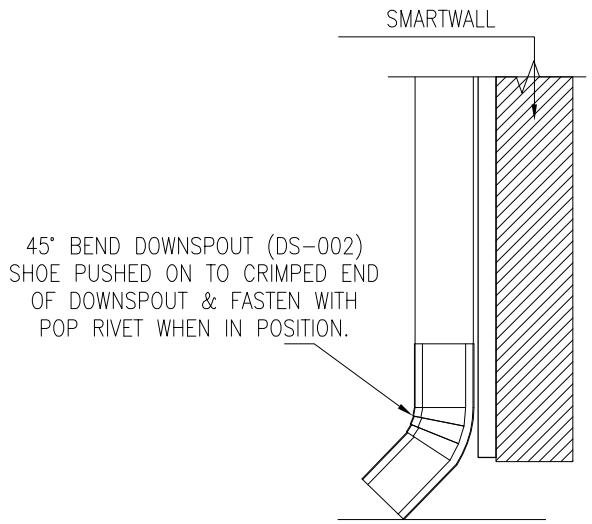


STANDARD LAP FOR TRIMS

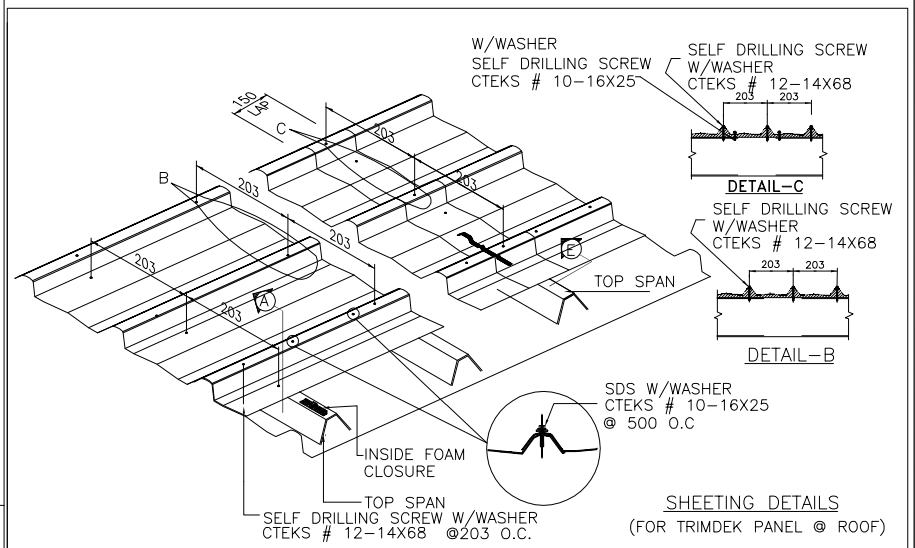
DETAIL-C (EAVE DETAIL)



BASE TRIM DETAIL-D



(D/S BOTTOM DETAIL)



SHEETING DETAILS @ ROOF (TRIMDEK)

NOTE :
THE BAY SPACING SHOWN IN THE PROPOSAL DRAWING ARE INDICATIVE & SUBJECTED TO CHANGE DEPENDING UPON FINAL DESIGN REQUIREMENT.

PRODUCT : PEB LITE

NOTE : FOR OTHER DETAILS REF. DESIGN DATA SHEET

EZYBUILD®
TATA BLUESCOPE BUILDING PRODUCTS

TATA Bluescope Steel Ltd.,
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NBTBSL– NOT BY TBSL
RV – ROTARY VENT

NOTES:–
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D2 :	XXXX(W) X	XXXX (H)	(00 NOS)
D :	XXXX (W) X	XXXX (H)	(00 NOS)
EX. :	XXXX (W) X	XXXX (H)	(00 NOS)
W :	(W) X	(H)	

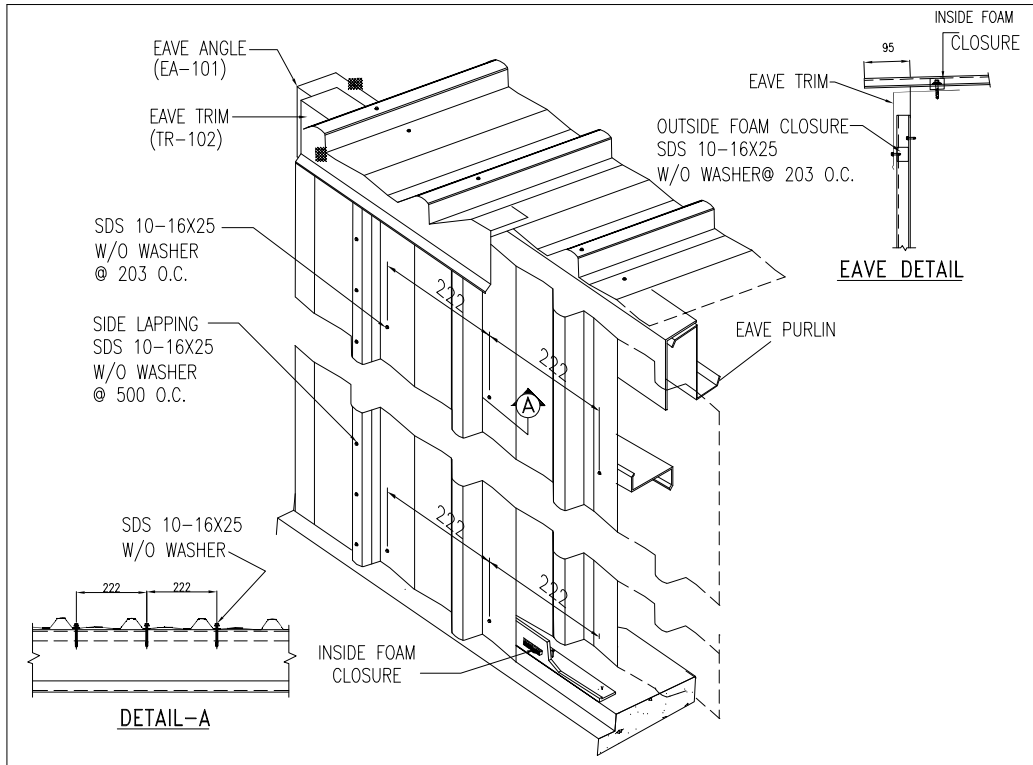
PROJECT NAME:
Toilet Block for Labours-BHEL

DRAWING TITLE:
PROPOSAL DRAWING

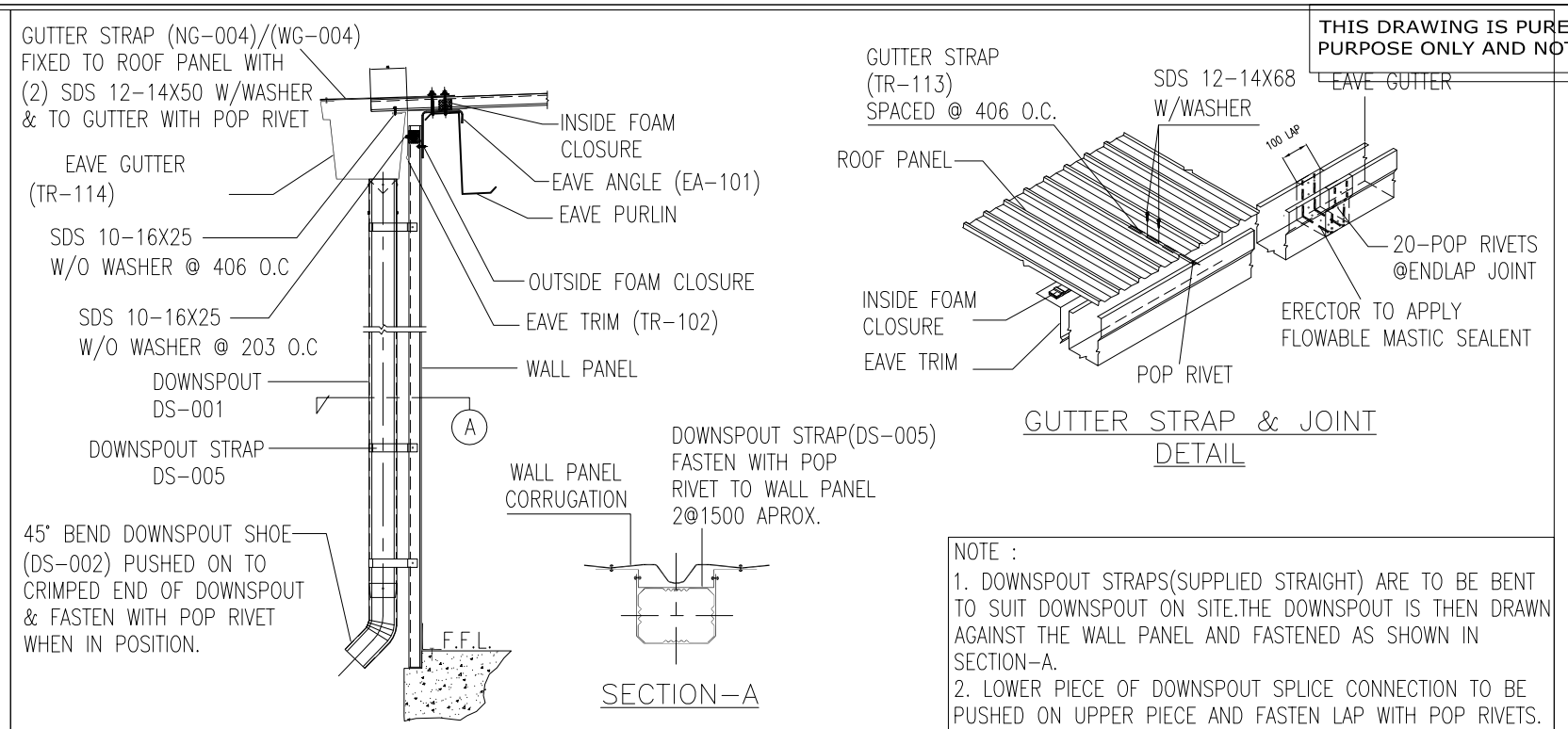
JOB SITE LOCATION : ENQ/WB/1735B		
QUOTE NO : Kolkata		REV: 0
DRG NO : E5	SCALE : NTS	
DRN : NMT	DATE : 26.04.17	
CHK : NMT	REV DATE : 00.00.00	
DSN : WAQ	SENT ON : 26.04.17	A3

TBSL/BPD-ENGG/FORM/007(R1)

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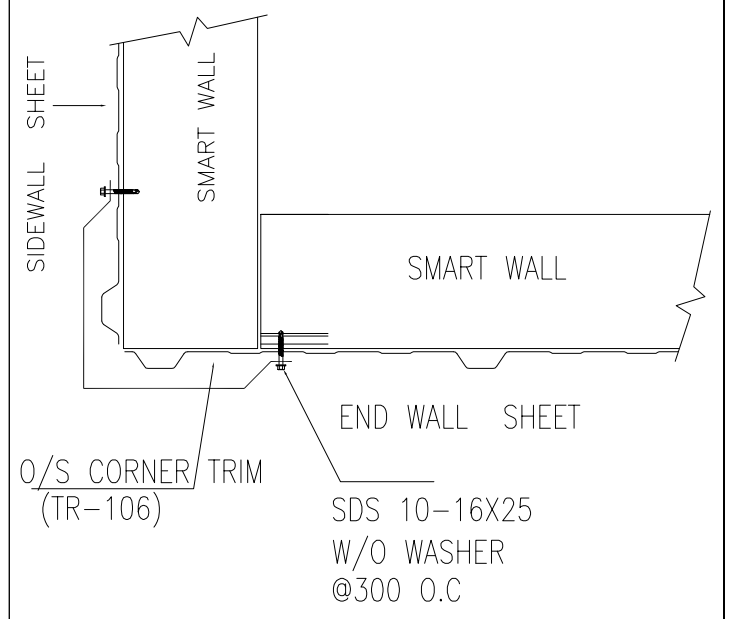


SHEETING DETAIL AT WALL

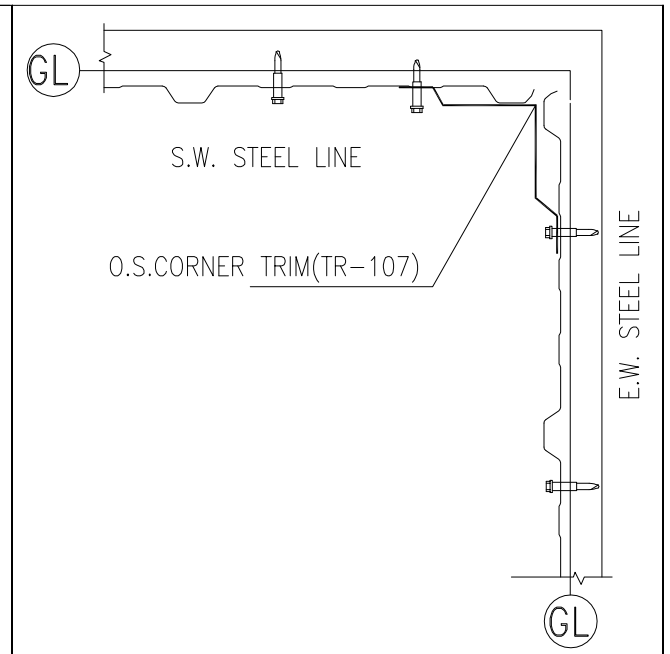


NOTE :
1. DOWNSPOUT STRAPS(SUPPLIED STRAIGHT) ARE TO BE BENT TO SUIT DOWNSPOUT ON SITE.THE DOWNSPOUT IS THEN DRAWN AGAINST THE WALL PANEL AND FASTENED AS SHOWN IN SECTION-A.
2. LOWER PIECE OF DOWNSPOUT SPLICE CONNECTION TO BE PUSHED ON UPPER PIECE AND FASTEN LAP WITH POP RIVETS.

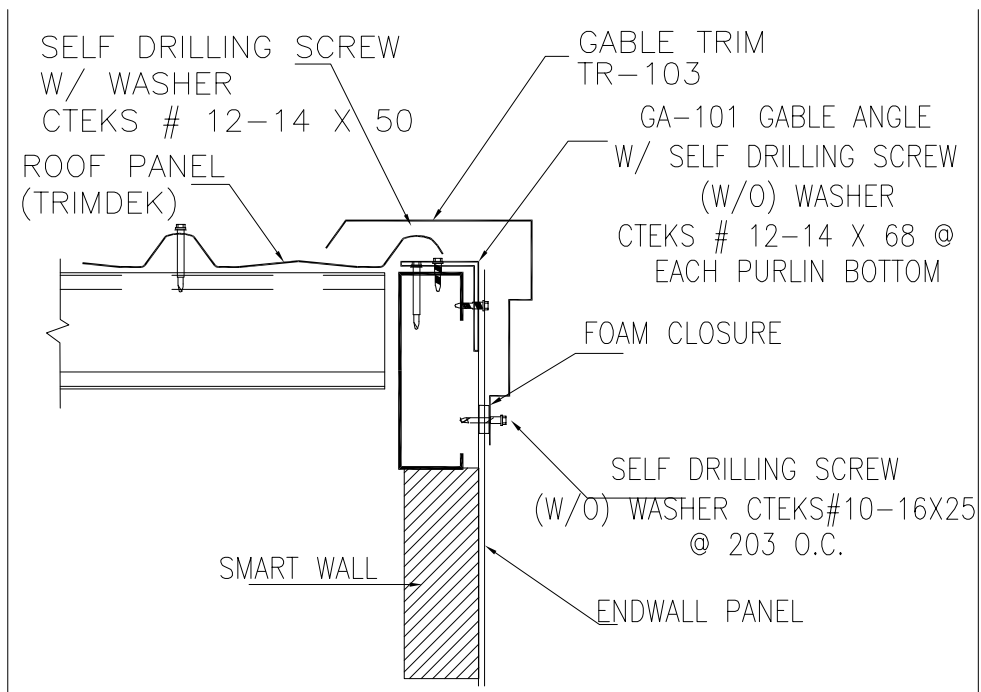
GUTTER & DOWNSPOUT INSTALLATION AT FULLY SHEETED SIDEWALL



O/S CORNER TRIM DETAIL



I.S.CORNER DETAIL



GABLE DETAIL

NOTE :
THE BAY SPACING SHOWN IN THE PROPOSAL DRAWING ARE INDICATIVE & SUBJECTED TO CHANGE DEPENDING UPON FINAL DESIGN REQUIREMENT.

PRODUCT : PEB LITE

NOTE : FOR OTHER DETAILS REF. DESIGN DATA SHEET

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Pune – 411 057 (India)
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VFO – VENTILATOR FRAMED OPENING
WFO – WINDOW FRAMED OPENING
NBTBSL– NOT BY TBSL
RV – ROTARY VENT

NOTES:–
1. ALL DIMENSIONS ARE IN MM.

D1 :	XXXX(W) X	XXXX (H)	(00 NOS)
D2 :	XXXX(W) X	XXXX (H)	(00 NOS)
D :	XXXX (W) X	XXXX (H)	(00 NOS)
EX. :	XXXX (W) X	XXXX (H)	(00 NOS)
W :	(W) X	(H)	

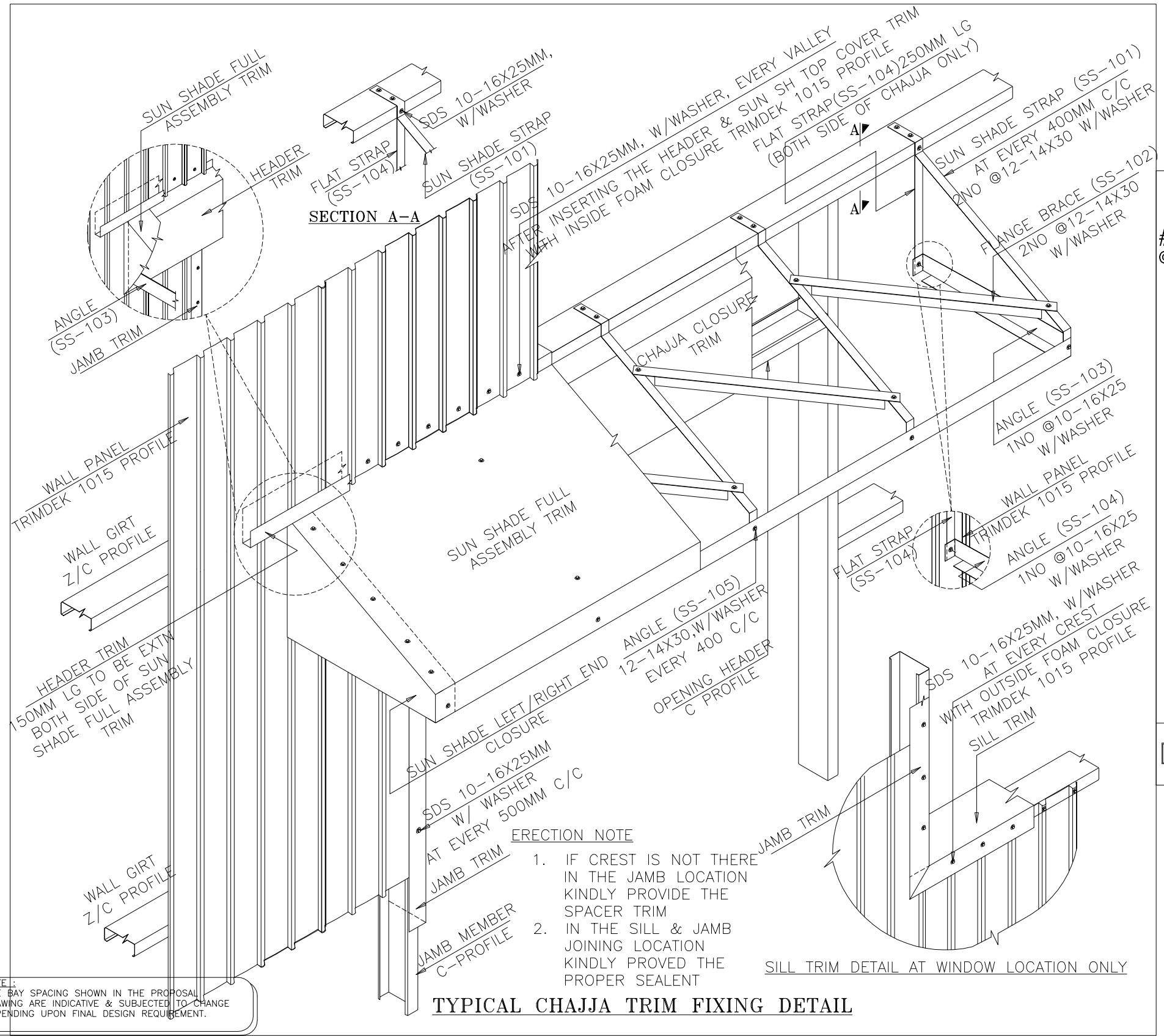
PROJECT NAME:
Toilet Block for Labours-BHEL

DRAWING TITLE:
PROPOSAL DRAWING

JOB SITE LOCATION : ENQ/WB/1735B		
QUOTE NO : Kolkata		REV: 0
DRG NO : E6	SCALE : NTS	
DRN : NMT	DATE : 26.04.17	
CHK : NMT	REV DATE : 00.00.00	
DSN : WAQ	SENT ON : 26.04.17	A3

TBSL/BPD–ENGG/FORM/007(R1)

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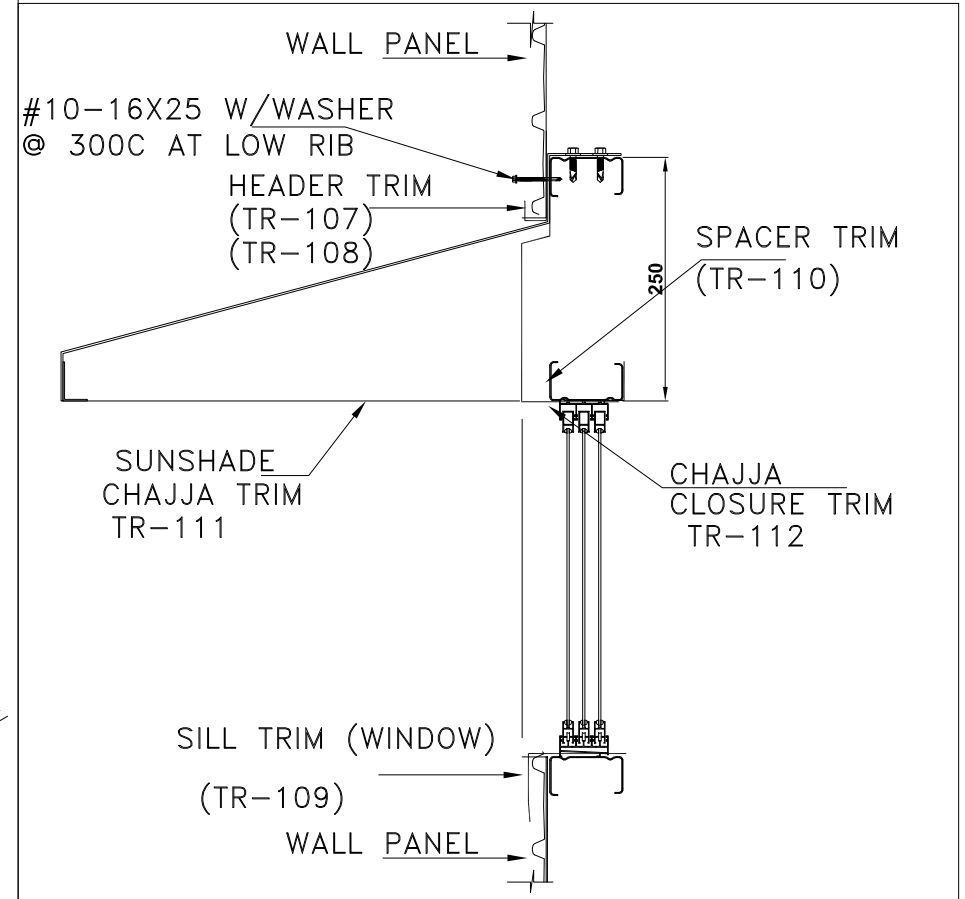
ERECTION NOTE

1. IF CREST IS NOT THERE IN THE JAMB LOCATION KINDLY PROVIDE THE SPACER TRIM
2. IN THE SILL & JAMB JOINING LOCATION KINDLY PROVED THE PROPER SEALENT

SILL TRIM DETAIL AT WINDOW LOCATION ONLY

TYPICAL CHAJJA TRIM FIXING DETAIL

NOTE :
THE BAY SPACING SHOWN IN THE PROPOSAL DRAWING ARE INDICATIVE & SUBJECTED TO CHANGE DEPENDING UPON FINAL DESIGN REQUIREMENT.



DOOR/WINDOW/LUV. CHAJJA DETAIL (TYP.)

PRODUCT : PEB LITE

NOTE : FOR OTHER DETAILS REF. DESIGN DATA SHEET

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LEGEND:

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WFO –	WINDOW FRAMED OPENING
NBTBSL–	NOT BY TBSL
RV –	ROTARY VENT

NOTES:–
1. ALL DIMENSIONS ARE IN MM.

D1 :	XXXX(W) X	XXXX (H)	(00 NOS)
D2 :	XXXX(W) X	XXXX (H)	(00 NOS)
D :	XXXX (W) X	XXXX (H)	(00 NOS)
EX. :	XXXX (W) X	XXXX (H)	(00 NOS)
W :	(W) X	(H)	

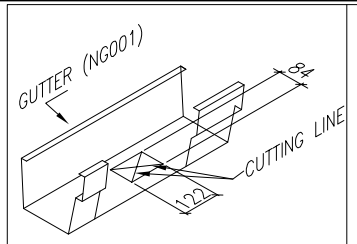
PROJECT NAME:
Toilet Block for Labours-BHEL

DRAWING TITLE:
PROPOSAL DRAWING

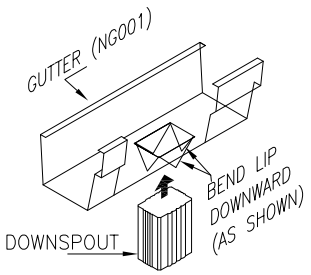
JOB SITE LOCATION : ENQ/WB/1735B		
QUOTE NO : Kolkata		REV: 0
DRG NO : E7	SCALE : NTS	
DRN : NMT	DATE : 26.04.17	
CHK : NMT	REV DATE : 00.00.00	
DSN : WAQ	SENT ON : 26.04.17	A3

TBSL/BPD–ENGG/FORM/007(R1)

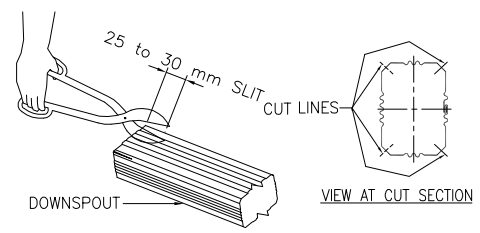
THIS DRAWING IS PURELY FOR APPROVAL PURPOSE ONLY AND NOT FOR CONSTRUCTION



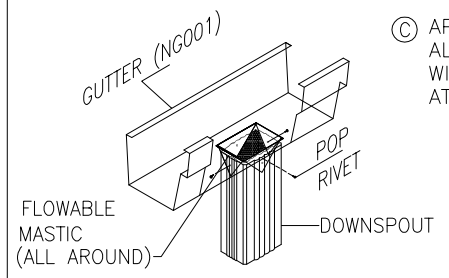
Ⓐ CUT EAVE GUTTER AS SHOWN.



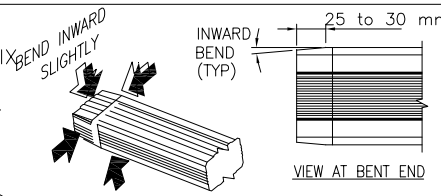
Ⓑ INSERT THE DOWNSPOUT TO THE GUTTER.



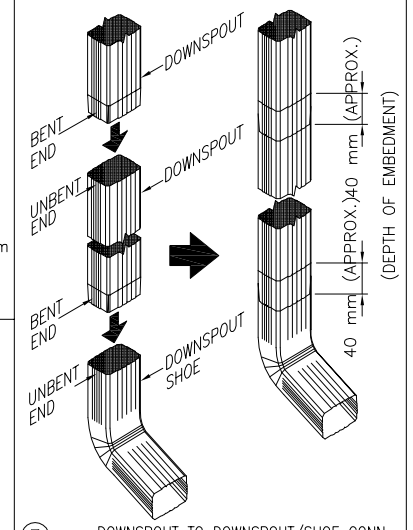
① SLIT AT FOUR CORNERS OF THE DOWNSPOUT UP TO 30mm AS SHOWN ABOVE.



Ⓒ APPLY FLOWABLE MASTIC ALL AROUND AND ALSO FIX WITH ONE POP RIVET AT EACH SIDE AS SHOWN.

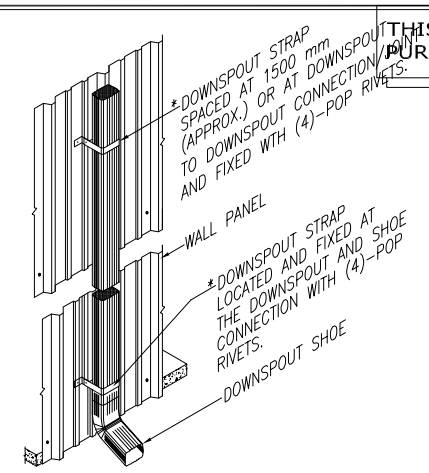


② SLIGHTLY BEND INWARD ALL FOUR SIDES OF THE SLITTED END AT AN APPROPRIATE ANGLE JUST ENOUGH FOR THE DOWNSPOUT TO SLIDE INTO ANOTHER DOWNSPOUT OR DOWNSPOUT SHOE AS SHOWN IN FIGURE 3.



③ DOWNSPOUT TO DOWNSPOUT/SHOE CONN.

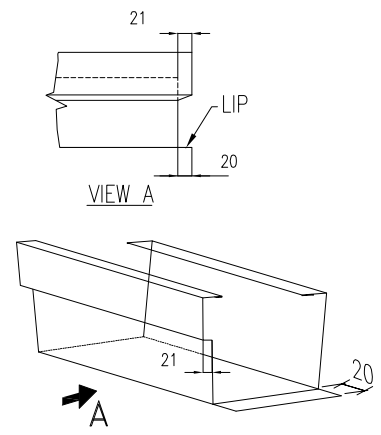
INSERT THE DOWNSPOUT INTO THE DOWNSPOUT AND/OR DOWNSPOUT SHOE.



④ THE ASSEMBLED DOWNSPOUT IS FIXED TO THE WALL PANEL USING DOWNSPOUT STRAP.

*FOR FIXING DOWNSPOUT STRAP TO WALL PANEL AND FOR QUANTITY OF POP RIVETS TO BE USE, SEE GUTTER AND DOWNSPOUT DETAIL.

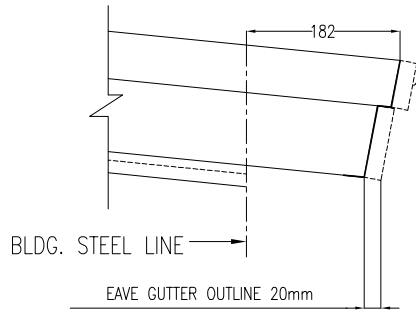
GUTTER AND DOWNSPOUT CONNECTION DETAIL



① CUT EAVE GUTTER AS SHOWN.

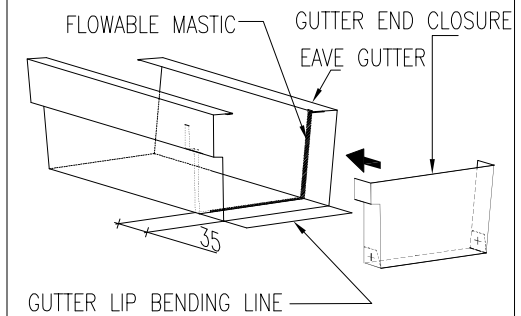
NOTES:

–DIMENSION SHOWN IS FOR 1:10 SLOPE & FOR NARROW GUTTER FOR OTHER SLOPES,–DIMENSION TO BE ADJUSTED.

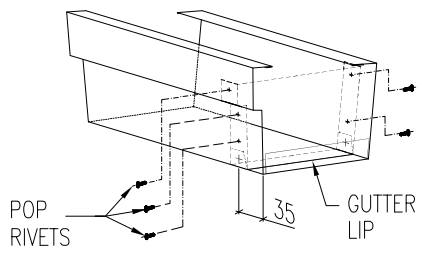


GABLE TRIM TOP TWO VERTICAL LEGS NEED TO BE EXTENDED TO COVER EAVE GUTTER AND 20MM LIP (EXTRA LENGTH) TO BE PROVIDED TO FOLD AND RIVET WITH EAVE GUTTER WALL.

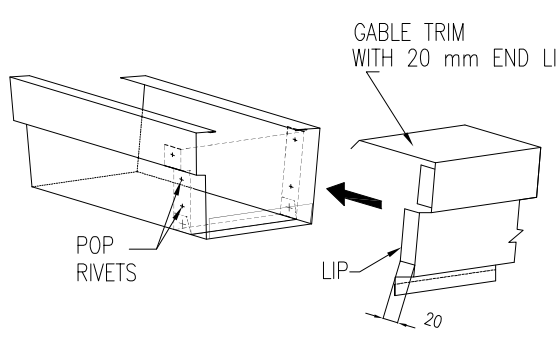
② CUT GABLE TRIM AS SHOWN.& EAVE GUTTER OUTLINE



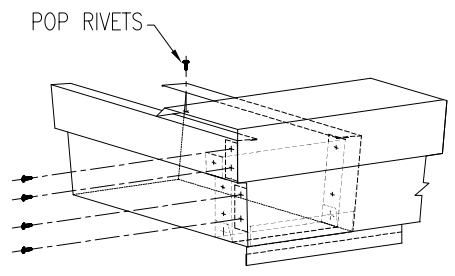
③ APPLY FLOWABLE MASTIC INSIDE EAVE GUTTER AND INSERT END CLOSURE.



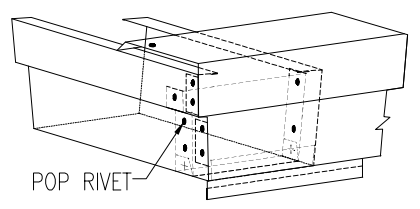
④ FIX END CLOSURE TO EAVE GUTTER BY POP RIVETS AND BEND GUTTER LIP.



⑤ CONNECT GABLE TRIM TO EAVE GUTTER.



⑥ FIX GABLE TRIM TO EAVE GUTTER BY POP RIVETS.



⑦ FINAL ASSEMBLY.

EAVE GUTTER & GABLE TRIM CONNECTION DETAIL

NOTE :
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PRODUCT : PEB LITE

NOTE : FOR OTHER DETAILS REF. DESIGN DATA SHEET

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NSW –	NEAR SIDE WALL ELEVATION
FSW –	FAR SIDE WALL ELEVATION
LEW –	LEFT END WALL ELEVATION
REW –	RIGHT END WALL ELEVATION
DFO –	DOOR FRAMED OPENING
RUD –	ROLL UP DOOR
VFO –	VENTILATOR FRAMED OPENING
WFO –	WINDOW FRAMED OPENING
NBTBSL–	NOT BY TBSL
RV –	ROTARY VENT

NOTES:–
1. ALL DIMENSIONS ARE IN MM.

D1 :	XXXX(W) X	XXXX (H)	(00 NOS)
D2 :	XXXX(W) X	XXXX (H)	(00 NOS)
D :	XXXX (W) X	XXXX (H)	(00 NOS)
EX. :	XXXX(W) X	XXXX (H)	(00 NOS)
W :	(W) X	(H)	

PROJECT NAME:
Toilet Block for Labours-BHEL

DRAWING TITLE:
PROPOSAL DRAWING

JOB SITE LOCATION : ENQ/WB/1735B		
QUOTE NO : Kolkata		REV: 0
DRG NO : E8	SCALE : NTS	
DRN : NMT	DATE : 26.04.17	
CHK : NMT	REV DATE : 00.00.00	
DSN : WAQ	SENT ON : 26.04.17	A3

TBSL/BPD–ENGG/FORM/007(R1)

THIS DRAWING IS PURELY FOR APPROVAL PURPOSE ONLY AND NOT FOR CONSTRUCTION

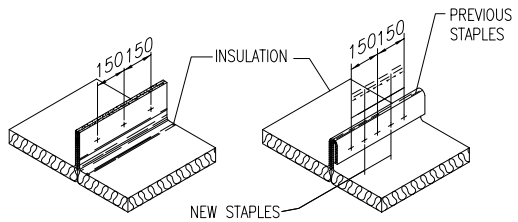


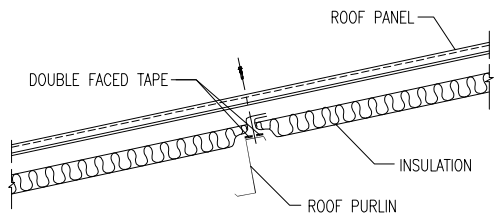
FIG. 1 FIG. 2

STAPLE PIN & STAPLER NOT BY TBSL

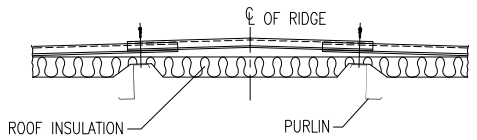
NOTE:

1. PULL TABS TOGETHER & STAPLE AT APPROX. 150mm ON CENTERS ALONG FULL LENGTH AS SHOWN IN FIG.1
2. FOLD TABS OVER & STAPLE THRU FOLDED TABS BETWEEN PREVIOUS STAPLES AS SHOWN IN FIGURE 2.

INSULATION SIDE LAPPING DETAIL

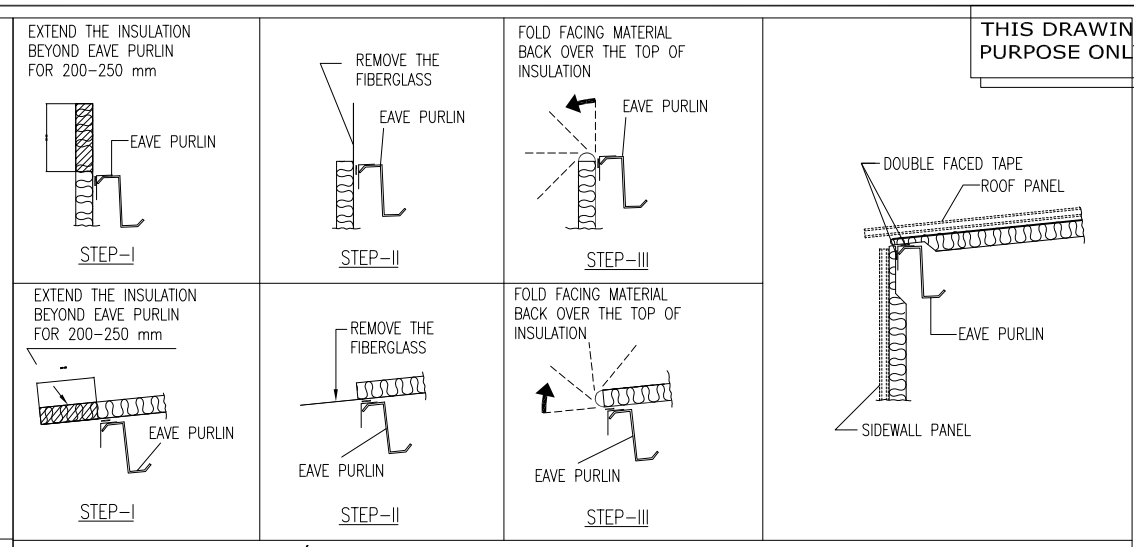


INSULATION END LAP

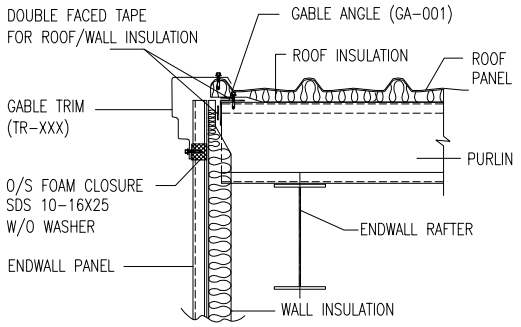


INSULATION AT RIDGE

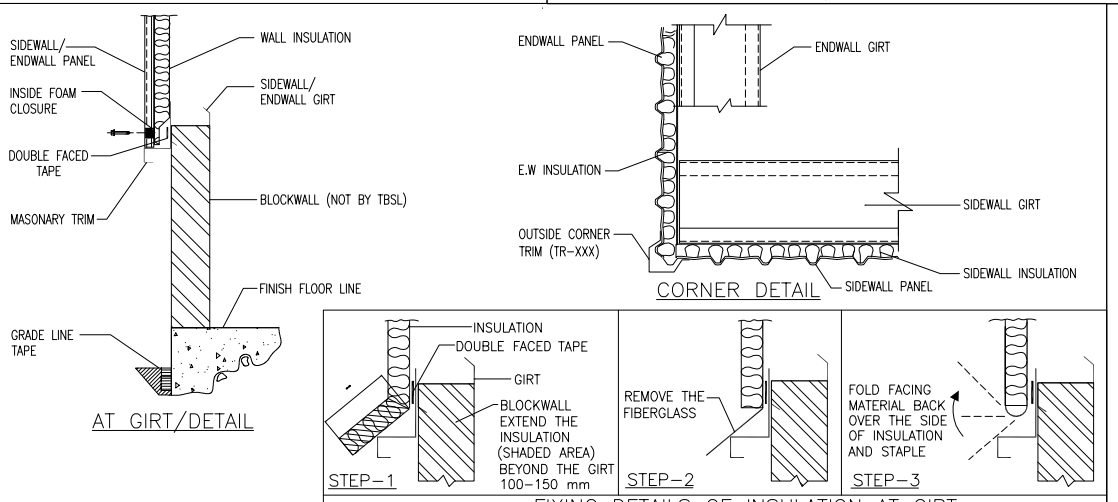
INSULATION DETAIL AT END LAPPING



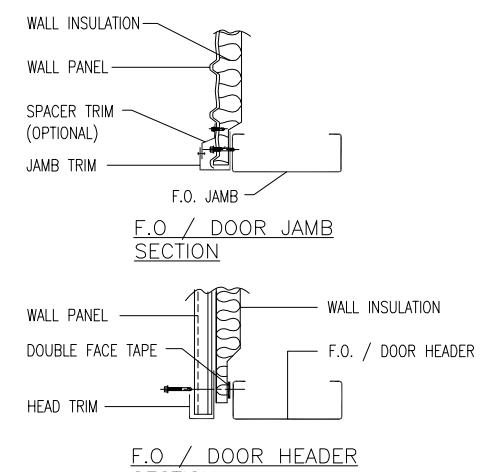
WALL/ROOF INSULATION DETAIL AT EAVE PURLIN



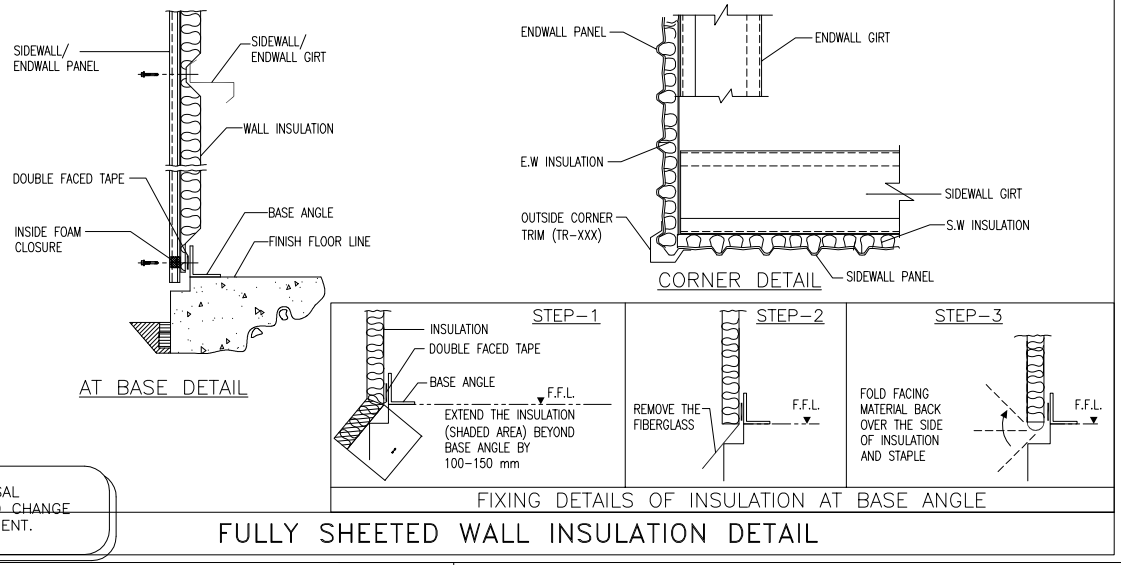
GABLE DETAIL W/ INSULATION



PARTIALLY SHEETED WALL INSULATION DETAIL



F.O. DETAIL W/ INSULATION



FULLY SHEETED WALL INSULATION DETAIL

NOTE :
THE BAY SPACING SHOWN IN THE PROPOSAL DRAWING ARE INDICATIVE & SUBJECTED TO CHANGE DEPENDING UPON FINAL DESIGN REQUIREMENT.

PRODUCT : PEB LITE

NOTE : FOR OTHER DETAILS REF. DESIGN DATA SHEET

EZYBUILD®

TATA BLUESCOPE BUILDING PRODUCTS

TATA Bluescope Steel Ltd.,
Survey No. 247 & 250
Hinjewadi, Taluka Mulshi,
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Fax : +91 20 6674 2001

LEGEND:

NSW – NEAR SIDE WALL ELEVATION
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D : XXXX (W) X XXXX (H) (00 NOS)
EX. : XXXX (W) X XXXX (H) (00 NOS)
W : (W) X (H)

PROJECT NAME:
Toilet Block for Labours-BHEL

DRAWING TITLE:
PROPOSAL DRAWING

JOB SITE LOCATION : ENQ/WB/1735B		
QUOTE NO : Kolkata		REV: 0
DRG NO : E9	SCALE : NTS	
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DSN : WAQ	SENT ON : 26.04.17	A3

TBSL/BPD–ENGG/FORM/007(R1)

TECHNICAL SPECIFICATIONS FOR SMARTBUILD BUILDINGS	
Structural Members for Roof and wall	Design, Supply and erection of • Light gauge high strength framing system manufactured from (55% aluminum-zinc alloy coated G550 Zincalume AZ150 steel complying with AS1397. • The stud-Cee profiles shall be manufactured using 1.0mm BMT G550 AZ150 Zincalume with depth of 75mm/100mm and flange 40mm/50mm with lip size of 8.0mm/12.0mm & R 5.0 mm respectively. • The roof purlin/roof batten should be Top hat section, manufactured using 1.0mm BMT with 61mm depth and top width of 36.5 mm with flute length of 14.0 mm & leg of 6.0 mm with R 2.5 mm, and shall be fixed using self-tapping and drilling screws. • The ceiling battens should be Top hat section and manufactured using 0.75mm BMT with 40mm depth and top width of 32.0 mm with flute of 12.5 mm & leg of 4.0 mm, shall be fixed using self-tapping and drilling screws. • The framing system shall be design using SupraCadd software & complying to design codes of AS/ NZS 4600-2005, AS: 4055-2006 & AS/NZS: 1170-2002. All accessories like nogging, lintel, screws etc. shall be used as per manufacturer recommendations. The building shall be designed with max. 50 m/s wind speed or as per local wind conditions. • All the material shall be manufactured by reputed manufacturer (Tata BlueScope Steel or equivalent) Necessary material test certificate to be issued by the manufacturer.
Outer Roofing and Wall Panels	• Supply of COLORBOND panels of width 1015mm shall be roll formed from nominal 0.45 mm base metal thickness and minimum yield strength of 550 MPa, coated with an aluminum /zinc alloy i.e. Zincalume, AZ150 (min 150 gm/m2 total on both side), conforms to Australian standard AS1397, pre-painted with Colorbond steel quality paint coat as per AS/NZS 2728 Class 3. The paint finish thickness shall have a total coating thickness of nominal 35 µm, comprising of nominal 20 µm on exterior face and nominal 5 µm reverse coat on interior face over nominal 5 µm epoxy primer coat on both surfaces of approved color shade. • **Profile dimensions:** Trapezoidal type profile sheet shall have min 1015 mm effective cover width (Trimdek), min 28 mm deep ribs with subtle square fluting in the five pans at min 203 mm centre to centre. The end rib shall be designed for anti-capillary action, to avoid any seepage of water through the lateral overlap. • All the material shall be manufactured by reputed manufacturer (Tata BlueScope Steel or equivalent) Necessary material test certificate to be issued by the manufacturer.

Inner Roof and Wall Liners	• Supply of Zincalume panels shall be roll formed from nominal 0.45 mm base metal thickness of minimum yield strength of 550 MPa, coated with an aluminum /zinc alloy i.e. Zincalume, AZ150 (min 150 gm/m2 total on both side), confirms to Australian standard AS1397 • **Profile dimensions:** Profile sheeting shall have 1110 mm effective cover width (Panelrib) profile with nominal 3.5 mm deep ribs at pitch of nominal 48 mm center to center distance • All the material shall be manufactured by reputed manufacturer (Tata BlueScope Steel or equivalent) Necessary material test certificate to be issued by the manufacturer.
Trims & Flashings	• All the openings and sheet terminations to be closed with appropriate factory made flashings / Trims (Ridge, Corner Flashings, Gable Ends, framed opening etc.) Finish /Color of the material will be same as roof /Wall / Liner panels. • Eave gutters, downspouts and rain water down take pipes are cold-formed from the same material (color & finish) as wall panels or approved by concern authority.
Fasteners	• Supply of Self tapping/ drilling fasteners shall be min. 40 µm Zinc coated / min. 25 µm Zinc-Tin alloy coated, Hex head, self-drilling screw as per AS 3566-2002 Class 3 fasteners of approved make (Buildex or equivalent). The fastener size shall be calculated as per the design and recommendation of the manufacturer. • The fasteners shall be a minimum of 12 gauge, 14 threads per inch and of material AISI 1022 heat treated carbon steel. The other details are as below; • Screw Hex steel CTEKS 12-14X20 HGS (Unpainted) • Wafer Head SDS CTEKS 10-24X22 without washer • Screw Hex Steel CTEKS 10-16X16 HGS Unpainted with washer • M5X45 fully threaded bolt assembly with nut & washer fully threaded ASTM A325M • Expansion bolt HST- M12X115/20, Anchor - 80MM Grip - 20mm
Protection accessories and flashings	• Special grade of silicone sealant non-hardening, neutral cure type of GE or approved equivalent make and grade shall be applied at all side laps and end laps (with flowable mastic) as per manufacturer's recommendation and as approved by the Project Management Consultant / Chief Architect/Engineer
Foam closures	• Providing foam closures to match the panel profile made of expanded polyurethane or similar approved material by Project Management Consultant / Chief Architect/Engineer

Erection and installation	• Installation shall be done in accordance to the standard practices as specified by the manufacturer and as approved by the Project Management Consultant. All sheets and accessories must be stored and finally erected without any damage. The Vendor will be required to submit design calculations in support of the proposed profile of the sheet and standard loading etc. to the satisfaction of the design consultant and the Architect. The Vendor shall also submit methodology for fixing and also a maintenance manual for routine maintenance. Special flashing, ridge capping and trims shall be fixed as per manufacturer's recommendation. The shape and girths shall be as per design requirement.

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.

Date: 15-Jun-2018

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03	04.06.2018	Revision 03	YS	KSB	JPS
02	05.03.2018	Revision 02	YS	KSB	JPS
01	16.12.2017	Revision 01	YS	KSB	JPS
00	09.10.2017	FRESH ISSUE	YS	KSB	JPS
	DATE	DESCRIPTION/ NOTE	PRD	CHD	APD

REVISIONS

TITLE:

PAINTING SCHEDULE FOR ENTIRE PLANT

OWNER/ PROJECT:

BANGLADESH-INDIA FRIENDSHIP POWER PVT. LTD, DHAKA, BANGALADESH 2x660 COMPANY MW MAITREE STPP, RAMPAL, BANGLADESH

OWNER CONSULTANT:

M/s FICHTNER GmbH & Co KG,

Stuttgart, GERMANY

EPC CONTRACTOR :

BHARAT HEAVY ELECTRICALS LTD.

	NAME	DATE	
PREPARED BY	**YS**	**04/06/2018**	**STATUS: FOR APPROVAL**
CHECKED BY	**KSB**	**04/06/2018**	**REV 03**
APPROVED BY	**JPS**	**04/06/2018**	

DOC NO.: MAITREE-0-BFA-FF-100000-GEN	**Rev 03**

APPROVED ON CONDITION
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Date: 15-Jun-2018

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1. Scope & Philosophy
2. General Requirements
3. Codes & Standards
4. Surface Preparation and Cleaning of Surfaces in the Shop
5. Cleaning to be performed on site
6. Cleaning of prime and intermediate coats (if required)
7. Application procedure
8. Galvanizing
9. Appendix-A

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1. Scope & Philosophy

This document covers the Painting Scheme including Corrosion Protection, Coating and Galvanizing requirements applicable for the entire power plant packages, equipment, structures, piping etc. and any other surfaces.

Corrosion Protection, Coating and Galvanizing requirements shall conform to Contractual requirement stipulated in B0.6.5.

This documents contains list of annexure (mentioned at appendix-A) for Painting Scheme to be followed for various packages, equipment, items and structures.

Painting scheme shall be approved item/ equipment wise and not package wise i.e Painting scheme once approved for any equipment, items and structures etc shall be applicable for all similar equipment, items and structures in entire power plant.

2. General Requirement

Coating material shall only be supplied by manufacturers with international experience and their products can be obtained internationally.

It is the responsibility of the Contractor to ensure that, for all supplied equipment (including that from sub suppliers):

- The protection system is perfectly suitable for the Site conditions and for the specific purpose.
- The shop paints provide a sufficient protection during transport, storage and erection.
- The shop paints are suitable for handling and erection conditions (slinging, Site welding works etc.) and are compatible with the Site finishing coats
- All necessary precautions are taken in order to prevent damage to paints during storage, handling, welding.
- The necessary repairs are carefully executed as soon as possible.
- The colour RAL number of the finishing coat has been approved by the Employer, including identification code for piping.
- All items/equipment shall be painted as per the specification.

3. Codes and standards

Corrosion Protection, Coating and Galvanizing requirements will conform to the below mentioned applicable standards or equivalent:

- Product data of coating manufacturer
- DIN 2403 Indication of pipe-lines according to flowing material
- DIN 4762 Surface roughness
- ISO 8503 Surface roughness

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- DIN 8201 Part 1-9 tight blasting agents
- DIN 50976 Corrosion protection, hot dip batch galvanizing of single parts, requirements and testing
- DIN 55928 Part 1-9 corrosion protection of structural steel work through protective coatings and topcoats
- ISO 8501 Preparation of steel substrates before application of paints and associated products
- ISO 12944 Paints and varnishes corrosion protection of steel structures by protective paint systems
- RAL Colour card
- ISO 8501-1 Preparation of steel substrates before application of paints and related products
- SSPC Vol. 1 and 2 Steel structure painting council

4. Surface Preparation and Cleaning of Surfaces in the Shop

All surfaces to be painted will be thoroughly cleaned of all grease, oil, paint residues, welding splashes, loose mill scale, dust, rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes will be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, sand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents will be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents will be adopted only after written approval of the Purchaser/Consultant.

Sharp edges have to be rounded off. Contaminations caused by salts, acids and alkali solutions shall be eliminated by rinsing with water up to a pH value of 6-8. Soluble salt contamination is to be tested using the Weber Reilly test method (or similar approved) and pH is to be tested using universal indicator paper strips prior to continuation with the blasting.

The preparation of substrates shall be carried out on the basis of the specifications of ISO 12944 part 4 and ISO 8501. The preparation of steel before application of paint and related products shall be in line with ISO 11124 for metallic blast cleaning abrasives and ISO 11126 for non-metallic blast cleaning abrasives. No recycled blast grit may be utilised.

After blasting, an anchor profile of 25 - 50 µm shall be achieved. Blasted surfaces have to be provided with a prime coat of the approved coating system immediately within 4 hours of blasting. All blasting and priming must take place outside of the high humidity periods of the day (i.e. maximum relative humidity of 80%).

5. Cleaning to be performed on site

Steel work protected by shop primer after arrival on site must be cleaned of salt, sand, oil, etc. before the first coat of paint is applied on site. Shop rimer damaged during transport must be rectified by blast-cleaning and coating before application of the site coats. Wood surfaces shall be sanded clean. All nail holes shall be puttied and sanded

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before priming, unless the specific coating system allows for coating onto damp concrete, in which case only with approval from the Employer.

If a protective coating of concrete is required, concrete shall be allowed to cure before painting. Transport and erection damages, as well as damages which result out of additional welding have to be repaired as soon as possible. The damaged areas have to be derusted with rotating or steel brushes, abrasive wheels, and abrasive blasting according to DIN ISO 8501-1.

6. Cleaning of prime and intermediate coats (as required)

To prevent contamination by mineral oil products, areas with prime and intermediate coat have to be treated with suitable cleaning agent. Cleaning has to be done free of residues, e.g. with alkaline detergents and thorough washing done with fresh water. Rusty spots have to be removed according to required purity. Metallic areas which are provided with temporary corrosion protection have to be cleaned. No oxidation products shall remain on the surface. Further care shall be taken that on hot components, no destructive or reaction products will be released when heating which could injure insulation.

7. Application procedure

When using the provided coating material, strict adherence to all application instructions given in product data of coating manufacturer is necessary. To obtain the maximum performance, technical data as well as application instructions for the individual coating material have to be strictly followed.

For a multi-layer coating system each layer has to have a different colour shade in order to clearly identify number of coats applied. The last finish coat has to be applied in the specified colour shade.

All paintings shall be performed according to ISO 12944. The durability of all paintings shall be high which corresponds to 15 years.

The interval between applying the different coats has to follow according to suppliers specifications. Each layer shall be cleaned and released from spray dust before the next layer will be applied. Prior to applying a further layer, the last one has to be repaired. All coatings have to be applied without retarding.

Following application procedures are allowed:

- prime coats by airless spray
  areas like disconnections, angles, corners, etc. which are difficult to be reached can be applied by brush or roller
- finish coats
  - at works by airless spray, roller or brush
  - at site by roller or brush or airless spray.

Control areas in accordance with the coating supplier's instructions have to be applied. For this procedure, a schedule for control areas has to be prepared by the

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Contractor and coating supplier which corresponds with the requirements of the warranty agreement.

Number and performance of the control areas have to be done in accordance with ISO 12944 part 7 and have to be documented in writing. No application shall take place either in the condition of the relative humidity not within the given limit or in case of poor weather conditions such as fog, dust, rain, snow, hail or when it can be assumed that such conditions of poor weather will arise within 2 hours after application. Temperature of the coated parts has always to be above 5 °C and 3 K above dew point.

All specified dry film thicknesses (DFT) are minimum thicknesses. Welding seams executed at site have to be taped with an adhesive tape of about 30-50 mm after surface preparation (blasting or manual derusting) and prior to application in the manufacturing plant and to be coated with stripping coat.

Chequered plates, nap plates, etc. have not to be covered with adhesive tape, but have to be coated with stripping coat in a dry film thickness of at least 150 µm. Edging lines on steel structure have to be taped prior to application and after blasting in sufficient width or have to be protected with varnish before application. Thickness of prime coat may be 50 µm maximum. During repairing works at site on shop-primed structures, it is important that different coats will have different colour shades. Numbers of layers have to be the same as the original coating system to be used.

Application of temporary primer on structures which have to be insulated has to be in accordance with a sufficient corrosion protection for the period of storage respectively erection time.

8. Galvanizing

Galvanizing work shall conform in all respects to ISO 1461 or equivalent standards and shall be performed by the hot dip process unless otherwise specified.

It is essential that details of steel members and assemblies which are to be hot-dip galvanized should be designed to suit the requirements of the process. They should be in accordance with ISO 12944.

Vent holes and drain holes shall be provided to avoid high internal pressures and air locks during immersion and to ensure that molten zinc is not retained in pockets during withdrawal. Careful cleaning of welds is necessary before welded assemblies are dipped.

All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with BS 4360. All drilling, cutting, welding, forming and final fabrication of unit members and assemblies shall be completed, where feasible, before the structures are galvanized.

The minimum coating thickness shall be as specified in Table 1 of BS 729. Structural steel items shall be first grit-blasted to BS 4232, second quality, (Sa 2 1/2) or pickled in a bath, and the minimum average coating weight on steel Sections 5 mm thick and over shall be 900 g/m2, on steel Sections 2 – 5 mm thick 600 g/m2.

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Galvanized contact surfaces to be joined by high-tensile friction-grip bolts shall be roughened before assembly so that the required slip factor is achieved. Care shall be taken to ensure that the roughening is confined to the area of the mating faces.

Protected slings must be used for off-loading and erection. Galvanized work, which is to be stored at the works or on site shall be stacked so as to provide adequate ventilation for all surfaces to avoid wet storage staining (white rust).

Small areas of the galvanized coating damaged in any way shall be restored

by:

- cleaning the area of any weld slag and thorough wire brushing to give a clean surface
- The application of two coats of zinc-rich paint, or the application of a low melting point zinc alloy repair rod or powder to the damaged area, which is heated to 300 °C or the treatment with suitable cold galvanizing paint, such as ORAPI n.z.a.b 706. All zinc rich paint used for such repairs must contain a minimum of 81% by mass of zinc in the dry film.

Connections between galvanized surfaces and copper, copper alloy or aluminium surfaces shall be protected by suitable tape wrapping.

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Appendix-A

#	Painting Schedule for	Document No.	Remarks
1.	Steam Generator & Aux	MPS-1	
2.	Turbogenerator, Steam Turbine, Condenser, Turbine Integral System, Auxiliaries, Control Instrument of STG & Associated Auxiliaries.	MPS-2	
3.	Fire Protection System	MPS-3	
4.	Flue Das Desulphurization (FGD) System	MPS-4	
5.	Power House Structures, Bunker Shells, AHP/CHP Structures, RODM & Sub Station Structures	MPS-5	
6.	Air Pre Heater (APH), Electrostatic Precipitator (ESP) FAN and Gates & Dampers	MPS-6	
7.	MISC TANKS – SITE FABRICATED I.E. CONDENSATE STORAGE TANKS, DM WATER STORAGE TANKS, SERVICE WATER STORAGE TANKS AND DESALINATED WATER STORAGE TANK	MPS-7	
8.	Low Pressure Piping	MPS-8	
9.	Ash Handling Plant	MPS-9	These packages shall comply with Painting specifications as per contractual specifications
10.	Pumps, Mills & Auxiliaries		
11.	Drain Cooler, LP Heaters, Deaerator, HP Heaters And Oil Cooler		
12.	Coal Handling Plant		
13.	Limestone & Gypsum Handling Plant		
14.	RE Joint		
15.	Mill Reject System		
16.	Chimney		
17.	D/G EOT Cranes		
18.	Sewage Treatment Plant		
19.	Pre Treatment Plant		
20.	Fuel Oil Handling System		
21.	Weigh Bridge		
22.	Electrical & Associated Systems		
23.	Other Balance of Plant Packages		

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BHARAT HEAVY ELECTRICALS LIMITED, Tiruchirappalli - 620 014
PAINTING SCHEDULE FOR BOILER COMPONENTS

MPS-1

Coating System (refer Contract Book No.3 Clause B0.6.5)

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat microns	Total DFT (Micro m)
1	**Structural steel works, piping, vessels, tanks INDOOR**	**Boiler scope of components doesn't fall under this category**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Finish	1	Epoxy High Solid	80	80
									160
2	**Structural steel works, piping, vessels, tanks OUTDOOR**	**Buck stays 08-001,003,006,007,111,380,501,503, 08-901,910; 34-100,101,102,103,104,200,300,390,441, 34-442,443,444,445,511,512,513,514,515; Boiler supporting structures, Columns, Girders, Bracings 35-131,132,133,134,135,136,137,141, 35-142,143,144,145,146,147,151,152,153, 35-154,155,156,157,181,182,183,184,185, 35-186,187,211,212,213,214,221,222,231, 35-232,311,312,321,322,331,332,341,342, 35-351,352,361,362,371,372,374,375,381, 35-382,383,384,385,386,387,388,390,441, 35-442,443,444,445,446,447,448,451,452, 35-453,454,455,456,457,458,511,512,513, 35-514,515,516,517,518,521,522,523,524, 35-525,526,527,528,531,532,533,534,535, 35-536,537,538; 36-110,150,311,312,313,314; 36-315,316,321,322,323,324,325,326,331; Galleries, Stair-ways & inter connecting Walkways 36-332,333,334,335,336,337,338,341,342; 36-343,344,345,346,351,352,353,354,355; 36-356,361,362,363,364,365,366,371,372; 36-373,374,375,376,377,391,392,393,394; 36-395,610,620,621,740;38-210,299,310; 38-381,410,510,610,611,710;39-101,102, 39-141,142,150,299,300,301,304,305,306; 48-015,115,225,265,385,435,465,485,495; 48-665,911,912;**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Intermediate	1-2	Epoxy High Solid	160	160
					Finish*	1	2-Comp Polyurethane Shade: Window Grey to RAL 7040	50	50
									290
* Finish paint To be applied at site									
3	**Piping, tanks, etc INDOOR and OUTDOOR, Insulated**	**Boiler scope of components doesn't fall under this category**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	50	50
					Primer	1	Zinc-Epoxy	80	80

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4	**Pump, motors, other equipment OUTDOOR**	**Boiler scope of components doesn't fall under this category**	upto 120	SA 2.5	Intermediate	1	Epoxy High Solid	110	110
					Finish	1	2-Comp Polyurethane	50	50
									240
5	**Pump, motors, other equipment INDOOR**	**Boiler scope of components doesn't fall under this category**	<120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Finish	2	Epoxy High Solid	50	100
									180
6	**Piping, reactors OUTDOOR Insulated**	**Components >95° C Insulated other than components in Sl.No.6 &8 Ring Headers, Down Comers, Hot air Headers outside the gas path etc. 05-155,227,231,251,327,330,350; 07-102,110,125,223,231,232,317; 10-174,178,191,194,195,274,278,283,284, 10-285,291,294,295,315,687;12-178,900; 15-136,178;15-236,278;17-504,900,903; 18-001,002,010;19-701,702,903; 21-600; 24- 800,805,806,807,808,809, 24-811,815;32-010,210; 33-970; 37-010; Hot Air: 48-202, 207,212,214, 48-222,224,262,264,662,664,667. Flue Gas: 48-372,382,384,432,434 48-462,464,482, 484,492,494;**	>120	SA 2.5	Primer	1	Zinc-Ethysilicate Shade: Grey	75	75
7	**Stack OUTDOOR**	**Boiler scope of components doesn't fall under this category**							
8	**Steel Surfaces Uninsulated**	**Components >95° C and <450° C uninsulated other than components coming in gas path. Valves, exhause pipes, man hole doors 20-511; 24-820,824,835,860,865,867; 42-200,300; 48-200,915;**	95-450	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
					Finish	2	Silicone Aluminium Gr.II Shade: aluminium	25	50
									125
9	**Galvanized Surfaces**	**Boiler scope of components doesn't fall under this category**	upto 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or sweep-blasting with fine stand	When finish coat is required, such as sea climate with chloride exposure	1	Epoxy High Solid *	125	125

* Additional 1xFinish Coat 2-Comp. Polyurethane,50µm

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10	**Steel Surfaces permanently in contact with water, also river water splash zone**	**Boiler scope of components doesn't fall under this category**	medium temp upto 60 degree Celsius	SA 2.5	Prime and finish coat in one	1	Glassfake reinforced High Solid Epoxy	500	500
11	**Plant/Cooling Water pipes**	**Boiler scope of components doesn't fall under this category**	GRP, or steel lined concrete pipes with cathodic protection and coating according to AWWA C 203						
12	**NOT GIVEN IN THE TENDER SPECIFICATION**	**Collector & Separator Vessels (Except Internals), Supports 04 –147,321,547;**	upto 200	SA 2.5	PRIMER	1	Zinc-Ethysilicate	75	75
					FINISH	1	Epoxy polyamide cured finish paint Smoke grey	30	30
									105
13	**NOT GIVEN IN THE TENDER SPECIFICATION**	**Collector & Separator Vessels Internals & foundation materials 04-347; Machined components and threaded surfaces (Dd items): 07-302,309,331,361,362,393;12-314,317; 12-324,327,328,344,348,354,393;17-304; 17-306,319;19-306,307;21-602,605; 24-352,803,813,818,823,827,842;28-700; 32-700; 35-010,190,700,701; 36-700,701;39-012,700; 41-710;42-700,710; 43-710;45-710;47-710;48-019,913; 65-710;67-710; All Columns below '0' level (embedded in concrete) PGs 34,35,36,38 39**	---	SA 2.5	PRIMER	2	Sea worthy Rust Preventive Fluid Shade: Amber	25	50
									50
14	**NOT GIVEN IN THE TENDER SPECIFICATION**	**Loose tubes, SH, RH & Eco. coils, 11-074,078,095,374,378,395,406,416,467, 11-469, 474,487,494,606,608,684,694,716, 11-717,718,767,768,769,787, 791,916,917, 11-918,967,968,969,987,991; 12-179,181,184,187,368,395,403,405,495, 12-514,515,517,524,528,544,548,554,568, 12-619,800,803,805,850,852,903,914,917, 12-924,927,928,944,948,954,968; 16-079,201,202,203,270,379; 19-092,802,814,824,884; 19-914,924,984;**	COMING IN THE GAS PATH	SSPC – SP6 or SSPC – SP3 Commercial Blast cleaning/ Power tool cleaning	PRIMER	2	*Red Oxide Zinc Phosphate Dip coat primer to PR: CHEM: 09 – 03 Shade: Red oxide	35	70
									70
*-In lieu of dip painting, 2 coats of brush painting of Red oxide Zinc Phosphate primer to a coating thickness of 60µ is also permitted in line with Sr.No.16									

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15	**NOT GIVEN IN THE TENDER SPECIFICATION**	**Miscellaneous casing sheets, fuel firing, duct plates, expansion joints and coal handling items** **07-409,431,460,461,462,502,503,531,560, 07-561; 12-906,907;21-601,604,700; 24-350,700,804;** **24-817,822,825,826,836,837,840;** **24-841,855,950; 30-219,233,234,235; 35-995;** **36-396, 611, 613,999; 38-993; 39-302;** **41-350,390,500;** **42-001,002,005,010,046,065,070,120,152,** **42-154,157;43-004,005,104,105,200; 45-200,801;** **45-802,804,805,858;47-281,283,858;** **Cold Air** **48-012,014,112,114,141;** **Tempering Air:** **48-142,144,145,204,205;** **65-736;67-204,272,276,283,801,802,803;** **95-088,089,091,485;96-186; 97-585,591,592;** **Handling equipment** **99-100,300,400,514,600;**	---	SA 2.5	PRIMER	2	Red Oxide Zinc Phosphate Primer (Alkyd Base)	30	60
				FINISH	2	Synthetic Enamel paint (Long Oil Alkyd) DFT= 20µm per coat Smoke grey	20	40
								100
16	**NOT GIVEN IN THE TENDER SPECIFICATION**	**Components >95° C coming in the gas path, Headers, Commissioning Spares &erection Materials, Miscellaneous materials etc.,** **05-137,147;06-400,401,431,434,437,441;** **06-444,447,451,453,455,500,501,731,732;** **06-734,735,737,741,744,745,747,751,752;** **06-753,755,759;07-315,316,318,423,993;** **10-182,183,184,185;11-491;12-993;** **17-174,474,476,506; 19-753,763,783,793,850,851,852,853;** **20-998;24-993; 30-215;** **30-223,224; 31-010,104,993;** **35-993; 38-993;39-993;** **42-858;** **48-993;65-200;67-200;97-282,590;** **99-099;20-988;21-987,988;24-987,988;** **24-989;41-988;42-988;**		SA 2.5	PRIMER	2	Red Oxide Zinc Phosphate Primer (Alkyd Base)	30	60
				FINISH	1	Synthetic Enamel paint (Long Oil Alkyd) Smoke grey	20	20
								80

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17	**B0-97, 8140A01/FICHT-15702705-v5 BIFPCL/ EPC-Main Plant/ 2015/ 1/**	**Hand rails and posts, ladders / rungs** **34 - 820,850** **35 - 821,822, 823,851** **36 -820,851,852,853;** **38 - 820,850** **39 - 820,850** **Floor Grills, Guard plates** **34-810;35 -811,812;36-811,812,813,814;** **38 -810;39 – 810;**	---	Acid pickling to SSPC-SP8	Hot dip Galvanizing to a coating weight 600 g/m2 for 2-5mm thickness and 900 g/m2 for thickness more than 5mm. Refer Notes given below **				
			Notes **: Hood ladders, Stringer channels and Guard plates shall be painted as per painting scheme prescribed in System. No: 02						
18	**NOT GIVEN IN THE TENDER**	**Cast carbon steel valves (Conventional)** **Cast alloy steel valves (Conventional)** **All API valves, QCNRV, SV & SRV Silencers,** **24-885;** **21-800,825** **Safety valves & ERV** **21-850; 24-880,881,883,885;** **Seal Boxes & Doors etc.** **09-003,004,005;28-220;**	> 400	SA 2.5	PRIMER	2	Heat Resistant Aluminium Paint to Gr. I	20	40
					FINISH	2	Heat Resistant Aluminium Paint to Gr. I Shade: Aluminium	20	40
									80
19	**NOT GIVEN IN THE TENDER SPECIFICATION**	**Forged valves**	Phosphating to a coating weight of 1500 mg per Sq. ft.						
20	**NOT GIVEN IN THE TENDER SPECIFICATION**	**Soot Blower components (Outside surface – shell)** **20-051,054,201,204,794,962;** **For CLH & VLH$** **PGs 07,08,12,17,19,21,24,47,48 &80** **07-402,403,405;17-519,904,906,919;** **19-506,507,906,907;** **24-351,353, 801,810; 48-206,395;**		SA 2.5	PRIMER	1	Epoxy zinc rich Primer	40	40
					FINISH	1	Aliphatic acrylic poly-urethane paint %VS = 35(min) Shade: Phirozi Blue	30	30
									70
$- For components other than CLH & VLH, Painting scheme shall be as given in System. No. 15									
21	**NOT GIVEN IN THE TENDER SPECIFICATION**	**HP / LP system**		**SSPC-SP3/Power Tool Cleaning**	PRIMER	2	Heat Resistant Aluminium Paint to Gr. I Shade: Aluminium	20	40
					PRIMER	1	Zinc-Ethysilicate	65	65

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22	**NOT GIVEN IN THE TENDER SPECIFICATION**	**Components >95 C & < 150 C, un-insulated Fuel pipes** **47-289, 858.**		SA 2.5	FINISH	2	Heat resistant Aluminium paint Gr.II Shade: aluminium	20 40
								105

NOTES:

1. Seaworthy Rust Preventive Coating should be given on HSFG Bolt and nut threads.
2. All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, Sleeves, machined surfaces and retainers shall be coated with Seaworthy Temporary Rust Preventive Fluid and during execution of civil works; the dried film of coating shall be removed using organic solvents.
3. Ground shade/ colour of Finish paints & identification tag/Band for equipments, pipings pipe service, boiler supporting structures and other boiler components shall be followed.
4. Refer respective engineering document for all sub-vendor items not covered under this document.
5. No painting is required for Stainless Steel, non-ferrous & galvanized components. Abrasive blast cleaning to SSPC-SP6 (Sa2) shall be done to prepare the surfaces of hot worked pipes prior to application of primer.
6. Wherever inside surfaces of components under PGMA 48 – XXX & others, need protection till erection, two coats of Red-oxide zinc phosphate primer paint to IS12744 to a DFT of 60 microns followed by 1 coat of synthetic enamel paint – shade smoke grey shall be applied, after blast cleaning. It is not applicable for sealed channel boxes of duct supports e.g. 48-485. For items meant for spares and subcontracting where no further processing is involved, the painting scheme selected shall be the same as that of similar product configuration/ description.
07. The Temporary Rust Preventive coating that already been applied on any components, tubes, pipes etc., shall be visually inspected for good adherence. If the coating is intact, direct coating of alkyd based red oxide paints over the coating is permitted. In case the coating has peeled off over a large area, the coating is to be removed by suitable solvents / heating to 350 –400 □C for an hour before primer paint application –but, in this case, it should be ensured that the minimum surface cleanliness required for primer paint application shall be SSPC – SP2 (equivalent – Hand Tool cleaning).
08. In components, wherever plates / sheets of thickness less than or equal to 5 mm and rods of <25mm/tubes/drain pipes are used, power tool / hand tool cleaning to SSPC – SP3 shall be followed and the painting shall be done as described in Sl.No.15.
09. For all commissioning components-erection materials (xx-993) two coats of Redoxide Zinc Phosphate Primer shall be applied to meet the temporary protection till erection, after power tool cleaning.
10. Touch-up painting of damaged areas shall be carried out as per clause of Page. No. B0-95 of Amendment no. 06, Part 01, Annexure 01, Fichtner's doc. no: 8140A01/FICHT-15702705-v5 BIFPCL/EPC-Main Plant/2015/1/ – 2x660MW MAITREE STPP.
11. All components covered under different PGMA's are to be painted in case any component is left out, the same shall be deemed to be included under the relevant section based on paint logic approved.
12. For very small components like clamps etc. Sl.no.15 shall be followed with power tool cleaning.
13. Only weldable primer 2 coats to a DFT of 50µ (2x25µ) shall be applied on both external and internal surfaces within 50mm from the end of the component to be welded subsequently at site. At those locations no other paint shall be applied. All small components (less than 300x300 mm in dimension) shall be given only weldable primer.
14. DUs coming under Constant Load Hangers (CLH)/ Variable Load Hangers (VLH) shall be painted as per the system - PS 15 indicated in Sl. No. 20 of the table. However, for DUs other than CLH/VLH, the painting shall be as per Painting Scheme PS 1JS indicated in Sl. No. 15 of the table. (i.e., two coats of Red Oxide Zinc Phosphate Primer followed by two coats of Synthetic Enamel Paint –shade smoke grey, total DFT – 100 microns)
15. For internal protection of Pipes, tubes, headers and other pressure parts, Volatile Corrosion Inhibitor (VCI) pellets shall be put (after sponge testing/ draining/ or drying) and subsequently end capped. The dosage of VCI pellets shall be approximately 100 g/ Cu.m. For tubes typically 4 – 5 tablets per end are to be put. For C & I items the dosage of self-indicating Silica Gel (colourless) shall be 250 g/ cu.m. (About 2 to 3 bags weighing approximately 100 grams each). VCI pellets shall not be used for stainless steel components and its composite associates.
16. All threaded components of spring assemblies and turnbuckles shall be galvanized and achromatized to 15 microns minimum thickness.
17. Soot blower components i.e Valve head assembly having high surface temperature (> 200 and <600 deg. C) shall be applied with HR aluminium IS13183 Gr.II paint (up to 400 deg.C) and Gr.I paint (up to 600 deg.C)
18. Handrails of PGMA under Sl. No. 2 need to be galvanized in line with scheme for handrails (i.e. Sl .No. 17). For chequered plates having thickness <=5mm, surface preparation can be power tool cleaning to St3 and painting shall be in line with Sl. No. 15.
19. It is mandatory that for finish coat each layer shall have a permanent DFT and free from any paint defects like sags, wrinkles etc. Total DFT of a component correspond to respective painting scheme has to be ensured.
20. Periodical maintenance shall be carried out after thorough inspection of painted components, till they are erected.
21. Stenciling is preferably screen printed using lacquer paints.
22. Blast cleaning to SA2½ (Near white metal) shall be done with surface profile, 25-50 microns.

Details for paint procurement & application purposes (In accordance with ISO 12944)

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Sl. No.	Generic nature of paint	Theoretical Covering Capacity Sq.m per Litre.	No. of pack	Volume solids, % (min)**	DFT in microns per coat (approx.)	Shade	Mode of appln.	Over coating interval, Hrs.
1	Inorganic ethyl zinc silicate primer, % Zn content in non volatile portion of paint = 75 minimum	8	2	60	75	Grey	Spray only	16
2	Polyamide cured Epoxy based MIO pigmented intermediate coat (epoxy high solid)	7	2	60	80	Brown	## Spray	24
3	Epoxy based polyamide cured finish paint. (Smooth and Glossy finish (Gloss @ 60 deg. angle of incidence = 61 min) Acid/alkali resistance (10 percent Nitric acid at 27 ± 2°C — 24 h, 20 percent sulphuric acid at 27 ± 2°C — 16 h, 25 percent, caustic soda at 27 ± 2°C — 24 h, 10 percent	10	2	40	35	Smoke Grey	Spray	24
4	Aliphatic acrylic polyurethane paint. (Resistance to acid, alkali, oil and solvents. Smooth and Glossy finish (Gloss @ 45 deg. angle of incidence = 52 min))	8	2	40	50	Phirozi Blue/ Window Grey to RAL 7040	Spray	24
5	Heat resistant Aluminium paint (Silicone aluminium). Heat resistance up to 600 deg.C for Gr.I and 400 deg.C for Gr.II. Salt spray resistance for 96 hours	10	1	--	20 - 25	--	Spray	24
6	Red oxide zinc phosphate primer paint (Zinc phosphate percent by mass on pigment = 16 min)	10	1	--	25-30	Red oxide	Spray	12
7	Red oxide Zinc Phosphate Dip coat primer paint to PR: CHEM: 09-03	10	1	--	35	Red oxide	Dip	12
8	Long oil alkyd synthetic enamel finish paint. (1. Accelerate storage stability test @60 deg.C shall pass for 96 hours; 2. Pthalic anhydride content of non-volatile vehicle, percent by mass = 20 min; Gloss @60 deg = above 71)	10	1	35	15-20	Corrpdg. Shade no	Spray	12
9	Sea worthy Temporary Rust preventive fluid to PR: CHE: 09 – 06	10	1	--	25	Amber	Spray	12
10	HB Epoxy zinc rich primer (zinc - epoxy). % Zinc dust pigment content = 80 minimum.	7	2	60	80	grey	Spray	24
11	Epoxy Zinc rich primer (for Soot blowers and CLH/VLH) % Metallic Zn content = 85 minimum.	8	2	35	40	Grey	Spray	24

Brush painting is accepted, if recommended by the Paint suppliers. The covering capacity of paints specified is only approximate.

Records of revision

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Revision No.	Date	Details of revision	Remarks
1	04-06-2018	Coating thickness in system no.17 is changed as per technical spec. Heat resistant aluminium paint is indicated in system no.22. Description of items included in system no. 8. Brush application removed in sheet 07 of 07.	As per BIFPCL comments on painting scheme approval.

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PAINTING SCHEDULE FOR 2X660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH
(EPC MAIN PLANT PACKAGE)
BHARAT HEAVY ELECTRICAL LTD.
HEAVY ELECTRICAL EQUIPMENT PLANT RANIPUR, HARIDWAR

7	Generator CO2 piping		<120	Manual wire brush/emary paper/Solvant cleanng	Primer	2	Epoxy based Zinc rich primer paint	35	70	Final Shade: Grey RAL 9002 Identification Band Colour for piping:Canary Yellow ISC 309. Legend on piping-CO2	I Final painting is done at site.
					Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cured Paint	70	70		
					Finish	1	Aliphatic Acrylic 2 Pack Polyurethane Finish paint	60	60		
									200		
8	ACW Piping for Generator H2 coolers	-	<120	Manual wire brush/emary paper/Solvant cleanng	Primer	2	Epoxy based Zinc rich primer paint	35	70	Final Shade: Grey RAL 9002 Identification Band Colour for piping:Sea Green,ISC 217 Legend on piping-ACW	I Final painting is done at site.
					Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cured Paint	70	70		
					Finish	1	Aliphatic Acrylic 2 Pack Polyurethane Finish paint	60	60		
									200		
9	PW Piping including impulse piping	-	<120	Manual wire brush/emary paper/Solvant cleanng	Primer	2	Epoxy based Zinc rich primer paint	35	70	Final Shade: Grey RAL 9002 Identification Band Colour for piping:Sea Green,ISC 217 Legend on piping-DMW	I Final painting is done at site.
					Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cured Paint	70	70		
					Finish	1	Aliphatic Acrylic 2 Pack Polyurethane Finish paint	60	60		
									200		
10	Hanger & Pipe supports for generator pipings.	-	<120	Manual wire brush/emary paper/Solvant cleanng	Primer	2	Epoxy based Zinc rich primer paint	35	70	Final Shade: Black, RAL 9011	I Final painting is done at site.
					Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cured Paint	70	70		
					Finish	1	Aliphatic Acrylic 2 Pack Polyurethane Finish paint	60	60		
									200		

Note: For painting in BHEL scope at site:- For painting work at Site and for touch-up paints (if required), the procurement & application of paint & painting materials are in BHEL-Site (P.S.) scope inline with earlier projects.

B: PAINTING SCHEME FOR STEAM TURBINE & AUXILIARIES

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat micro m	Total DFT (Micro m)	Final Paint Shade	Remark
1	HP Outer Casing IP Outer Casing	-	<600	Manual wire brush/emary paper/Solvant cleanng	–	–	–	–	–	–	
						–	–	–	–	–	
					Finish	2	Aluminum Paint	20	**40**		
2	IP Inlet	-	<600	Manual wire brush/emary paper/Solvant cleanng	–	–	–	–	–	–	
						–	–	–	–	–	
					Finish	2	Aluminum Paint	20	**40**		
3	Cross Over Pipe	-	<400	Manual wire brush/emary paper/Solvant cleanng	–	–	–	–	–	–	
						–	–	–	–	–	
					Finish	2	Aluminum Paint	20	**40**		
				Manual wire	Primer	2	Epoxy based Zinc rich primer paint	35	70	-	

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PAINTING SCHEDULE FOR 2X660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH
(EPC MAIN PLANT PACKAGE)
BHARAT HEAVY ELECTRICAL LTD.
HEAVY ELECTRICAL EQUIPMENT PLANT RANIPUR, HARIDWAR

4	Front Wall & Side Wall	-	<120	Manual wire brush/emary paper/Solvant cleanng	Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cured Paint	70	70	-	
					Finish	2	Aliphatic Acrylic 2 Pack Polyurethane Finish paint	30	60	Light Blue (RAL5012)	
									200		
5	LP Outer Casing Upper Part	-	<120	Manual wire brush/emary paper/Solvant cleanng	Primer	2	Epoxy based Zinc rich primer paint	35	70	–	
					Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cured Paint	70	70	–	
					Finish	2	Aliphatic Acrylic 2 Pack Polyurethane Finish paint	30	60	Light Blue (RAL5012)	
									200		
6	Overload Valve Assembly	-	<600	Manual wire brush/emary paper/Solvant cleanng	–	–	–	–	–	–	
						–	–	–	–	–	
					Finish	2	Aluminum Paint	20	**40**		
7	Bearing Pedestals & Covers	-	<150	Manual wire brush/emary paper/Solvant cleanng	Primer	2	Epoxy based Zinc rich primer paint	35	70	–	
					Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cured Paint	70	70	–	
					Finish	2	Aliphatic Acrylic 2 Pack Polyurethane Finish paint	30	60	Light Blue (RAL5012)	
									200		
8	Shaft Lifting Device (LPT) Assembly Fixture for HPT	-	-	Manual wire brush/emary paper/Solvant cleanng	Primer	2	Epoxy based Zinc rich primer paint	35	70	–	
					Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cured Paint	70	70	–	
					Finish	2	Aliphatic Acrylic 2 Pack Polyurethane Finish paint	30	60	Light Blue (RAL5012)	
									200		
9	E.S.V. & C.V. Casing	-	<600	Manual wire brush/emary paper/Solvant cleanng	–	–	–	–	–	–	
						–	–	–	–	–	
					Finish	2	Aluminum Paint	20	**40**		
10	IV & CV Casing	-	<600	Manual wire brush/emary paper/Solvant cleanng	–	–	–	–	–	–	
						–	–	–	–	–	
					Finish	2	Aluminum Paint	20	**40**		
11	ESV, HPCV, IV & IPCV Servomotor	-	<150	Manual wire brush/emary paper/Solvant cleanng	Primer	2	Epoxy based Zinc rich primer paint	35	70	–	
					Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cured Paint	70	70	–	
					Finish	2	Aliphatic Acrylic 2 Pack Polyurethane Finish paint	30	60	Canary Yellow ISC No. 309	
									200		
12	LPBP Stop/Control Valve Servomotor	-	<150	Manual wire brush/emary paper/Solvant cleanng	Primer	2	Epoxy based Zinc rich primer paint	35	70	–	
					Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cured Paint	70	70	–	
					Finish	2	Aliphatic Acrylic 2 Pack Polyurethane Finish paint	30	60	Canary Yellow ISC No. 309	
									200		

C: PAINTING SCHEME FOR CONDENSER & AUXILIARIES

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.
Date: 15-Jun-2013
*Approval does not absolve the EPC contractor of it's responsibility as specified in the Contract

PAINTING SCHEDULE FOR 2X660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH
(EPC MAIN PLANT PACKAGE)
BHARAT HEAVY ELECTRICAL LTD.
HEAVY ELECTRICAL EQUIPMENT PLANT RANIPUR, HARIDWAR

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat micro m	Total DFT (Micro m)	Final Paint Shade	Remark
1	Structural steel works, piping, vessels, tanks INDOOR	Outside surfaces of: 1. Condenser 2. L.P. Heater No. 1 3. Hydrogen Cooler	upto 120	SA 2.5	Primer	2	Epoxy base zinc rich primer paint	35	70		
					Intermediate Paint	1	Epoxy TiO2 Pigmented Polyamide cured paint	70	70		
					Finish	2	Aliphatic Acrylic 2 Pack Polyurethane Finish Paint	30	60		
									200 (180 min.)		
		Inside surfaces of: 1. Condenser 2. L.P. Heater No. 1 3. Hydrogen Cooler		NA	Inside surfaces are supplied coated with steam washable paint at works. This paint is to be washed before commissioning.						
2	Structural steel works, piping, vessels, tanks OUTDOOR	N.A.	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80		
					Intermediate	1-2	Epoxy High Solid	160	160		
					Finish	1	2-Comp Polyurethane	50	50		
									290		
3	Piping, tanks, etc INDOOR and OUTDOOR, Insulated	N.A.	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	50	50		
4	Pump, motors, other equipment OUTDOOR	N.A.	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80		
					Intermediate	1	Epoxy High Solid	110	110		
					Finish	1	2-Comp Polyurethane	50	50		
									240		
5	Pump, motors, other equipment INDOOR	1. Vacuum Pump	upto 50	SA 2.5	Primer	1	Zinc-Epoxy	80	80		
					Finish	2	Epoxy High Solid	50	100		
									180		
		2. GSC Air Exhauster	upto 80								
6	Piping, reactors OUTDOOR Insulated	N.A.	<120	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75		
7	Stack OUTDOOR	N.A.	<120	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75		
					Finish	2	Silicone Acrylic	50	100		
									175		
8	Steel Surfaces Uninsulated	N.A.	200-450	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75		
					Finish	2	Silicone Aluminium	25	50		
									125		
9	Galvanized Surfaces	N.A.	upto 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or sweep-blasting with fine stand	When finish coat is required, such as sea climate with chloride exposure	1	Epoxy High Solid *	125	125		

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.
Date: 15-Jun-2018
*Approval does not absolve the EPC contractor of it's responsibility as specified in the Contract

PAINTING SCHEDULE FOR 2X660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH
(EPC MAIN PLANT PACKAGE)
BHARAT HEAVY ELECTRICAL LTD.
HEAVY ELECTRICAL EQUIPMENT PLANT RANIPUR, HARIDWAR

10	Steel Surfaces permanently in contact with water, also river water splash zone	1. Waterbox inside surface. 2. Water side portion of Water Chamber not cladded with titanium.	medium temp upto 60 degree Celsius	SA 2.5	Prime and finish coat in one	3	Glassflake reinforced High Solid Epoxy	1000	3000		
11	Plant/Cooling Water pipes	To be filled in by BHEL Units	GRP, or steel lined concrete pipes with cathodic protection and coating according to AWWA C 203								
* Additional 1 x Finish Coat 2-Comp. Polyurethane, 50 micro m, when exposed to UV or weathering conditions and color retention is required											

Deviation Sought

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat	Total DFT (Micro m)	Justification/ Reasoning
D-1	**Steel Surface uninsulated**	Turbine oil cooler-Part of oil module skid- indoor	100	-	-	-	-	-	-	Cooler is of Stainless steel, hence no painting is required.

D: PAINTING SCHEME FOR TURBINE INTEGRAL SYSTEM

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat micro m	Total DFT (Micro m)	Final Paint Shade	Remark
1	**Structural steel works, piping, vessels, tanks INDOOR**	Spring Cages	<60	SA 2.5	Primer	1	Epoxy Base Zinc Rich	35	35		
					Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cure	70	70		
					Finish	2	Aliphatic Acrylic 2 Pack Polyurethane	37.5	**75**		
					TOTAL:				**180**		
		Oil tank (MOT)	>60	SA 2.5	Primer	1	Epoxy Base Zinc Rich	35	35		
					Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cure	70	70		
					Finish	2	Aliphatic Acrylic 2 Pack Polyurethane	37.5	**75**		
					TOTAL:				**180**		
		MOP,EOP, JOP (With Motors)	>60	SA 2.5	Primer	1	Epoxy Base Zinc Rich	35	35		
					Intermediate	1	Epoxy TiO2 Pigmented Polyamide Cure	70	70		
					Finish	2	Aliphatic Acrylic 2 Pack Polyurethane	37.5	**75**		
					TOTAL:				**180**		
* Additional 1 x Finish Coat 2-Comp. Polyurethane, 50 micro m, when exposed to UV or weathering conditions and color retention is required											

E: PAINTING SCHEME FOR CONTROL INSTRUMENT OF STG & AUXILIARIES

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat micro m	Total DFT (Micro m)	Final Paint Shade	Remark
1	**Pump, motors, other equipment INDOOR (STARTER PANELS)**	-	>120	SA 2.5	Primer	1	Zinc-Epoxy	80	80		
					Finish	2	Epoxy High Solid	50	100		
									180		

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.
Date: 15-Jun-2018
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PAINTING SCHEDULE FOR 2X660MW MAITREE SUPER THERMAL POWER PROJECT, RAMPAL, BANGLADESH
(EPC MAIN PLANT PACKAGE)
BHARAT HEAVY ELECTRICAL LTD.
HEAVY ELECTRICAL EQUIPMENT PLANT RANIPUR, HARIDWAR

*** Additional 1 x Finish Coat 2-Comp. Polyurethane, 50 micro m, when exposed to UV or weathering conditions and color retention is required**

Deviation Sought

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat micro m	Total DFT (Micro m)	Justification/ Reasoning
D-1	INDOOR	DC STARTER PANELS & GIC	Ambient (0-50 C)	7 tank process	Powder coating	1	Epoxy based powder	75	75	

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.

Date: 15-Jun-2018

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Coating System (refer Contract Book No.3 Clause B0.6.5)

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat micro m	Total DFT (Micro m)	REMARKS
1	**Structural steel works, piping, vessels, tanks INDOOR**	**1. HYDRANT COMPONENTS PACKAGE 2. WATER SPRAY SYSTEM (for Structural steel, Pylon Pipes, detection pipes, equipmnets like DV, Nozzles, QBD, instruments, Valves etc.) 3. Piping & structurals for Inert Gas Extinguishing system 4. Foam system**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80	A) PIPING:(Surface preparation, Primer and finish coats at site) BASE COLOR : SIGNAL RED / RAL : 3001 LETTERING : SIGNAL WHITE / RAL :9003 B) EQUIPMENTS like DV, Nozzles, QBD, instruments, Valves etc : (Surface preparation, Primer and finish coats at shop) Final shade:WINDOW GREY / RAL 7040 C) DV LOCAL CONTROL PANELS:(Surface preparation, Primer and finish coats at shop) Final shade: LIGHT GREY / RAL 7035 D) STRUCTURAL STEEL:((Surface preparation, Primer and finish coats at site) Final shade:WINDOW GREY / RAL 7040 E)
					Finish	1	Epoxy High Solid	80	80	
									160	
2	**Structural steel works, piping, vessels, tanks OUTDOOR**	**1. HYDRANT COMPONENTS PACKAGE 2. WATER SPRAY SYSTEM (for Structural steel, Pylon Pipes, detection pipes,equipmnets like DV, Nozzles, QBD, instruments, Valves etc.) 3. Piping & structurals for Inert Gas Extinguishing system 4. Foam system**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80	A) PIPING:(Surface preparation, Primer,intermediate and finish coats at site) BASE COLOR : SIGNAL RED / RAL : 3001 LETTERING : SIGNAL WHITE / RAL :9003 B) EQUIPMENTS like DV, Nozzles, QBD, instruments, Valves etc: (Surface preparation, Primer,intermediate and finish coats at shop) Final shade: WINDOW GREY / RAL 7040 C) DV LOCAL CONTROL PANELS: (Surface preparation, Primer,intermediate and finish coats at shop) Final shade: LIGHT GREY / RAL 7035 D) STRUCTURAL STEEL:((Surface preparation, Primer,intermideate coat and finish coats at site) Final shade:WINDOW GREY / RAL 7040
					Intermediate	1-2	Epoxy High Solid	160	160	
					Finish	1	2-Comp Polyurethane	50	50	
									290	
3	**Piping, tanks, etc INDOOR and OUTDOOR, Insulated**	**NA for FPS**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	50	50	
4	**Pump, motors, other equipments OUTDOOR**	**NA for FPS**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80	
					Intermediate	1	Epoxy High Solid	110	110	
					Finish	1	2-Comp Polyurethane	50	50	
									240	
5	**Pump, motors, other equipments INDOOR**	**1. Hydrant System 2. Water Spray System 3. Foam System**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80	Shade: RAL 3001
					Finish	2	Epoxy High Solid	50	100	
									180	
6	**Piping, reactors OUTDOOR Insulated**	**NA for FPS**	>120	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75	
7	**Stack OUTDOOR**	**NA for FPS**	<120	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75	
					Finish	2	Silicone Acrylic	50	100	
									175	
8	**Steel Surfaces Uninsulated**	**NA for FPS**	200-450	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75	
					Finish	2	Silicone Aluminium	25	50	
									125	

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.

Date: 15-Jun-2018

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9	**Galvanized Surfaces**	**1. WATER SPRAY SYSTEM (for Galvanized Pipes)**	upto 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or sweep-blasting with fine stand	When finish coat is required, such as sea climate with chloride exposure	1	Epoxy High Solid *	125	125	A) PIPING(Galvanizing is at shop, and finish coat will be at site) BASE COLOR : SIGNAL RED / RAL : 3001 LETTERING : SIGNAL WHITE / RAL :9003
10	**Steel Surfaces permanently in contact with water, also river water splash zone**	**NA for FPS**	medium temp upto 60 degree Celsius	SA 2.5	Prime and finish coat in one	1	Glassfake reinforced High Solid Epoxy	500	500	
11	**Plant/Cooling Water pipes**	**NA for FPS**	GRP, or steel lined concrete pipes with cathodic protection and coating according to AWWA C 203							
12	**Fire detection and Alarm System panels**	**Fire detection and Alarm System**								Shall be as per OEM Standrard
13	**PLC Panels**	**PLC for Fire water pumps operation**								Shall be as per OEM Standrard
14	**Inert gas cylinders, Gas release panel, Inhibit/Release push button and Inert gas components for Inert gas systems**	**Inert Gas Extinguishing System**								Shall be as per OEM Standrard

** Additional 1 x Finish Coat 2-Comp. Polyurethane, 50 micro m, when exposed to UV or weathering conditions and color retention is required*

Deviation Sought, if any

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat micro m	Total DFT (Micro m)	Justification/ Reasoning
D-1										
D-2										
D-3										
D-4										
D-5										
D-6										
D-7										
D-8										
D-9										

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.

Date: 15-Jun-2018

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Painting Scheme for Flue Gas Desulphurization (FGD) System

Coating System (refer Contract Book No.3 Clause B0.6.5)

MPS-4

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat micro m	Total DFT (Micro m)
1	**Structural steel works, piping, vessels, tanks INDOOR**	**Indoor surfaces (Structural steel works, piping, vessels, tanks) of FGD system**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Finish	1	Epoxy High Solid	80	80
									160
2	**Structural steel works, piping, vessels, tanks OUTDOOR**	**Outdoor surfaces (Surface exposed to atmosphere of Structural steel work, piping, vessel, tanks) of FGD system**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Intermediate	1-2	Epoxy High Solid	160	160
					Finish	1	2-Comp Polyurethane	50	50
									290
3	**Piping, tanks, etc INDOOR and OUTDOOR, Insulated**	**Piping, Tanks Indoor and Outdoor (Insulated) of FGD system**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	50	50
4	**Pump, motors, other equipment OUTDOOR**	**Pumps, motor and other equipment (Outdoor) of FGD system**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Intermediate	1	Epoxy High Solid	110	110
					Finish	1	2-Comp Polyurethane	50	50
									240
5	**Pump, motors, other equipment INDOOR**	**Pumps, motor and other equipment (Indoor) of FGD system**	>120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Finish	2	Epoxy High Solid	50	100
									180
6	**Piping, reactors OUTDOOR Insulated**	**Piping, reactors Outdoor (Insulated) of FGD system**	<120	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
7	**Stack OUTDOOR**	**FGD System components does not fall under this category**	<120	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
					Finish	2	Silicone Acrylic	50	100
									175
8	**Steel Surfaces Uninsulated**	**FGD System components does not fall under this category**	200-450	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
					Finish	2	Silicone Aluminium	25	50
									125
9	**Galvanized Surfaces**	**Floor grills, Hand rails and Step Treads (As specified in drawing; if not specified, system 2.0 to be followed for painting)- Hot dip galvanizing to a coating weight of 610 gm per sq.M (minimum) and to a coating thickness of 85 microns (min) on steel sections 2-5mm thick and 900 gm per sq.M (minimum) for steel sections more than 5mm thick.**	upto 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or sweep-blasting with fine stand	There is no finish coat on galvanized surfaces as there is no sea climate with chloride exposure	-	-	-	-
10	**Steel Surfaces permanently in contact with water, also river water splash zone**	**Steel surfaces permanently in contact with water such as process water tank and Emergency water tank of FGD system**	medium temp upto 60 degree Celsius	SA 2.5	Prime and finish coat in one	1	Glassfake reinforced High Solid Epoxy	500	500
11	**Plant/Cooling Water pipes**	**Plant / cooling water pipes of FGD system**	GRP, or steel lined concrete pipes with cathodic protection and coating according to AWWA C 203						

** Additional 1 x Finish Coat 2-Comp. Polyurethane, 50 micro m, when exposed to UV or weathering conditions and color retention is required*

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.

Date: 15-Jun-2018

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PAINTING SCHEME FOR
Power House Structures, Bunker Shells, AHP/CHP Structures, RODM & Sub Station Structures

MPS-5

Coating System (refer Contract Book No.3 Clause B0.6.5)

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat micro m	Total DFT (Micro m)
1	**Structural steel works, piping, vessels, tanks INDOOR**	**Power House Structures, Bunker Shells, AHP/CHP Structures, RODM & Sub Station Structures does not fall under this category**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Finish	1	Epoxy High Solid	80	80
									160
2	**Structural steel works, piping, vessels, tanks OUTDOOR**	**Structural steel of AHP/ CHP, PHS, RODM Structures & Bunkers and supporting structures**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Intermediate	1-2	Epoxy High Solid	160	160
					Finish	1	2-Comp Polyurethane	50	50
									290
3	**Piping, tanks, etc INDOOR and OUTDOOR, Insulated**	**Power House Structures, Bunker Shells, AHP/CHP Structures, RODM & Sub Station Structures does not fall under this category**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	50	50
4	**Pump, motors, other equipment OUTDOOR**	**Power House Structures, Bunker Shells, AHP/CHP Structures, RODM & Sub Station Structures does not fall under this category**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Intermediate	1	Epoxy High Solid	110	110
					Finish	1	2-Comp Polyurethane	50	50
									240
5	**Pump, motors, other equipment INDOOR**	**Power House Structures, Bunker Shells, AHP/CHP Structures, RODM & Sub Station Structures does not fall under this category**	>120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Finish	2	Epoxy High Solid	50	100
									180
6	**Piping, reactors OUTDOOR Insulated**	**Power House Structures, Bunker Shells, AHP/CHP Structures, RODM & Sub Station Structures does not fall under this category**	<120	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
7	**Stack OUTDOOR**	**Power House Structures, Bunker Shells, AHP/CHP Structures, RODM & Sub Station Structures does not fall under this category**	<120	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
					Finish	2	Silicone Acrylic	50	100
									175
8	**Steel Surfaces Uninsulated**	**Power House Structures, Bunker Shells, AHP/CHP Structures, RODM & Sub Station Structures does not fall under this category**	200-450	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
					Finish	2	Silicone Aluminium	25	50
									125
9	**Galvanized Surfaces**	**Floor grills, Hand rails, Step Treads and Switchyard Structures (As specified in drawing; if not specified, system 2.0 to be followed for painting)- Hot dip galvanizing to a coating weight of 610 gm per sq.M (minimum) and to a coating thickness of 85 microns (min) on steel sections 2-5mm thick and 900 gm per sq.M (minimum) for steel sections more than 5mm thick.**	upto 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or sweep-blasting with fine stand	There is no finish coat on galvanized surfaces as there is no sea climate with chloride exposure	-	-	-	-

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.

Date: 15-Jun-2018

*Approval doesn't absolve the EPC contractor of it's responsibility as specified in the Contract.

10	**Steel Surfaces permanently in contact with water, also river water splash zone**	**Power House Structures, Bunker Shells, AHP/CHP Structures, RODM & Sub Station Structures does not fall under this category**	medium temp upto 60 degree Celsius	SA 2.5	Prime and finish coat in one	1	Glassfake reinforced High Solid Epoxy	500	500
11	**Plant/Cooling Water pipes**	**Power House Structures, Bunker Shells, AHP/CHP Structures, RODM & Sub Station Structures does not fall under this category**	GRP, or steel lined concrete pipes with cathodic protection and coating according to AWWA C 203						

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.

Date: 15-Jun-2018

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Sl No	Description	Surface preparation	Primer/ DFT	Intermediate DFT	Finish DFT	Total DFT
1.0	Indoor surfaces (Structural steel works,piping,vessels,tanks, pump,motor, other parts/equipment of APH, ESP,FAN, Gate and Damper,etc)	Blast cleaning SA2.5	One coat of Epoxy zinc phosphate, 80 µm per coat	NIL	One coat of Epoxy high solid paint, , 80 µm per coat	160 µm (min)
2.0	Outdoor surfaces (Surface exposed to atmosphere of APH, ESP,FAN and Gates&Damper,etc)	Blast cleaning SA2.5	One coat of Epoxy zinc phosphate, 80 µm per coat	One/two coats of epoxy high solid, total dft of 160 µm	One coat of 2-component polyurethane paint, 50 µm per coat	290 µm (min)
3.0	Insulated parts of indoor/outdoor surfaces	Blast cleaning SA2.5	One coat of Epoxy zinc phosphate, 80 µm per coat	NIL	NIl	80µm (min)
4.0	Uninsulated steel surfaces of temperature 200-450 deg celsius	Blast cleaning SA2.5	One coat of Inorganic ethyl zinc silicate, 75 µm per coat	NIL	Two coats of Silicone Aluminium, 25 µm per coat	125µm (min)
5.0	Outdoor stacks	Blast cleaning SA2.5	One coat of Inorganic ethyl zinc silicate, 75 µm per coat	NIL	Two coats of Silicone Acrylic, 50µm per coat	175µm (min)
6.0	Floor grills , step treads , Hand rails,etc of ESP and other items	Hot dip galvanizing to a coating weight of 610 gm per sq.M (minimum) and to a coating thickness of 85 microns (min)				

1. Painting of APH, ESP, Fan and G&D commissioning spares and Mandatory spares shall be as per respective items as above.
2. No painting for SS, Aluminium and Galvanized items.
3. All components covered under different SL no. are to be painted. Incase any component is left out, the same shall be deemed to be included under the relevant section.

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.

Date: 15-Jun-2018

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PAINTING SCHEME FOR

Item Description: MISC TANKS – SITE FABRICATED I.E. CONDENSATE STORAGE TANKS, DM WATER STORAGE TANKS, SERVICE WATER STORAGE TANKS AND DESALINATED WATER STORAGE TANK

MPS-7

Coating System (refer Contract Book No.3 Clause B0.6.5)

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat micro m	Total DFT (Micro m)
1	**Structural steel works, piping, vessels, tanks INDOOR**	**INTERNAL SURFACE OF TANK, PIPE SUPPORTS AND ROOF STRUCTURE**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Finish	1	Solvent Free Epoxy	100	100
									180
2	**Structural steel works, piping, vessels, tanks OUTDOOR**	**EXTERNAL SURFACE OF TANK, PIPE SUPPORTS AND APPURTENANCES EXPOSED TO ATMOSPHERE**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Intermediate	1-2	Epoxy High Solid	160	160
					Finish	1	2-Comp Polyurethane	50	50
									290
3	**Piping, tanks, etc INDOOR and OUTDOOR, Insulated**	**Not Applicable for above mentioned Items**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	50	50
4	**Pump, motors, other equipment OUTDOOR**	**Not Applicable for above mentioned Items**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Intermediate	1	Epoxy High Solid	110	110
					Finish	1	2-Comp Polyurethane	50	50
									240
5	**Pump, motors, other equipment INDOOR**	**Not Applicable for above mentioned Items**	>120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Finish	2	Epoxy High Solid	50	100
									180
6	**Piping, reactors OUTDOOR Insulated**	**Not Applicable for above mentioned Items**	<120	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
7	**Stack OUTDOOR**	**Not Applicable for above mentioned Items**	<120	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
					Finish	2	Silicone Acrylic	50	100
									175
8	**Steel Surfaces Uninsulated**	**Not Applicable for above mentioned Items**	200-450	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
					Finish	2	Silicone Aluminium	25	50
									125
9	**Galvanized Surfaces**	**Not Applicable for above mentioned Items**	upto 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or sweep-blasting with fine stand	When finish coat is required, such as sea climate with chloride exposure	1	Epoxy High Solid *	125	125
10	**Steel Surfaces permanently in contact with water, also river water splash zone**	**Not Applicable for above mentioned Items**	medium temp upto 60 degree Celsius	SA 2.5	Prime and finish coat in one	1	Glassfake reinforced High Solid Epoxy	500	500
11	**Plant/Cooling Water pipes**	**Not Applicable for above mentioned Items**	GRP, or steel lined concrete pipes with cathodic protection and coating according to AWWA C 203						

** Additional 1 x Finish Coat 2-Comp. Polyurethane, 50 micro m, when exposed to UV or weathering conditions and color retention is required*
COLOR SHADE SIGNAL GREEN (RAL 6032), SIGNAL WHITE (RAL 9003) FOR LETTERING

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.

Date: 15-Jun-2018

*Approval doesn't absolve the EPC contractor of it's responsibility as specified in the Contract.

Other Locations

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat micro m	Total DFT (Micro m)	Justification/ Reasoning
12	**UNDERNEATH SURFACE OF BOTTOM PLATE**	UNDERNEATH SURFACE OF BOTTOM PLATE	-	Cleaning to ST-3	Primer Coat	2	High Build Coal TAR Epoxy	80	160	

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.
Date: 15-Jun-2018
*Approval doesn't absolve the EPC contractor of it's responsibility as specified in the Contract.

BHARAT HEAVY ELECTRICALS LIMITED
PIPING CENTRE, CHENNAI– 17
QUALITY ASSURANCE & CONTROL DEPT.

PAINTING SCHEME FOR LOW PRESSURE PIPING

(CW / ACW / ECW / Plant water, Air Piping, etc…,)

PROJECT NAME : - BIFPCL MAITREE STPP - 2X660 MW
BHEL CUSTOMER Nos : 7328, 7329, 7330, 7331.

MPS-8

Sl. NO	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate coat			Finish coat			Total DFT Microns (Min.)	REMARKS
			Primer	No of coats	Paint	No of coats	Shade	Paint	No of coats	Shade		
1	2	3	4	5	6	7	8	9	10	11	12	13
1	(a) Internal Surface - CW Pipe (for pipe - dia - 350 mm to 1200mm)	Blast Cleaning SSPC SP-10 / SA 2½	Rubber lining								5000 Microns / 5mm *(Refer Note 3)*	
	(b) Holiday test (Refer Note 3)	Holiday test @ 5KV/mm. Holiday test Equipment to be calibrated before testing.										
2	(a) Internal Surface - CW Pipe (for pipe - dia - 1200 mm and above)	Blast Cleaning SSPC SP-10 / SA 2½	POLY - URETHANE COATING OF 2000 MICRONS DRY FILM THICKNESS . (Refer Note 2)								2000 Microns *(Refer Note 3)*	
	(b) Holiday test (Refer Note 3)	Holiday testing as per AWWA C222 and Paint Manufacturer recommendation. Holiday test Equipment to be calibrated before testing.										
3	External Surface of CW --Buried Piping / Encased in concrete (For pipe dia- 1000 mm and above) (Temporary Protection for transportation from works to site). **Further protection to be done by BHEL Erection Group as per Contract requirement.	Blast Cleaning SSPC SP-10 / SA 2½	Epoxy Zinc Phosphate	1 (40 Microns per coat)	-----	-----	-----	-----	-----	-----	40 Microns	
4	External Surface (over ground piping) of CW,ACW.(For all diameters)	Blast Cleaning SSPC SP-10 / SA 2½	Epoxy Polyamide resin based Zinc Phosphate Primer	2 (35 microns per coat)	Epoxy resin with MIO	1 (75 microns per coat.)	-----	Epoxy Polyamide finish Paint	1 $ (40 microns per coat)	Smoke Grey Shade No 692 of IS 5 (Refer Note-4)	145 at shop + 40 at site	$: 1 coat of DFT-40 microns finish coat at site
5	External Surface of ECW, Plant water (For all diameters)	Blast Cleaning SSPC SP-10 / SA 2½	Epoxy Polyamide resin based Zinc Phosphate Primer	2 (35 microns per coat)	Epoxy resin with MIO	1 (75 microns per coat.)	-----	Epoxy Polyamide finish Paint	1 $ (40 microns per coat)	Smoke Grey Shade No 692 of IS 5 (Refer Note-4)	145 at shop + 40 at site	$: 1 coat of DFT-40 microns finish coat at site
6	Galvanised and Stainless steel Piping	No painting										

Notes:

1. Blast cleaning to near white metal to obtain roughness as per epoxy paint data sheet.
2. Application of Poly-Urethane coating shall be done as per manufacturer's data sheet / recommendation, meeting the thickness requirements as per this document.
3. Witness by BHEL / BHEL nominated inspection agency.
4. Shade for finish coat to be done at site shall be as per project specification/contract requirement.

APPROVED ON CONDITION
Checked and approved subject to necessary corrections.

Date: 15-Jun-2018

*Approval doesn't absolve the EPC contractor of it's responsibility as specified in the Contract.

PAINTING SCHEME FOR

Item Description: Ash Handling Plant, Pumps, Mills & Auxiliaries, Drain Cooler, LP Heaters, Deaerator, HP Heaters And Oil Cooler, Coal Handling Plant, Limestone & Gypsum Handling Plant, RE Joint, Mill Reject System, Chimney, D/G EOT Cranes, Sewage Treatment Plant, Pre Treatment Plant, Fuel Oil Handling System, Weigh Bridge, Electrical & Associated Systems, Other Balance of Plant Packages

MPS-9

Coating System (refer Contract Book No.3 Clause B0.6.5)

System No.	Surface location	Item Description/ PGMA details	Temp in Celsius	Surface Preperation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat micro m	Total DFT (Micro m)
1	**Structural steel works, piping, vessels, tanks INDOOR**	**As above**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Finish	1	Epoxy High Solid	80	80
									160
2	**Structural steel works, piping, vessels, tanks OUTDOOR**	**As above**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Intermediate	1-2	Epoxy High Solid	160	160
					Finish	1	2-Comp Polyurethane	50	50
									290
3	**Piping, tanks, etc INDOOR and OUTDOOR, Insulated**	**As above**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	50	50
4	**Pump, motors, other equipment OUTDOOR**	**As above**	upto 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Intermediate	1	Epoxy High Solid	110	110
					Finish	1	2-Comp Polyurethane	50	50
									240
5	**Pump, motors, other equipment INDOOR**	**As above**	>120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
					Finish	2	Epoxy High Solid	50	100
									180
6	**Piping, reactors OUTDOOR Insulated**	**As above**	<120	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
7	**Stack OUTDOOR**	**As above**	<120	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
					Finish	2	Silicone Acrylic	50	100
									175
8	**Steel Surfaces Uninsulated**	**As above**	200-450	SA 2.5	Primer	1	Zinc-Ethysilicate	75	75
					Finish	2	Silicone Aluminium	25	50
									125
9	**Galvanized Surfaces**	**As above**	upto 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or sweep-blasting with fine stand	When finish coat is required, such as sea climate with chloride exposure	1	Epoxy High Solid *	125	125
10	**Steel Surfaces permanently in contact with water, also river water splash zone**	**As above**	medium temp upto 60 degree Celsius	SA 2.5	Prime and finish coat in one	1	Glassfake reinforced High Solid Epoxy	500	500
11	**Plant/Cooling Water pipes**	**As above**	GRP, or steel lined concrete pipes with cathodic protection and coating according to AWWA C 203						

** Additional 1 x Finish Coat 2-Comp. Polyurethane, 50 micro m, when exposed to UV or weathering conditions and color retention is required*

BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED

2x660MW MAITREE STPP, RAMPAL

BANGLADESH

VOLUME – II B

CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

PE-TS-421-600-C006 R02

SECTION C
SPECIFIC TECHNICAL REQUIREMENT

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida-201301

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1.0 Civil Works

This specification covers the design, manufacturing, supply, erection, commissioning and handing over of the complete civil works for the entire specified power plant.

It is to be emphasized, that this specification does not enumerate or describe all the materials and equipment to be supplied and all the services to be performed. However, the civil works shall be complete in every respect and shall ensure safe and reliable operation of the Plant. This means, all material and equipment shall be provided as required to make a complete, properly functioning installation and shall conform to the highest standards of engineering design and workmanship.

Contractor shall read the parts of specification relevant to contract and shall ignore other parts of specification. In case of ambiguity between BOQ, Part C and Part D of specification, the following priority for acceptance of items may be followed:
a) BOQ
b) Specific technical specification (Part C)
c) General technical specification (Part D)

1.1 General

This section covers the design, construction and supply of all civil works including building services and fire fighting works of the specified power plant.

The various buildings and parts of the Project must form an architectural, structural and functional unit. Special attention must be paid, in addition to basic design and construction, to the aspects which are specific to climate and local requirements.

The buildings and structures shall be designed with due respect regarding the need for inspection, maintenance, cleaning and repair and able to operate for long-time periods with a minimum of inspection, adjustment and repair.

All material shall be new and of the best quality suitable for working under the conditions, variations in temperature and load encountered in service without undue distortion or deterioration or the occurrence of undue stresses in any part, such as to affect the efficiency and reliability of the plant.

The Contractor is not allowed to use the works, materials or furniture or parts thereof for temporary purposes without the written consent of the Employer.

The conceptual and detailed plant configuration of the various components shall be proposed by the Contractor, subject to the approval of the Employer to suit the requirements of the supplied equipment, under consideration of the existing situation, as well as the tie-in points. In doing so, adequate safety clearances, fire compartments, favorable layout of the plant components for monitoring and maintenance and any other requirements of up-to-date power plant construction shall be taken into account.

Optimization can be executed by the Bidder/Contractor while finalizing layout during basic/detail engineering subject to BIFPCL approval.

2.0 Civil Design Criteria

2.1 Codes and standards

The engineering and execution of all the civil works shall be based on the latest editions and revisions of the applicable codes and standards as listed in **Section D**.

If any standard contains a provision, which is inconsistent with a provision in another standard, the more stringent in respect of quality shall apply. In case of selection of equivalent international code instead of the code specified in the documents, the same shall be used only after approved by BHEL/BIFPCL.

2.2.2 Architecture

Architectural Design and detailing Aspects of all buildings shall be rendered through professional services of an Architect of reputation having experience in similar kind of works and familiar with vernacular architecture of Bangladesh.
For detail working drawings preparation, in house pool of architects may be utilized.

The overall architectural character of main plant buildings e.g. Administration Building, Auditorium, Main Gate Complex, Canteen Building and Service Building shall be architecturally treated in such a way that it presents an overall image befitting the image of the Employer as a reputed international Power Company, comparable with international buildings of repute and yet, incorporates a pleasing composition of mass and void with suitable and functionally designed projections and recesses.

All external and internal finishes shall be modern finishes as per international standards and latest construction technology. Buildings shall be designed considering the climatic condition, building orientation, landscape design, interior design, to meet the International Building Code and the vernacular architecture. The overall architectural character shall be in sympathy with the local environment and in harmony with the local culture

Requirements and international fire safety regulations and shall incorporate sustainable Building Design features like energy efficiency, solid waste management, water conservation and recycling etc. Service building, Administration Building, Auditorium and Canteen Building shall be designed as Green Buildings compliant to minimum LEEDs Gold rating. Certification of buildings is in the scope of Contractor.

All Buildings with RCC Roof and suitable/sufficient space shall be designed for installation of Solar Photovoltaic Panels on roof tops for Renewable Energy Purpose.

All public buildings like administration building, auditorium, main gate complex, canteen building, service building (the list may be finalized/ extended during design phase) shall be furnished with reinforced concrete stairs. The minim width of the flight shall be min 1500mm, risers" 150mm and threads 300mm.

All public buildings like administration building, auditorium, main gate complex, canteen building, service building (the list be finalized/extended during design phase) shall be designed incorporating the provision of barrier free environment for physically disabled persons.

All buildings shall be provided with toilets and drinking water facilities as per international building code requirements.

Buildings shall be designed as Intelligent Buildings with futuristic concepts with Standardized Components and incorporating Building Information Management System (BIMS, for details, refer clause no. 2.3.11). Aesthetic Treatment shall be designed with a view to develop responsible structures, acceptable to the Community and visually pleasing for next 25 to 30 years Landscaping shall be designed to take care of rain water harvesting and

ground water recharging.
An intelligent building may be understood as a building which makes use of technology & process to create a building that is safer and more productive for its occupants and more operationally efficient for its owner. It involves Energy Efficient Design, Sustainable Construction Practices, Access Control & Monitoring, Lighting Control, Energy Information & Management Systems etc.

Interiors of the buildings shall be designed based on functional requirements and shall interface smoothly with Mechanical & Electrical Services, so as to

have an ergonomically designed and visually stimulating environment.

The Bidder shall submit a convincing architectural concept along with tendering documents, for guideline see **Annex C.**

Detailed working drawings, perspective views, walkthrough views and model (to scale) of the entire plant shall be submitted after contract award.

2.2.3 Design loads

The following design loads shall be considered for the design of buildings and structures:

- **Dead load**
  Dead load is defined as the weight of all permanent construction including walls, foundations, floors, roofs, ceilings, partitions, stairways, and fixed service equipment and shall be calculated according to BS EN 1991-1-1 or equivalent (e.g. DIN EN 1991-1-1) and the Bangladesh National Building Code, whichever is more stringent.

  For heavy industrial work, this would include equipment, vessels, including internals, pipes, valves, and accessories, electrical and lighting conduits, switchgear, instrumentation, fireproofing, insulation, ladders, platforms, and other similar items. Equipment and piping should be considered empty of product load when calculating dead load. The gravity weight of soil overburden shall be considered as dead load.

- **Erection dead load**
  The erection dead load is the weight of the equipment at time of erection plus the weight of the footing, pedestal and overburden soil.

- **Live load**
  Live load is defined as the weight superimposed by the use and occupancy of the building or other structure, but not permanently attached to it. For industrial design, live load can be defined as the load produced by personnel, moveable equipment, tools, and other items placed on the structure, but not permanently attached to it. Design shall be done for the actual plant live loads or the live loads specified in according to BS EN 1991-1-1, (or equivalent DIN EN 1991-1-1) or the Bangladesh National Building Code, whichever is more stringent.

  Unless specified otherwise, or required due to erection, operation and maintenance the minimum live load values for floors and roofs given in Table below shall be considered.

The Employers consent is required in all cases for reductions of load

carrying capacities and for exceeding the permissible stresses.

Minimum requirements for live loads [kN/m^2]

	Slabs and secondary supports	Gratings [2]	Main girders	Supports, e.g. columns, walls, brackets, etc.	Foundations
1. Reinforced concrete structures					
1.1 at road level in areas used by large vehicles	15 SLW 30[3])	5	15 SLW 30[3])	10	10
In areas of major assembly work at their access roads	SLW 60[3])		SLW 60[3])		
1.2 Machinery floor for storage of heavy machine parts	30	10	20	20	20
1.3 Heavy intermediate floor slabs	10	5	10	7,5	7,5
1.4 Medium intermediate floor slabs	7,5	5	7,5	5	5
1.5 Light intermediate floor slabs	5	5	5	5	5
1.6 Roofs	1,5		1,5	1,5	0,75
2. Steel structures					
2.1 Heavy platforms	15	10	15	10	10
2.2 Medium platforms	5	5	5	5	5
2.3 Platforms and walkways in Conveyor galleries	5	5	5	5	5
2.4 Light platforms and walkways	2,5	2,5	2,5	2,5	2,5
2.4 Roofs	1,5		1,5		0,75

1) Figures in kN/m²
2) The loads shown are used for determining the load for structural analysis but not for dimensioning the gratings
3) Truck loads according to DIN 1072

Areas designated for different loadings on the same floor shall be clearly and permanently marked.

- **Crane/hoist load**
  Crane/hoist loads shall be considered as live loads. The vertical and horizontal loads from cranes/hoists shall be as per the supplier"s loading data. In the absence of specific information, the following minimum horizontal loads shall be considered at the location of each wheel:

  - transverse surge = 20 % of static wheel load
  - ii) longitudinal surge = 10 % of static wheel load.
- **Product load**
  The load shall be defined as the gravity load imposed by liquid, solid, or viscous materials in vessels, tanks, equipment or piping during operation.

- **Test load**
  The test load shall be defined as the gravity load imposed by any method necessary to test vessels, tanks, cranes, equipment or piping.

- **Thermal load**
  Thermal loads shall be defined as forces caused by changes in temperature (ambient temperatures see Section B0). The primary source of thermal loads in an industrial plant is the expansion or contraction of vessels and piping. Another source of thermal loads in a structure is the expansion or contraction of the entire structure or individual structural components.

- **Truck load**
  Structures accessible to trucks shall be designed to withstand the gravity, lateral and impact effects of truck loading. Truck loading shall be SLW 60 or equivalent as per relevant standards or codes.

- **Soil load**
  Soil loads shall consist of lateral earth pressures. Active and passive coefficients for lateral pressures shall be obtained from the project soils report. The weight of soil shall be considered as dead load.

- **Hydrostatic load and buoyancy**
  Hydrostatic load is the load due to water pressure. The design of structures shall include hydrostatic loads when applicable. The buoyancy load is equal to the weight of the volume of displaced water.

- **Wind load**
  The wind load calculation for the buildings and structures shall be as per Bangladesh National Building Code -2012, Part 6, Chapter 2.4.

Basic wind Speed, V, shall be taken as 73 m/s, Three-second gust at 10 m above ground in exposure C, having a return period of 50 years.

- **Earthquake load**

  All buildings, structures and foundations shall be designed and adopt necessary earthquake design criteria.

  The Project site is exposed to seismic conditions. The area is in Seismic Zone 1 as determined by the Bangladesh National Building Code (BNBC-2012).

  Related to Soil Type as identified to Soil Investigation Report, the effect of local soils on earthquake ground motion shall be determined.

  For site class S1 and S2, as expected for this project, site specific studies shall be carried out to determine Design acceleration response spectrum.

  Values regarding Soil Factor shall be verified during Soil Investigation.

- **Dynamic loads**

  Each structure shall be designed to withstand the effects of vibration and impact to which it may be subjected. Each structure and foundation supporting a compressor, turbine, pump or other machinery having significant dynamic unbalance shall be designed to resist the peak loads specified by the manufacturer. Vibration amplitudes of the supporting structure or foundation shall be kept within acceptable limits for dynamic forces that occur during normal machine operation. In the case of a tall and slender structure, there may be a need to investigate the dynamic effects of wind gusts. The vibration pad for absorbtion of vibration due to rotating or reciprocating machine shall be suitably designed to reach maximum thickness of material required and its complete spreading below entire foundation.

  In the dynamic analysis, the following codes are to be considered: DIN 4024, ISO 1940-1 and ISO-10816. The vibration amplitudes & velocities, if not specified by the manufacturer, shall follow ISO-10816.

- **Impact loads**

  When a structure, structural component or connection is subjected to moving or vibrating loads which do not warrant a dynamic analysis, the following impact loads shall be considered:

Elevator machinery	100% machinery weight
Shaft or motor driven machinery	50% machinery weight
Reciprocating machinery	20% machinery weight
Overhead travelling crane • Vertical force • Lateral force • Longitudinal force	Crane load shall be considered as live load, when applying this load the following impact load shall be considered as per BS 6399:PART 1 EN 1991 or equivalent. 25% of maximum wheel loads for cab operated crane. 10% of maximum wheel loads for pendent operating crane. 20% of the weight of the trolley and lifted load (but exclusive of other parts of the crane. 10% of maximum wheel loads.
Truck loads	Impact effects of truck loading shall be considered according to BS EN 1991-1-7 6399: PART 1 or equivalent. (e.g. DIN EN 1991-1-17)
Vertical force	20% of lifted loads

- Load combinations
  Design load combinations shall be generally in accordance with the relevant British standard or equivalent. The load combinations shall include the erection loads and crane test loads also.

2.2.4 Deflections

The maximum allowable deflections under the serviceability loads shall be as given below, if not other requirements due to functionality of the structures shall be followed, e.g. for transfer points and trestles of conveyor belt:

a) Structural steel

Cantilevers	L/180
Beams carrying plaster	L/360 or 20 mm, whichever is less
Other beams (except purlins and sheeting rails)	L/200

Top of columns (single floor)	H/300
Top of columns in each floor (more than one floor)	H/300
Crane gantry girders	
Vertical	L/600
Horizontal	L/500
(where L: span/H: Height)	
Purlins and sheeting rails	L/200

b) Concrete structures

L/500 or 20 mm (whichever is less)

2.2.5 Settlements

Settlements have to be calculated according to BS EN 1997-1 or equivalent and to be monitored.

The following requirements for settlements shall be applied:

- Max. settlement 25 mm,
- Max. differential settlement 1/500 rad.

2.2.6 Stability

All ground stability analysis should be based on data given in the soil investigation report.

Ground stability of structures has to be calculated according to BS EN 1997 - 1 or equivalent.

Embankment stability analysis shall be calculated according to BS 6031 or equivalent.

Stability of masonry wall shall be checked according to BS 5628 or equivalent.

The structures shall be designed and checked using a factor of safety of 1.50 for stability against overturning and sliding under the permanent loads and 1.2 under the temporary loads.

For Buoyancy the structures shall be designed to fulfill the purpose and follow BNBC.

2.2.7 Miscellaneous metal works

Stairways

Main stairways shall be min. 1250 mm wide.

Riser max. 180, Tread min. 260, and Local stairway shall be min. 1200 wide. The number of steps between flights shall be limited to 12.

Head clearance min. 3000 mm for air conditioned buildings, and min. 3500mm for non-conditioned buildings.

Head clearance of toilets shall be designed as per good engineering practice and applicable regulations.

The requirements of the specific local codes of procedures and the Local Authority requirements have to be respected by the Contractor.

Steel ladders other than companion way ladders

Rung: round bars of 20 to 50 mm diameter
Rise: 250 mm
Width: 400 mm

Safety cages shall be provided if height exceeds 2.5 m and the ladder design shall comply with BS 5395: Part 3.

Handrails

Handrails shall be min. 1100mm high. Design to follow BS 5395: Part 3/BS 4592-0:2006+A1:2012 or equivalent.

Gratings

Gratings shall be hot-dip galvanized and comply with BS 4592: Part 1 & 2 or equivalent.

Chequered plates

Chequered plates shall be minimum 6 mm thick mild steel.

2.2.8 Drainage systems

General

The drainage systems will consist of open reinforced concrete drains for stormwater and surface drainage and piping for other drainage systems and reinforced concrete culverts for street crossings. In general, drainage systems shall be designed in accordance with BS 6367 or equivalent, the Bangladesh National Building Code 2012 and all relevant Local Authority requirements.

The drainage shall be separated into the following systems:

- storm water and surface drainage
- sanitary sewage reticulation
- oily water drainage
- chemically polluted water drainage.

Rain run-off

Rainwater runoff shall be determined in accordance with the relevant Bangladesh Standards by considering the maximum rainfall intensity of 95 mm/hr for a one hour rainfall with 50 year return period. The maximum surface rainfall shall be considered with 349mmper day.
water shall be collected in a storm water pond located outside the Plant The (indicated on Indicative Plant Layout). The Pond is not in scope of EPC-Contractor.
The Tie-in point of the system will be at the pond. In addition, contractor may develop retention basins/ponds for rainwater to be used for spraying the coal stockyard and landscape irrigation, in the plant area.

Sizing of ditches and pipes shall be determined by using Manning`s formula, using the following Roughness coefficient N for the various types of material:

Type	Roughness efficient N
Concrete pipe	0.014
Plastic pipe	0.013
Vitrified clay pipe	0.013
Smooth concrete channels	0.014

Gradient

Drains shall have the following minimum gradient:

- open ditch for storm water drainage l/1000
- sanitary sewage drainage pipes l/150
- oily water drain pipes l/200
- chemically polluted water drains/pipes l/250
- other drainage systems l/400.

However, the sectional shapes have to be determined by the water carrying requirements and must have the most favorable hydraulic qualities so as to remove the drain water in a proper manner without settlements.

Velocity of flow

Minimum velocity 0.80 m/s (to maintain self cleaning)

2.2.9 Road works

Plant access roadways shall be designed to accommodate AASHTO HS-20 semi-truck loading with impact added. Parking areas for cars and light trucks shall be designed for AASHTO H-10 loading. The roads shall be designed to sustain the maximum loads from the vehicles likely to use them during construction and throughout the life of the facility including articulated vehicles and transporters used for the removal and replacement of major items of equipment during maintenance.

The following requirements shall be met:

- single lane 3.75 m with solidly compacted shoulders of 1.50 m at each side all along (Total width 6.75 m)
- double lane 7.5 m with solidly compacted shoulders of 2.25 m at each side all along (Total width 12 m)
- patrol roads 3.75 m with solidly compacted shoulders of 1.50 m at one side all along Patrol road is to be constructed inside Plant boundary (Total width 5.25 m).
- minimum kerb radius at junctions shall be 10 m for double lane roads and 4 m for single lane/patrol roads
- cross-falls shall be 2.5% from one side to the other
- maximum longitudinal slope shall be 1:25.
- The roads and paving shall be laid to falls leading the storm water to gullies and to the discharge system and shall also comply with the Local Authority requirements.

All road/pavement shall be plain jointed concrete pavement (JCP) designed as per AASHTO. The road shall be provided as follows:-

- Subgrade
  The area for the roads shall be cleared of any material or obstructions and the top layer removed to a depth of 300 mm (or more if the design so required). Any ruts or soft areas caused by improper drainage conditions, hauling or any other cause shall be corrected and rolled to the required compaction before sub-base is placed thereon. The formation shall be compacted to 85% relative density (ASTM D-4253 and D-4254) for free draining soils containing less than 15% by weight finer than 75 micron sieve non plastic material or 98% of the maximum density as determined by ASTM D-1557 for soils containing more than 15% material passing the 75 micron sieve.

- Subbase course
  A layer of 250 mm granular sub-base shall be provided. Sub-base material shall be crushed rock or other approved local material like brick metal having suitable properties (materials passing 425 micron sieve when tested in accordance with AASHTO or British Standard should have Liquid Limit and Plasticity Index of not more than 25 and 6 respectively) and confirming to the following grading

Sieve [mm]	Percentage by Weight Passing
75	100
37.5	85 - 100
10	45 - 100
5	25 - 85
0.6	8 - 45
0.075	0 - 10

  The material shall be spread evenly on the preceding material in layers not exceeding 150 mm compacted thickness.

  The sub-base shall be compacted by approved plant to a dry density, which shall not be less than 98% relative compaction until movement of the surface ceases and the surface is closed. The CBR value shall be at least 30% at the optimum moisture content.
  Brick aggregates shall be made of overburnt bricks or brick bats and free from dust and other foreign materials. The LAA(LOS ANGELES ABRASION) value for coarse aggregate either from bricks, gravels or stone shall not be more than 50% and AIV AIV(Aggregate Impact Value) shall not be more than 40%. The water absorption shall be less than 18%.
- Base course
  100 mm thick dry lean concrete (DLC) of grade C8/10 shall be provided as base course. A layer of 125 micron plastic sheet shall be laid over the PCC layer.

- Pavement slab
  Pavement concrete slab of grade C25/30 shall be laid over the sub-base. The thickness of pavement slab shall be as per the design requirement conforming to AASHTO. Transverse contraction joints shall be provided at 4 m c/c spacing alongwith dowel bars. Longitudinal contraction joints shall be provided at 3.75 m spacing (for double lane road only) alongwith tie bars.

Chlorides and sulphates

The level of chlorides and sulphates in the wet mix sub-base shall be within the following limits:

	Maximum by weight	
	Sub-base	**wet-mix road base**
Acid soluble chloride (NaCl)	3.5%	0.5%
Acid soluble sulphate (SO_3)	2.0%	0.5%

Shoulders

The shoulders for double lane road shall be raised with kerbs at the edge of the road. The shoulders for single lane road and patrol road shall be at the level of the road top.
The shoulder shall consist of 150 mm thick granular layer. The material used for shoulders shall comply with the specification for wet mix as following:
The wet mix material shall consist of crushed gravel or crushed rock and shall be suitably proportioned to conform to the following grading:

Sieve [mm]	Percentage by Weight Passing
50	100
37.5	90-100
20	60-80
10	40-60
5	25-40
2.36	15-30
0.6	8-22
0.075	0-8

Road construction shall consider all required measures to avoid different settlements.

- Main approach road to BTG and BOP from main gate complex shall be : Double Lane Road
- Access Roads to buildings/facilities inside BTG area shall be:
  Single lane road for access roads to minor structures and double lane road for access to main equipment. Road shall be suitable for expected traffic.
- Access Roads to buildings/facilities inside BOP area shall be:
  Single lane road for access roads to minor structures and double lane road for access to main equipment. Road shall be suitable for expected traffic.
- Patrol road shall be as suitable for purpose

2.3 Scope of Supplies and Services

This section sets out the scope of civil works and installations covered by this specification as well as the requested supplies and services, but without excluding other necessary components and services not mentioned.

2.3.1 General

The Contractor shall supply and erect all buildings, structures and systems which are necessary to support, to protect and to provide the required environmental conditions for the entire plant including roads, security fencing and any other measures needed for safe and practicable operation of the plant.

Social and sanitary rooms in the appropriate size and arrangement shall be provided wherever required due to usage of the building, minimum in the buildings as per 2.3.2.

The following types of works have to be considered, but without excluding other necessary works and services not mentioned:

- all necessary surveys
- all necessary soil investigation required in addition to the investigation works carried out prior to the EPC Contract
- all other investigations and studies necessary for the design and execution of civil works (drainage system, flooding possibility of the site, safety measures, etc.)
  If Bidder/Contractor is of the option that design criteria are sufficient for design, no further drainage study is required.
  Flooding possibility of site shall be investigated.
- site organization works for the entire project execution phase including but not limited to:
  - arrangements of all temporary and permanent surfaces allocated for the new plant
  - temporary buildings for offices, stores, workshops, sanitary rooms, canteen and kitchen, first aid station, etc. offices for the staff of the Employer, creche, safety centre & field quality assurance lab, prayer room, visitor habitations
  - open area for future maintenance works
  - security installation on the site, including temporary fencing; temporary bridges, etc.
  - access roads and outdoor storage facilities
  - temporary water
  - temporary electricity supply
  - temporary storm water drainage and sewage system
  - final cleaning of the temporary and permanent plant sites to the full satisfaction of the Employer
  - housekeeping and cleaning of the sites during construction and equipment erection/testing works
  - temporary fire fighting facilities for the entire execution phase of the project
  - provision and maintenance of lay-down area including access roads

  (Temporary facilities can be located within site installation area. Un-leveled/un-filled land outside plant boundary can be provided to the Contractor for temporary accommodations of Contractors' labors or laydown. Exact acquisition line will be furnished before award of contract. Employers temporary accommodation shall be inside the plant boundary. Labour camp shall be located outside the plant boundary on BIFPCL land, e.g. north of boundary.)
- site fill on the location of all required buildings and areas
  Leveling and Grading is required under the Contract. Contractor shall make himself familiar with the site, to estimate the effort.
- structural and civil engineering design of all buildings, structures, foundations including the complete structural and dynamical analysis, design, execution and workshop drawing
- Third Party Verification of structural documents, including the complete structural and dynamical analysis, design, execution and workshop drawings

All structural documents e.g. calculation, formwork drawings, reinforcement drawings, steelwork drawings requires 3rd Party verification.
Verification shall consider Structural Stability, Ultimate Limit State and Serviceability Limit State.
An appropriate local design consultant, having similar work experience would be appreciated.

- removal of all debris, underground obstacles (if any) and surplus materials to approved dumping locations
- earthworks, permanent drainage works, soil exchange (if needed), refilling works on the plant site and on the additional areas allocated for temporary works
- all ancillary works and installations necessary for the execution of civil works, such as but not limited to: sheet piling, dewatering, fencing, signs, scaffoldings, etc.
- permanent roads, paved areas, footpaths, etc. on the plant site
- piling works
- execution of complete building, foundations and structures necessary for the installation of the indoor and outdoor equipment of the plant
- execution of all finishing and indoor installation works (such as doors, windows, wall cladding and rooting) painting and coating works, sanitaries, plumbing, ventilation-and air conditioning works, fire fighting, sanitary works, sewage, electrical lighting-and lightning, earthing, etc.
- supply of all necessary furniture, housekeeping small equipment (kitchen, refrigerators, exhaust installations, etc.), laboratory equipment, etc.
  This Phrase is related to Employer‟s and Engineer‟s office and Living accommodation, as specified under B.9.3.
  Details shall be defined by Bidder/Contractor and shall be subject to approval by BIFPCL during basic/detail engineering.
- Every working place shall be equipped with a computer, connected to a local network with connection to the plant computer network.
- execution of all necessary outdoor works for water supply, sewage and drainage works, fire fighting, earthing etc.
- all necessary crane and hoist girders, pipe and cable bridges and supports according to the requirements of the electrical and mechanical installations.

2.3.2 Buildings and structures

2.3.2.1 Steam turbine building

The steam turbine building shall be sized to accommodate the steam turbine generator(s) together with all associated facilities and ancillary plant installations.

Measures shall be taken to avoid the transmission of vibrations due to

equipment and rotating machines (mainly steam turbines, feedwater pumps) to the building structure. These measures shall mainly be separate reinforced concrete foundation to be insulated from the remainder of the structure either by shock absorbing joints or vibration control systems typically consisting of spring elements and viscodampers to prevent the transmission of vibrations.

The building shall be served by overhead traveling crane(s). Capacity and Number of cranes as per requirements of heaviest lift.

At ground floor level access ways for traffic with heavy trucks shall be provided.

At all levels toilets for operation and maintenance staff shall be provided.

Within the Steam Turbine Building the main electrical components of the project shall be accommodated:

- unit switchgear and I&C
- auxiliary switchgear
- central control room.

Next to the Central Control Room additionally to the required technical rooms such as switchgear room, relay rooms for electronic panels battery rooms, relay rooms, computer room, UPS and DC equipment room, DCS engineering rooms, the following rooms have to be provided:

- 1 (one) office
- tea kitchen
- archive/storage room
- engineering diagnostic room
- toilets for operators (male and female).

Description of building:

- structure: steel structure
- floors: Groundfloor with intermediary platforms/levels
- flooring: reinforced concrete with suitable hardener and special oil resistant coating; TG hall combination of granite and heavy duty vitrified tile
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations; special attention has to be paid for the safe transmission of dynamic loads and vibrations to the underground 230
- external wall: mm thick brick walls or autoclave aerated concrete blocks with plaster finish up to 3.0 m or autoclave

aerated concrete blocks from floor level and	double skin metal cladding above. For architectonical appearance, inside in addition single skin metal cladding from operating floor up to EOT Crane girder External walls on transformer side shall have 250 mm thick RCC wall up to 5.0 m height as fire barrier wall, with single skin metal cladding above 5.0 m up to turbine floor. From turbine floor to crane girder level, double skin cladding will be provided.
• internal wall:	230 mm thick brick walls or autoclave aerated concrete blocks or autoclave aerated concrete blocks with plaster finish
• roof:	double skin metal roofing or as applicable
• doors:	self closing sandwich steel doors with insulation
• roller shutters as required	
• windows:	double glazed aluminum
• entrances:	electrical driven roller shutters
• ventilation:	natural/mechanical
• louvers:	aluminum alloy
• lifting equipment:	travelling crane (see mechanical section).

The battery room shall be equipped with:

- cleaning sink minimum size 580 x 450 mm
- emergency shower with eye wash
- acid resistant floor and drain
- sink outlets and floor drains shall be chemical resistant and piped into the chemical drain system.

False floors and suspended ceilings wherever required.

Electrical hoist designed for the transport of the electrical and control panels.

Finishes: The control room shall be of noble appearance. Flooring of the control room shall consider electrostatic problems (suitable earthing mats where required). Powder coated metal false ceiling with noise reduction factor (0.5) shall be implanted. Airlocks of glass or at least with visions shall be provided. The lighting shall be adequate and in accordance with the arrangement of the individual working places.

The design of finishing works will comply with the requirements of the code of procedures with regard to the mirroring effects, lighting of working places, shadowing etc.

The minimum head clearance for the control room shall be 3650 mm.
The front towards the operation floor shall be fully glazed.

Turbine Generator foundation shall be finished with chemical resistant, anti-slip, abrasion resistant rubber flooring. Areas considered for maintenance purpose shall be marked permanently including the allowable bearing capacity as per structural calculation. Bearing Capacity shall consider maximum loads as per Operation and Maintenance Concept.

Operating floor of Main Power House shall be finished with Granite Stone and General Circulation/Movement area shall be provided with Vitrified Ceramic Tile flooring. Unit control Room & Control Equipment Room shall have Vitrified Ceramic Tiles floor with pattern."

This Specification shall be applicable for flooring; other surfaces are not considered here.

2.3.2.2 Steam generator and air heater building

The Steam Generator and Air Heater Building may be of open or semi-open installation.

Description of building:

- foundation: according to the soil investigation report and Special Technical Requirements of Foundations
- floors: as required for proper O&M access
- flooring: reinforced concrete in ground floor, metal grating in other floors
- structure: steel structure
- walls: double skin metal cladding (if necessary, else single skin metal cladding)
- roof: double skin metal roofing (if necessary, else single-skin metal casing)
- lift: 1 passenger & goods lift with a minimum capacity of 4,000 kg to the highest accessible platform
- hoist: outdoor hoist arrangement at one side for long items.

2.3.2.3 CENTRAL WORKSHOP

General

The area for the workshop shall be about (but not limited to) 3,000 m^2 overall, designed for all maintenance facilities with related services e.g. offices, locker and sanitary rooms. The clear height shall be minimum 6m. However the clear height shall be determined by requirement of overhead travelling crane clearance.

The workshops will allow all required works for daily maintenance and repair, which can be executed at site. The building will have enough capacity for the personnel of the plant which usually is employed in the workshops and for external personnel in case of major inspections or repairs.

Partitioned areas with suitable work benches, equipment and racking shall be provided for:

- mechanical workshops (welding, machine, overhaul)
- electrical workshops
- I & C workshops
- civil workshops (carpenters, etc.)
- air conditioned plant room
- tool rooms
- 1 meeting room 35 m² each,
- 5 offices for technical and admin. personnel (15 m² each)
- Sanitary equipment as below.
- locker rooms
- kitchen.

The complete workshop areas shall be designed for the use of fork lifters with a minimum lifting capacity big enough for the heaviest part to be handled.

Overhead travelling cranes shall be provided in the area of the workshops.

Description of building:

- structure: steel structure
- floors: one
- flooring: reinforced concrete with hard screed topping carborundum type (25 mm thick heavy duty cement concrete tiles) with oil resistant epoxy coating (300 micron thick)
  WCs tiled; offices with PVC flooring,
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- external wall: double skin metal cladding
- internal wall: 230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
- roof: double skin metal sheet roof
- doors:
  - main entrance: electrically operated rolling shutter
  - external: self closing sandwich steel doors with insulation
  - internal: wooden doors with steel frames
- windows: double glazed aluminum
- air conditioning: centralized air conditioning,
- ventilation: natural/mechanical
- sanitary equipment in the office area:
  - showers in changing room
  - eastern WC with cleaning brush in toilet
  - western WC with cleaning brush in toilet
  - bowl urinal in male toilet
  - wash basins in toilet

Special design criteria

The minimum load bearing capacity of ceilings and floors shall be as defined in BS 6399: Part 1 or equivalent and in Section "General technical requirements" of this Specification.

The live loads for ground floor shall be min. 50 kN/m^2.

2.3.2.4 Dozer maintenance shed

General

The area for the Dozer Maintenance Shed shall be about (but not limited to) 500 m^2 overall, designed for all routine maintenance on mobile equipment with related services e.g. washing area, storage area locker and sanitary rooms.

The workshops will allow all required works for daily maintenance and repair, which can be executed at site. The building will have enough capacity for the personnel of the plant which usually is employed in the workshops and for external personnel in case of major inspections or repairs.

Description of building:

- structure: steel structure
- floors: one
- flooring: reinforced concrete with hard screed topping carborundum (25 mm thick heavy duty cement concrete tiles) with oil resistant epoxy coating (300 micron thick)
  WCs tiled; offices with vitrified tile flooring
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- external wall: double skin metal cladding
- internal wall: 230 mm thick brick walls or autoclave aerated concrete blocks or autoclave aerated concrete blocks with plaster finish
- roof: double skin metal sheet roof
- doors:
  - main entrance: folding doors with motor drive
  - external: self closing sandwich steel doors with insulation
  - internal: wooden doors with steel frames
- windows: double glazed aluminum
- air conditioning: decentralized air conditioning,
- ventilation: natural/mechanical
- sanitary:
  - showers in changing room
  - eastern WC with cleaning brush in toilet
  - western WC with cleaning brush in toilet
  - bowl urinal in male toilet
  - wash basins in toilet

Special design criteria

The minimum load bearing capacity of ceilings and floors shall be as defined in BS 6399: Part 1 or equivalent and in Section "General technical requirements" of this Specification.

The live loads for ground floor shall be min. 30 kN/m^2.

2.3.2.5 Operation and maintenance storage building

General

The area for the Operation and Maintenance storage shall be about (but not limited to) 3000 m^2 overall, designed for required storage with related services e.g. locker and sanitary rooms.

Partitioned areas with suitable, equipment and racking shall be provided for:

- small spare parts store
- spare parts pallet store
- large spare parts store
- 2 (two) offices for store keeper (15 m² each)
- sanitary equipment as below
- locker rooms
- tea kitchen.

The dimensions of the building shall be adequate to accommodate all different types of racks for goods and spare parts necessary for the operation of the Plant as specified in **Section B12**.

Heavy material store shall be single storey building, free of columns for easy movements of material. Light material store shall be double storey building. 1 No. of Goods lift with a capacity of 1,000 kg with rated speed of 0.5m/s shall be implemented.

A part of light material store shall have facility for storing electronic equipment/instruments.

Lifting devices shall be provided as required for heaviest part.

- structure: reinforced concrete,
- floors: one/two floors
- flooring: reinforced concrete with hard screed topping carborundum (25 mm thick heavy duty cement concrete tiles) with oil resistant epoxy coating (300 micron thick); WCs tiled; offices with PVC flooring
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- external wall: 230 mm thick autoclave aerated concrete blocks with metal cladding
- internal wall: 230 mm thick brick walls with plaster finish
- roof: double skin metal sheet roof
- doors:
- main entrance: electrically operated rolling shutter
  external: self closing sandwich steel doors with insulation
  internal: wooden doors with steel frames
- windows: double glazed aluminum
- sanitary:
  - showers in changing room
  - eastern WC with cleaning brush in toilet
  - western WC with cleaning brush in toilet
  - bowl urinal in male toilet
  - wash basins in toilet

2.3.2.6 Administration building

General

The area for the Administration Building shall be about (but not limited to) 5,000 m² overall, designed as 4 G+3 storey building for administration purpose with related services e.g. locker and sanitary rooms.

2 panoramic elevators shall be provided in the building.

The top floor of the building shall be reserved for provision of IT and satellite communication services.

The building shall house:

- a representative entrance and waiting hall and an information desk
- head of plant office (50 m²) incl. restroom and 2 assistant offices (20 m²)
- HOP Conference Hall (50m²)
- 6 Head of Department offices (25 m²) with each 1 assistant offices (10 m²)
- 11 Middle level executive offices (10 m²)
- 84 Workstations/Halls
- meeting rooms at each floor (30 m² each)
- archive (30m²)

- electrical rooms, as required
- library (50 m²)
- print room (20 m²)
- sanitary facilities
- prayer room (30 m²)
- canteen (150 m²)
- recreation room for the number personnel mentioned here above,
- first aid center with medical support facilities (2 rooms 30 m² each).
- gym (35 m²)
- model & exhibition room (70 m²).

Furniture for this building is also in the scope of the Contractor as per local practice.

Medical support facilities are also in the scope of the Contractor as per requirements due to Bangladesh regulations.

Description of building:

	reinforced concrete 3 to 4 floors
• structure:	see below
• floors:	according to the soil investigation report and Special Technical Requirements of Foundations
• flooring:	
• foundations:	230 mm thick brick wall or autoclave aerated concrete blocks or autoclave aerated concrete blocks with aluminum composite panel cladding
• external wall:	
	230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
• internal wall:	internal stairway
• access:	representative double plain door
• doors:	aluminum glazed doors and wooden doors with steel frames
• external:	
• internal:	double glazed aluminum with internal sun shades centralized air conditioning
• windows:	natural/mechanical
• air conditioning:	
• ventilation:	• showers in changing room
• sanitary equipment in the office area:	• eastern WC with cleaning brush in toilet • western WC with cleaning brush in toilet • bowl urinal in male toilet • wash basins in toilet
• finishes:	For this building prestigious finishes shall be provided. The offices shall have vitrified tile flooring; in the manager‟s office carpet flooring, fabric wall coverings, and decorative suspended ceilings with lighting fittings embedded. Floor and walls of the kitchen future and recreation room shall be fully tiled. Entrance hall and stairs with polished granite stone flooring. The shower cabins to have partition walls with doors.

2.3.2.7 Service building near turbine hall

General

The area for the Service Building shall be about (but not limited to) 5,500 m² overall, designed as 5 G+4 storey building for administration purpose
with related services e.g. locker and sanitary rooms.
2 lifts with 16persons capacity shall be implemented.
A direct connection from Service Building to Turbine Hall shall be provided at Turbine Floor Level from the top floor (5th floor) of the Service building.
The building shall house:

- head of O&M (35 m²) incl. restroom and assistant offices (12 m²)
- HOP Conference Hall (50 m²)
- 8 Head of Department offices (25 m²)
- 31 Middle level executive offices (10 m²)
- 109 Workstations/Halls
- meeting rooms at each floor (30 m² each)
- archive (30 m²)
- electrical rooms, as required
- library (50 m²)
- print Room (20 m²)
- drawing hall (30 m²)
- prayer room (30 m²)
- canteen (75 m²)
- recreation room for the number personnel mentioned here
- first aid center with medical support facilities (2 rooms 30 m² each)
- gym (35 m²)
- locker and dressing rooms with showers and toilet rooms for the following personnel (Percentage ladies/men 25%/75%): • own personnel: 205
  - foreign personnel: 25
- electrical Laboratory (60 m²)
- C&I Laboratory - pneumatic (40 m²)
- C&I Laboratory - instrument(40 m²)
- 5 Department stores (60 m²).

  Furniture for the building is also in the scope of the Contractor as per local practice.

  Medical support facilities are also in the scope of the Contractor as per requirements due to Bangladesh regulations.

- floors: 3-4 floors
- flooring: see below
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- external wall: 230 mm thick autoclave aerated concrete blocks with aluminum composite panel cladding
- internal wall: 230 mm thick brick walls with plaster finish
- access: internal stairway
- doors:
  - external: representative double plain door
  - internal: aluminum glazed doors/wooden doors with steel frames
- windows: double glazed aluminum with internal sun shades
- sanitary equipment:
  - showers in changing room
  - eastern WC with cleaning brush in toilet
  - western WC with cleaning brush in toilet
  - bowl urinal in male toilet
  - wash basins in toilet
- finishes:

The offices shall have vitrified tile flooring covering; in the manager‟s office carpet flooring, fabric wall coverings, and suspended ceilings with lighting fittings embedded. Floor and walls of the kitchen future and recreation room shall be fully tiled. Entrance hall and stairs with natural stone or ceramic tiling. The shower cabins to have partition walls with doors.

2.3.2.8 Local service buildings including control room

Service Buildings including Control room shall be provided at the following locations:

- near coal handling unit
- near ash handling unit/jetty
- near FGD/ESP
- near Oil handling plant
- near intake structure
- near water treatment plants
- near cooling tower.

The buildings shall house:

- control room as per functional requirement 2 offices for technical personnel (15 m² each)
- electrical rooms

- locker and dressing rooms with showers and toilet rooms for 10 workers. (Percentage ladies/men 25%/75%).

Buildings can be constructed as single storey building, floor height shall be as per requirements and BNBC.

Description of building:

- structure: reinforced concrete
- floors: one floor
- flooring: see below
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- external wall: 230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
- internal wall: 230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
- doors:
  - external: self closing sandwich steel doors with insulation
  - internal: wooden doors with steel frames
- windows: double glazed aluminum with internal sun shades
- air conditioning: centralized air conditioning
- ventilation: natural/mechanical
- sanitary equipment in the social area:
  - showers in changing rooms
  - eastern WC with cleaning brush in toilets
  - western WC with cleaning brush in toilets
  - bowl urinal in male toilets
  - wash basins in toilets
- finishes: The offices shall have vitrified tiling covering; fabric wall coverings, and decorative suspended ceilings with lighting fittings embedded. Floor and walls of the kitchen future and recreation room shall be fully tiled. The shower cabins to have partition walls with doors.

2.3.2.9 Canteen

The central canteen shall be a building for workers and staff members shall be located suitably in the plant with an area about (but not limited to) 1000 m² overall. The building shall house the restaurant with all kitchen facilities and related services e.g. locker and sanitary rooms.

This building shall be a one storey building with attractive appearance. It consists of a reinforced concrete structure with concrete block walls, reinforced concrete floors and roof.

The following rooms shall be accommodated in this building:

- dining hall with partition for senior executives and others (250 persons in total at a time)

- kitchen approx. 100 m²
- wardrobe
- store
- cooling storage
- locker rooms
- sanitary rooms (toilets, showers)
- air conditioning room
- entrance
- electrical rooms.

  Wardrobe is also in scope of Contractor and shall be suitable for seize of canteen, floor height shall be as per requirements and BNBC.

Description of building:

• structure:	reinforced concrete
• floors:	one floor
• flooring:	see below
• foundations:	according to the soil investigation report and Special Technical Requirements of Foundations
• external wall:	230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
• internal wall:	230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
• doors:	
◦ external:	representative double plain door
◦ internal:	aluminum glazed doors/wooden doors with steel frames
• windows:	double glazed aluminum with internal sun shades
• air conditioning:	centralized air conditioning
• ventilation:	natural/mechanical
• waste water	grease trap
• sanitary equipment in the social area:	• showers in changing rooms • eastern WC with cleaning brush in toilets • western WC with cleaning brush in toilets • bowl urinal in male toilets • wash basins in toilets
• finishes:	The floor finishes shall be cement screed with different top finishes as vitrified tiling (60 cm x 60 cm) with skirting for dining and wardrobe and glazed non-slip vitrified tiles (60 cm x 60 cm) for kitchen and store. Glazed non-slip ceramic tiles (20 cm x 20 cm) for sanitary areas. Entrance with natural stone with skirting.

2.3.2.10 Auditorium

The area for the Auditorium shall be about (but not limited to) 1,000 m^2 overall, designed for a seating capacity of minimum 250 persons and related services e.g. sanitary rooms.
This building shall be a one storey building with attractive appearance. It consists of a reinforced concrete structure with concrete block walls, reinforced concrete floors and roof.
The following rooms shall be accommodated in this building:

- entrance hall with exhibition area
- information desk
- auditorium (clear headroom of min. 4.00 - 8.00 m, variable) incl. stage
- tea kitchen
- sanitary rooms (toilets)
- air conditioning room, as required
- electrical rooms, as required.

Description of building:

• structure:	reinforced concrete
• floors:	one floor
• flooring:	see below
• foundations:	according to the soil investigation report and Special Technical Requirements of Foundations
• external wall:	230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
• internal wall:	230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
• doors:	
◦ external:	representative double plain door
◦ internal:	aluminum glazed doors/wooden doors with steel frames
• windows:	double glazed aluminum with internal sun shades
• air conditioning:	centralized air conditioning
• ventilation:	natural/mechanical
• sanitary equipment in the social area:	◦ eastern WC with cleaning brush ◦ western WC with cleaning ◦ bowl urinal in male toilet ◦ wash basins
• finishes:	• For this building prestigious finishes shall be provided. The floor finishes shall be polished granite stone flooring in entrance hall and exhibition area, non-slip fully vitrified ceramic tiles (20 cm x 20 cm) for toilet, tea kitchen. Auditorium with carpet first quality, false ceiling and wall paneling. First quality means best quality suitable for this purpose.

2.3.2.11 Water and waste water treatment buildings

The buildings accommodate the water and waste water treatment facilities with a laboratory and sanitary facilities.

Description of building:

- structure: steel structure
- floors: one
- flooring: reinforced, water tight concrete, with acid-resistant coating or tiling, as applicable
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- external wall: double skin metal cladding
- internal wall: 230 mm thick brick walls or autoclave aerated concrete blocks or autoclave aerated concrete blocks with plaster finish
- roof: double skin metal sheet roof
- doors:
  - external: self closing sandwich steel doors with insulation
  - internal: wooden doors with steel frames
- windows: double glazed aluminum
- air conditioning: decentralized air conditioning,
- ventilation: mechanical

Laboratory with suspended ceiling tiled walls and floor. Laboratory has to be air conditioned and provided with fume extraction hood cabinet

Chemical unloading station (only slab and roof)

- structure: reinforced concrete
- floors: one
- flooring: reinforced, water tight concrete as per applicable codes and standards, with acid-resistant coating or tiling, as applicable
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- external wall: none, only reinforced concrete columns
- roof: reinforced concrete

Ring foundations for tanks shall be provided.

Special requirements for R/O building/room regarding HVAC shall be considered as per table in Section B12.6

Pits, tanks and basins will not require covering.

All wet areas (indoor and outdoor) and acid-alkali prone areas shall be provided with chemical-resistant catchments pits systems connected to the waste water tanks of the process waste water system. Acid resistant coating or tiling shall be provided in the catchments zones, subject to the approval of the Employer.

All water retaining structures shall be constructed as water tight concrete as per applicable international Codes/ standards e.g. DIN 1045-2:2008–08 and DIN EN 206-1:2001-07.

2.3.2.12 Fire station

This building accommodates the equipment for fire fighting described in the mechanical section.

In addition office, small duty room and maintenance room with window units shall be provided.

Space for fire engine truck and other equipment, such as trailer etc. as required, shall be provided.

Building description:

- structure: reinforced concrete
- floors: one floor
- flooring: reinforced concrete with hard screed topping carborundum type (25 mm thick heavy duty cement concrete tiles) with oil resistant epoxy coating (300 micron thick)
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- external wall: 230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
- internal wall: 230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
- doors:
  - main entrance: electrically operated rolling shutter
  - external: self closing sandwich steel doors with insulation
  - internal: double plain steel door
- windows: double glazed aluminum with internal sun shades
- air conditioning: centralized air conditioning
- ventilation: mechanical/louvers

Next to the fire station a drill tower shall be provided.

2.3.2.13 Pump houses

The structures of the following pump houses are included under this item:

- fire water pump house
- Fire water booster pump house
- Foam pump house
- portable water pump house
- ash water recirculation pump house
- HCSD pump house
- service water pump house
- Fuel Oil pressurizing pump house
- Fuel Oil unloading pump house
- other specified pump houses not included above
- concrete structure with fill-in blockwork and concrete roof.

Alternatively a structural steel structure, with metal cladding and roofing can be provided.

The building is divided in sections including a local switchgear room, if required.

Pump Houses shall be provided with an overhead crane with the capacity of the heaviest lift.

For pump houses other than cooling water and plant water intake appropriate cranes shall be employed to handle the heavy equipment; specific design shall be based on the equipment layout requirements and must comply with Section B0.

All requirements to enable Operation and Maintenance shall be considered. Adjacent to pump houses maintenance bay shall be provided.

2.3.2.14 Chlorination

The chlorination buildings accommodate the chlorination installation for the production of the hypochlorite solution.

Chlorination facilities shall be erected at the plant area and near the Intake structure, if applicable.

Building description:

- structure: reinforced concrete
- floors: one floor
- flooring: reinforced concrete, with acid-resistant coating where required;
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- external wall: 230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
- internal wall: 230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish

- doors
- external: Double plain steel doors
- internal: Double plain steel doors
- windows: Double glazed aluminum
- air conditioning: Decentralised air conditioning
- ventilation: mechanical

2.3.2.15 H2 generation plant building

The H2 Generation Plant building shall accommodate the equipment for the production H2, as described in **Section B12**.

Building description:

- structure: reinforced concrete
- floors: one floor
- flooring: reinforced concrete, with acid-resistant coating where required
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- external wall: 230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
- internal wall: 230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
- doors:
  - external: double plain steel doors
  - internal: double plain steel door double
- windows: glazed aluminum
- air conditioning: decentralized air conditioning
- ventilation: mechanical

2.3.2.16 Compressed air building

The building shall accommodate the equipment as described in **Section B12**.

Building description

- structure: light-weight steel structure
- floors: one
- flooring: reinforced concrete, with acid-resistant coating where required
- external walls/roofs: double skin metal sheet cladding/roofing
- ground floor: reinforced concrete with acid resistant finishing
- doors: double plain steel doors
- windows: double glazed aluminum

- ventilation: mechanical
- air conditioning: decentralized air conditioning.

2.3.2.17 FGD related building and structures

FGD absorber

According to **Section B3** the absorber shall be made of steel with respective lining. All necessary foundations resting on piles shall be provided as per structural analysis.

The Contractor shall provide a structural steel staircase with an elevator to reach all relevant platforms of the absorber.

FGD pump and blower building

The FGD pumps and blowers shall be housed in a separate building consisting of structural steel with insulated corrugated metal cladding and insulated and water tight roofing.

The various levels shall be created by reinforced concrete slabs with screed of industrial type and suitable epoxy coating.

Limestone silo and unloading facilities

The intermediate limestone silo shall be made of reinforced concrete.

Beneath the silo the crusher and milling systems and the limestone slurry preparation system shall be installed. The area below the silo shall be housed inside a structural steel building with insulated trapezoidal cladding.

The limestone silo shall be constructed on the jetty.

The unloading for the vessels shall be via coal conveying system to limestone storage.

The Contractor shall provide all necessary foundations and related civil works for the lime stone system.

Hydro cyclone and limestone slurry building

This building shall house the hydro cyclone station and the limestone slurry tanks.

The building shall be of a steel structure with insulated metal cladding.

A staircase shall be provided to reach all necessary platforms.

The Contractor shall provide all foundations and related civil works for the building and necessary mechanical and electrical installations.

Gypsum silo

The gypsum will be stored in an intermediate gypsum silo next to the plant, and transported via pipe conveyer to gypsum silo next to jetty.
The gypsum silo shall be a reinforced concrete silo on columns which are arranged such that loading of trucks and ships is possible. The silo shall be provided with all foundations and other structural elements needed for the mechanical installations. The Silo shall be located at the jetty.

The gypsum silo shall be equipped with an elevator of industrial type with a capacity sufficient for all operation and maintenance cases, leading up to the various platforms required for service and up to the top level of the gypsum store.

The gypsum not meeting the requirements shall be stored in an open storage area surrounded by a reinforced concrete wall which is protected by a steel liner in the lower portion against damage by front wheel loaders.

Emergency drain tank

The emergency drain tank shall consist of an enclosed steel structure on foundations according to the structural analysis.

2.3.2.18 Stack

One chimney with one outer structure (outer shell) of reinforced concrete each designed to be free standing against static and dynamic wind loads for two internal separate flue gas ducts shall be provided, including all necessary foundations, coatings, etc..

The height of the chimneys based on Bangladesh Standards for Gaseous Emission from Industries or Projects, of the Environment Conservation Rules 1997, shall be minimum 275 m.

The parameters required (e.g. maximum and minimum exit velocities) for finalisation of flue diameter and chimney height shall follow requirements of EIA and requirements of Section B3.

The diameter of the chimneys depends on the diameters of the inserted flue gas ducts. In all levels a clear space of at least 1 m between the chimney structure and the flue gas ducts shall be maintained. In this area the lift and staircase shall be integrated.

The design of chimney stack shall be checked & verified by wind tunnel test at a reputed institute, having prior experience of conducting such type of test.

Reinforced concrete designed in accordance with the recommendations of ACI-307 and CICIND (International Committee on Industrial Chimneys). Standard and strong anti-corrosion protection, UV-resistant and acid and heat resistant paint shall be applied on the outside. Color and selection of bands shall be to the requirements of the relevant authority.

Roof area shall be tiled with acid resistant tiling.

The structure shall be sturdy and well founded to enable it to support both the expected wind and earthquake loads as well as the temperature stresses. Preferably the structural analysis of the system shall be done in one system including outer shell, foundation plate and piles.

All concrete parts below ground level shall be protected outside by a waterproof membrane and protection board as specified.

The lift shall be of industrial type, installed at the inside of the chimney¨s concrete surface with a nominal carrying capacity of 500 kg. It shall travel from ground floor to each platform for service and maintenance except roof slab platform. From last platform to roof of chimney (approx 6 m), shall be accessed by a cage ladder. Inserts shall be provided as required for monitoring the stack gases.

Flue gas monitoring platforms, intermediate duct supporting provisions, landings and maintenance platforms with access shall be provided.

Galvanized steel ladder located in the space between the concrete

shel1 and ducts shall be provided from the ground level to the top of the stack. Galvanized steel floor grating landings shall be provided, as required for Maintenance and operation, including a 360 degree landing at the test ports and at aircraft warning lights levels.

Additional external platform at aircraft warning lights levels shall be provided, if required due to operation and maintenance works.

Installations necessary for rescuing persons have to be assured in the whole area of the chimney.

The flue gas pipe can be either be of GRP or alternatively of carbon steel coated externally and with a suitable internal liner (Pennguard System or similar) or Stainless Steel.

In case Bidder/Contractor will provide GRP flue gas liners, Codes and Standards as mentioned in section B5 shall be followed.

The design shall consider all operating conditions like Design Pressure, Design Temperature, etc.

Liners shall be designed to with stand all internal and external loads.

In case Bidder/Contractor will provide Flue liner material Austenitic stainless steel of designation UNS 31727, it shall be conforming to ASTM A240/A240M.

Finalizing the material for chimney flue liner, construction methodology and sourcing as per relevant codes/standards is in the scope of Bidder/Contractor. Supplier with traceable experience for this work shall be proposed by Bidder/Contractor and shall be subject to approval by BIFPCL during basic/detail engineering.

Flue gas liners shall be adequately insulated as per requirements **Section B0**.

Expansion joints shall be implemented as per requirement. Construction of joints shall follow international codes and standards.

A stainless steel stack cap and galvanized louvers, doors, and other openings with miscellaneous steel frames shall be provided.

Drainage system for condensates (inside the flues) and rainwater (from the roof top) shall be provided with appropriate treatment.

Aircraft warning lights, earthing, lightning protection, lighting and other

electrical installations for maintenance shall be installed. The local regulations and ICAO regulations shall be followed.

Building description

- structure: reinforced concrete structure
- surfaces: coating and protection painting inside and outside
- foundation: a reinforced concrete ring beam or block/slab on piles as stipulated by the results of the soil investigations
- floors: galvanized steel gratings on structural steel, all galvanized and painted
- stairs: open grid steel flooring mounted on galvanized steel structures inside the concrete structure
- railing: Along the steel gratings, around the various openings and for the stairs and ladders tubular steel railings of galvanized and painted tubular steel shall be provided.
- access and escape routes: Access shall be made by galvanized steel ladders with safety cages. For all escape routes the local regulations have to be followed. All ladders and stairs shall be secured by platforms and railings.

Note-1:Tension piles might be used. Piles must be suitable and tested for tension loads.
Note-2: Painting philosophy as follows would be accepted:

- Top 50 m of the outside surface of the shell shall be painted with acid and heat resistant paint (Polyurethane) in alternate bands of signal red and white color. The remaining portion of the outside surface of the shell shall be painted with Synthetic enamel paint in alternate bands of signal red and white color.
- Inside the shell does not require painting. Flue gas liner shall be insulated and protected, that no acid and heat attack shall be expected to concrete shell.

2.3.2.19 Laboratories

Laboratories shall be incorporated in the main buildings wherever required, such as water treatment building, as specified in B6 etc. One centralized laboratory for overall analysis e.g. coal analysis, gypsum analysis, etc. shall be provided. Contractor shall provide concept for location of laboratories. The laboratory rooms shall have suspended ceilings and tiled floors and shall be air conditioned. It shall be furnished with work benches, chemical fumes exhausting systems, acid proof sinks linked with acid collecting tanks-respective connected to neutralization systems and shall have different rooms for different tasks e.g. for tests related to the water and waste water treatment or test related to coal or oil, etc. Secure storage rooms for chemicals and emergency shower facilities are required.

2.3.2.20 Oil unloading station and forwarding pump house

The fuel unloading station shall accommodate the following: It shall be possible to unload several road tankers at the same time. Final requirements are to be determined by Contractor according **Section B4** and **Section B0**. The unloading pumps shall be installed 45 cm above the road level.

The station shall consist of a reinforced concrete slab (treated against oil leakages) and sunshade of about 6 m height. The sunshade shall be of steel covered with trapezoidal steel sheets. The floor scale shall be provided with retaining and discharge facilities for oil leakages.

The pump house shall be of solid reinforced concrete structure towards the tank yard and lightweight steel structure in the opposite site. The requirements of the valid rules and standards for the design and construction of fuel unloading stations especially with regard to the fuel oil catchment pit and fire protection have to be strictly respected by the Contractor.

2.3.2.21 400/230 KV GIS control building

The sizes of the control building have to be determined according to the requirements for the electrical and instrumentation/control equipment. The following rooms shall be accommodated in this building:

- battery room
- offices
- store
- sanitary tea kitchen
- AC/DC-Distribution rooms
- control room
- telecommunication, metering and SCADA rooms
- medium voltage rooms

Description of the building

- structure: reinforced concrete
- floors: one
- flooring: reinforced concrete, vitrified tile flooring
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- external wall: 230 mm thick brick walls with metal cladding
- internal wall: 230 mm thick brick walls with plaster finish
- roof: insulated-watertight RC roof
- doors:
  - external: self closing sandwich steel doors with insulation
  - internal: aluminum glazed doors/wooden doors with steel frames
- windows: double glazed aluminum
- finishes: The control room shall be of noble appearance and receive e.g. sound absorbing wall cladding and suspended ceiling.
- air conditioning: centralized air conditioning
- ventilation: natural/mechanical
- sanitary-equipment: toilets for ladies and gents consisting of
  - western type WC with cleaning brush
  - eastern type WC with cleaning brush
  - bowl urinal
  - wash basin
  - hot air hand drier.

The battery room shall be equipped with:

- cleaning sink minimum size 580 x 450 mm
- emergency shower with eye wash
- acid resistant floor and drain
- Sink outlets and floor drains shall be chemical resistant and piped into the chemical drain system.

False floors and suspended ceilings wherever required. The control room(s) shall have windows with sunshades and may be divided with a glass wall into two sections. Flooring of the control room to consider electrostatic problems (to provide suitable earthing mats where required) and the ceiling to be sound absorbing. Airlocks of glass or at least with visions shall be provided.

Electrical hoist designed for the transport of the electrical and control panels.

Finishes: the control room shall be of noble appearance and receive e.g. sound absorbing metal wall cladding. The lighting shall be adequate and in accordance with the arrangement of the individual working places. Windows to be double glazed aluminum PVDF coated.

The design of finishing works will comply with the requirements of the code of procedures with regard to the mirroring effects, lighting of working places, shadowing etc.

2.3.2.22 400/230 KV GIS building

The GIS buildings shall consist of a steel structure with trapezoidal metal panels for external walls and roofs. The floor shall be a concrete foundation.

Description of the building

- structure: steel structure
- floors: one
- flooring: reinforced concrete
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- walls: single skin metal sheet cladding
- roof: single skin metal roofing
- doors:
  - external: self closing sandwich steel doors with insulation
- windows: double glazed aluminum
- ventilation: natural/mechanical.

2.3.2.23 HCSD - building

The building shall accommodate the equipment for high concentrated slurry disposal, as described in **Section B04**.

Building description

- structure: reinforced concrete
- floors: one floor
- flooring: reinforced concrete
- foundations: according to the soil investigation report and Special Technical Requirements of Foundations
- external wall: 230 mm thick brick walls or autoclave aerated concrete blocks with metal cladding
- internal wall: 230 mm thick brick walls or autoclave aerated concrete blocks or autoclave aerated concrete blocks with plaster finish
- roof: double skin metal sheet roof
- doors:
- main entrance:
  external: folding doors with motor drive
  internal: self closing sandwich steel doors with insulation
  wooden doors with steel frames
- windows: double glazed aluminum
- air conditioning: centralized air conditioning, if required
- ventilation: natural/mechanical

2.3.2.24 Main gatehouse

The main gatehouse located inside of the plant site serves for control of the entrance. From the working place the gate keeper shall be able to watch the areas in the front and behind the gate house and to release the pedestrian and vehicle gates.

The main gate house symbolizes the entrance of the plant and shall be of a good esthetical appearance.

Electrically operated Mild steel (MS) gates are included in the scope.

The following rooms shall be accommodated in this building:

- security staff offices
- time office incl. time machine
- reception area
- lounge
- safety induction center.

Floor area shall be suitable for purpose and Floor height shall be as per

requirements and BNBC.

Description of building:

- structure: reinforced concrete structure
- floors: one
- flooring: vitrified tiling
- external wall: 230 mm thick brick walls or autoclave aerated concrete blocks with paster
- internal wall: 230 mm thick brick walls or autoclave aerated concrete blocks with plaster
- doors:
  - external: self closing sandwich steel doors with insulation
  - internal: wooden doors with steel frames
- windows: double glazed aluminum
- ventilation: mechanical
- air conditioning: decentralized air conditioning
- sanitary equipment: toilet with 1 WC and 1 wash basin.

2.3.2.25 Secondary gatehouses

On Plant area secondary Gatehouses shall be located at the following locations:

- near Jetty Area
- on additional location for labor entrance/ any suitable place.

The gate houses, serves for control of the entrance. From the working place the gate keeper shall be able to watch the areas in the front and behind the gate house and to release the pedestrian and vehicle gates. The building shall be provided with the guard room a small office and a sanitary room. Electrically operated Mild steel (MS) Gate is also included in the scope.

Floor area shall be suitable for purpose and Floor height shall be as per requirements and BNBC.

Description of building:

- structure: reinforced concrete structure
- floors: one
- flooring: vitrified tiling
- external wall: 230 mm thick brick walls or autoclave aerated concrete blocks with metal cladding
- internal wall: 230 mm thick brick walls or autoclave aerated concrete blocks with plaster
- doors:
  - external: self closing sandwich steel doors with insulation
  - internal: wooden doors with steel frames
- windows: double glazed aluminum
- ventilation: mechanical
- air conditioning: decentralized air conditioning
- sanitary equipment: toilet with 1 WC and 1 wash basin.

2.3.2.26 Construction sheds

On the plant area 30 small, partly enclosed buildings (closed by three sided, and open to one side, covered by roof sheet) shall be provided as permanent construction sheds for repair and maintenance issues.

Office and store shall a building structure, whereas the workplace is just a covered area.

The locations shall be:

- 8 pcs near ID-fan - chimney area
- 6 pcs near turbine hall - 0.00 mm
- 2 pcs near cooling water pump house
- 6 pcs near coal handling control room
- 4 pcs near ash handling control room
- 4 pcs near jetty.

The sheds shall consist of:

- office (15 m²)
- store (20 m²)
  workplace (50 m²), only covered.
  Floor height shall be as per requirements and BNBC.

Description of building:

• structure:	reinforced concrete structure
• floors:	one
• flooring:	PVC tiling or equivalent
• external wall:	230 mm thick brick walls or autoclave aerated concrete blocks with metal cladding
• internal wall:	230 mm thick brick walls or autoclave aerated concrete blocks with plaster finish
• doors:	self closing sandwich steel doors with insulation
• windows:	double glazed aluminum
• ventilation:	mechanical
• air conditioning:	window/split air conditioning system
• sanitary equipment in the office area:	• eastern WC with cleaning brush in toilet • western WC with cleaning brush in toilet • bowl urinal in male toilet • wash basins in toilet

For these structures, pre-engineered structures can be used.

2.3.2.27 Maintenance workshops

On the plant area Maintenance Workshops shall be provided as permanent construction sheds for repair and maintenance issues.

The locations shall be:

- mill maintenance workshop (70 m² with EOT)
- mill maintenance workshop (with cylinder holding fixtures, sand blasting facility)
- fan maintenance bay (with monorail)
- coal handling plant workshop cum office building with min. area 900 m². The workshop shall be in addition to the central workshop.

Where applicable, workshops can be combined with other facilities.

Floor area shall be suitable for purpose and floor height shall be as per requirements and BNBC.

Description of building:

- structure: steel structure
- floors: one floor
- flooring: concrete or paving
- walls: double skin steel cladding
- roof: double skin galvanized steel sheet
- doors: sandwich steel doors with insulation
- windows: double glazed
- ventilation: mechanical
- air conditioning: window/split air conditioning system.

2.3.2.28 ESP CONTROL ROOM BUILDING

Description of building:

- structure: concrete structure
- flooring: concrete or paving
- External walls: 250 mm thick Aerated concrete blocks
- Internal walls: 250 mm thick brick wall
- roof: concrete
- doors: sandwich steel doors with insulation
- windows: double glazed

2.3.3 Outdoor foundations and structures

2.3.3.1 Transformer bays

Oil-filled transformers shall be supported on reinforced concrete foundations.

Provision shall be made for the catchment of oil spillage and fire deluge water. Appropriate measures are to be made to prevent pollution of the environment by leading of ejected oil.

The foundation supporting the transformers shall incorporate transformer rails. Each transformer foundation shall be provided with slope and raised borders, enclosing an oil retention basinpit in which the oil content of the transformer can be carried in the event of an oil leak. The oil retention basin shall be sized to hold the oil capacity of the largest transformer, rainwater and water from fire fighting system. The basin shall be adequately coated Above the oil pit a min. 20 cm thick gravel layer on a steel grating shall be provided. The retention basins shall drain into a central oil separator conforming to VDE-Standard or equivalent. Water from the separator shall drain to the site drainage (process waste water) system.

A deluge system shall be installed.

The transformer bays shall have reinforced concrete fire walls towards the neighboring buildings and between each other –if applicable- and security fencing on the other sides with personnel gates to the front.

2.3.3.2 400/230kV GIS

The civil portion of the 400/230kV GIS consists of foundations, transformer foundation, control building, GIS building, Bus duct supports, tower & gantries and equipment support structures etc.

The transformers bays shall be provided, as described above.

The sizes of the control building have to be determined according to the requirements for the electrical and instrumentation/control equipment. It shall be constructed as reinforced concrete and brickwork building.

The GIS buildings shall consist of a steel structure with trapezoidal metal panels for external walls and roofs. The floor shall be a concrete foundation.

Details for tower and gantries and support details of outdoor switchyard equipment will be described in electrical part.

The complete Area shall be fenced off from site. The access shall be from Main Plant. Additional access from outside direct to the 400/230 GIS is not required.

2.3.3.3 Other outdoor foundations

The following foundations shall be included under this clause:

- for dust filter (electrostatic precipitator or fabric filter plant)
- for flue gas desulphurization plant
- for supporting structures of pipes/cables, etc.
- for outdoor switchgear supports and gantries
- for air condensers and coolers (as applicable)
- for other outdoor structures not explicitly mentioned above.

The foundations shall be of reinforced concrete designed and constructed according to the recommendations of the soil investigation report.

2.3.3.4 Foundations of various storage tanks

The foundations of the following storage tanks are included under this item:

- potable water storage tanks
- demineralized water storage tanks
- service water tanks
- condensate tanks
- feedwater tanks
- foam storage tanks
- fire fighting water
- neutralization buffer tanks - if applicable
- other specified tanks not included above, e.g. Section B6.

The tanks shall be founded 0.60 m above surrounding level on ring foundations of reinforced concrete and a well compacted layer of fine graded asphalt concrete of 50 mm thickness with max. grain size of 5 mm.

On the ground beside the tanks (other than the potable water storage tanks), concrete slabs with raised borders are to be provided which shall collect all the leakages. These slabs are to be adequately protected against the chemical attack involved.

2.3.3.5 LFO/HSD storage tank

Care should be taken to ensure that no pollution of groundwater through oil may occur and that all precautions for fire protection are taken. The LFO/HSD storage tank has to be installed as individual tank farm bund. The dewatering system of the oil catchment area of the substation shall be provided with a locking system, which should be activated during the unloading phase at the tanks.

- tank foundations:

  The tank shall be founded 0.40 m above tank yard level on ring foundations of reinforced concrete and a well compacted layer of fine graded asphalt concrete of 50 mm thickness.
- bund of LFO/HSD:

  The bund and floor are to consist of reinforced concrete. The whole tankyard shall be isolated by a non-rotting oil and water-proof foil laid on the soil. The top protection for the insulating foil shall be achieved by concrete slabs. The joints responsible for absolute water and oil tightness between foundations and oil bund must not be endangered by possible settlements.
- In case of storage tank including a double bottom, a double wall (second wall in steel serving as spilling basin) up to the top of the tank and a roof covering the two walls, the bund can be omitted.
- drainage:

  The tank farm floor is to be sloped and provided with drainage channels so that trouble-free drainage of rainwater into the oil separators is possible. No oil should get into the rain water line even when an oil separator is overfilled.

2.3.3.6 Cable and pipe ducts/pipe bridges

For cables and pipes the Contractor shall provide ducts in such areas where installation above ground is not possible or advisable. Cables and pipes shall be laid in separate ducts. In general, ducts shall be avoided, as appropriate.

Pipe bridges shall be provided for supporting and routing of various pipes and electrical cables between the plant components.

Pipe sleepers are also acceptable, as long as all aspects due to accessibility and head clearances are fulfilled.
Details will be discussed during design stage.

2.3.3.7 Covered car parks

The following parking provision shall be foreseen:

- in the area of the administration building: min. 75 shaded car parking lots and 75 unshaded car parking lots
- in the area of the service building: min. 75 shaded car parking lots and 100 unshaded car parking lots
- in the area of the central canteen: min. 50 shaded car parking lots and 50 unshaded car parking lots
- in the area of the auditorium: min. 75 shaded car parking lots and 75 unshaded car parking lots (when auditorium is near administration Building, number of car parks can be reduced)
- in the workshop and other areas: min. 50 unshaded car parking lots
- in different areas of the plant: min. 50 shaded motor-bicycle parking lot
- dividing stripes shall be marked.

2.3.3.8 Open storage area

A free area (one no.) of min. 2500 m², paved with interlocking blocks (for heavy traffic) shall be arranged in the immediate vicinity of the workshop/store for the future installation of a camp of containers used during the maintenance works of the plant equipment.

The design of the area shall consider the loading and space requirement of minimum 20 standard containers. To the scope of works belong the water, electrical power, telephone as well as sewage facilities necessary for the connection of the above-mentioned container. The area shall be enclosed with chain link fence with pedestrian and vehicle gate.

2.3.3.9 Underground services

Pipe & cable channels

Channels for pipes and cables shall be of reinforced concrete and must be watertight. Dimensions of the box shape channels shall be such that adequate working access and ventilation could be available to maintenance staff. The ducts shall be designed to comply with the fire protection requirements and shall withstand soil pressure and any live loads that may be imposed on the channels. Particular attention shall be paid to satisfactory expansion and settlement joints.

For drainage purposes the ducts shall be provided with slopes of a minimum 0.3% towards accessible pump sumps. An automatically controlled sump

pump shall be permanently installed for any sump which is found to need pumping.

Hot dip galvanized anchor rails at a spacing of 1.5 m shall be provided on the internal walls of the channels to support cable racks. Minimum required distance between power and instrumentation cables and between cables and pipes shall be observed. Heavy duty removable covers shall be provided at access points to the cable channel.

For smaller quantities of cables PVC pipe sleeves shall be placed from one manhole to the next.

Pipe laying under roads

Where it becomes necessary to lay a pipeline across and under a road the Contractor may install a permanent liner at a safe depth.

The liner shall be designed for the likely ultimate loadings and may be of spun concrete or steel. The diameter of the liner shall be adequate for the number of pipelines as required to accommodate and for possible maintenance requirements.

Cable and pipe ducts, trenches, tunnels outside building

Generally cables shall be placed directly below ground buried in a depth of at least 0.8 m below ground. All necessary measures shall be taken at road crossings to protect cables against damage.

The necessity of providing cable and pipe ducts, trenches and/or tunnels and their possible routing are all as outlined in the relevant parts of the specification for electrical and I&C works.

General

For construction of cable and pipe ducts, trenches and/or tunnels the requirements of DIN 1045, DIN 1054 (or equivalent ISO – EN Codes), BS EN 1992-1-1, BS 6031 or approved equivalent standards shall be complied with.

For large numbers of cables and pipes the Contractor shall provide ducts, trenches and/or tunnels in such areas where installation by directly burying or above ground on racks is not possible or advisable. Cables and pipes shall be laid in strictly unit-wise separated ducts, trenches and/or tunnels.

The ducts, trenches and/or tunnels are to be constructed of reinforced concrete according to the requirements of clause “Concrete works” specified herein, and must be watertight and non-buoyant under the prevailing groundwater conditions. Particular attention must be paid to satisfactory expansion and settling joints. The walls and covers of the ducts, trenches and/or tunnels must be designed and reinforced to withstand the prevailing soil & water pressure, the relevant traffic loads and the weight of suspended cables and pipes.

The ducts, trenches and/or tunnels are to be provided internally with hot dip galvanized anchor rails every 1.5 m for the easy attachment of clips and cable racks. Plugging and shooting of fixing devices are permissible only in isolated cases and are subject to the Employer"s agreement. All ducts, trenches and/or tunnels covered by removable covers will have to be provided with metal protection angles protecting on one hand the edges of removable covers and on the other hand the edges of the duct walls beside the removable covers. Every attempt shall be made to locate the ducts, trenches and/or tunnels away from roads in order not to disrupt or endanger traffic during subsequent necessary work such as overhauls and repairs. The corners of the duct walls in the vicinity of junctions, inlets and bends must be "rounded-off" so that no damage is suffered by the cables when they are being drawn in – allowing for their minimum bending radii.

If the bottom of slab of a duct, trench or tunnel is below groundwater level, the slab shall have a slope and openings in the slab for natural drainage.

For drainage purposes the cable and pipe ducts, trenches and/or tunnels shall be provided with sumps and slopes (min. slope 0.3%) towards the sumps. Where necessary, pumps with automatic water level control shall be provided within the sump. Sumps which are likely to be dry most of the time may subject to the Employer"s approval be designed for pumping by portable pumps to be provided by the Contractor.

If a culvert(s), and/or tunnel(s), trench(s) or any other underground services are crossing streets, the street shall be constructed as a bridge for truck loading without effecting the underground structures.

All open trench concrete covers shall be pre cast (not cast in-situ) using straight moulds. Covers shall be adequately reinforced to withstand the induced loads; with cover to reinforcement not less than 15 mm (reduced concrete cover due to weight constraints). The trench cover soffits shall receive a bituminous seal coat.

Small cable & pipe ducts/trenches

Where approved removable covers may be used for small ducts and trenches. The covers may be chequered plates, gratings internal or precast concrete slabs outside.

Dimensions of cable & pipe ducts trenches

Dimensions of ducts and trenches shall be appropriate to accommodate the installation of the cables and pipes with their required spacing and for the space required for their maintenance. Ducts and trenches with removable covers may not have any access manholes

Covers, trash gratings, climbing irons

Shaft and manhole covers shall be made from cast iron or reinforced concrete, of watertight construction, with or without dirt traps, to suit local

requirements. All covers shall be approved for loading as expected from the likely traffic conditions. The dimensions of trash gratings shall be those determined by proper structural design. Trash gratings shall be of cast iron.

The type and choice of climbing irons shall meet the requirements of BS 1247, BS EN 13101 or other approved standards. Only corrosion protected materials shall be used. Where shafts are constructed of reinforced concrete, the step spacing shall be 330 mm, and for brick shafts as close to that spacing as possible subject to the brick courses. Climbing irons shall be staggered, maintaining a horizontal axial spacing of 300 mm.

2.3.4 Outdoor facilities and installations

2.3.4.1 Potable water system

The scope of this section is to supply with potable water all buildings, which require sanitary and potable water, see also **Section B6**.

Foundations for storage tanks shall be provided.

The scope of this system includes all equipment required for the potable water system including piping for hot and cold water lines, water heaters, drinking fountains, valves, insulation and lagging, hungers and supports. Emergency showers and eye wash stations will be provided as required e.g. in the chemical feed area and station battery rooms and shall be supplied with potable water.

2.3.4.2 Service water system

The scope of this section is to supply with service water to all locations which require service water, see also **Section B6**.

Foundations for storage tanks shall be provided.
The service water tank shall also be designed to serve for the purpose of the fire fighting water needs as described in **Section B12**.

The scope of this system includes all equipment required for the service water system including piping, valves, insulation and lagging, hungers and supports.

2.3.4.3 Storm water drainage system

For the entire plant, a complete storm water drainage system is required. A substantially maintenance-free and, above all, an operationally safe installation must be guaranteed. The surface water drainage shall include all necessary open channels, gutters, down pipes, gullies, traps, catch pits, manholes, etc. and shall incorporate the plant drainage requirements.

Stormwater shall be drained by gravity. If this is not possible, necessary pumping stations with sand traps are to be provided. For each pumping station the pumps are to be provided with stand-by pump of 100% capacity.

Rainwater run-off from plant area shall be directed through drains, channels and culverts into a storm water collection pond. The size of the storm water collection pond shall be capable for rain water run-off. The volume shall be determined by EPC Contractor.

Any excess rain water during the monsoon season will overflow into the river.

During heavy rainfall site can get flooded with storm water carrying effluents from ash dyke, coal settling pond etc. It shall not be naturally discharged into river or low lying area without any treatment.

2.3.4.4 Sanitary sewage drainage system

Sanitary sewage from administration, control, workshop buildings etc. shall be discharged in the sewage drainage system. The wastewater shall be treated in a Sewage Treatment Plant. For further Details see **Section B6**.

2.3.4.5 Sewage treatment plant

The Sewage treatment Plant shall be provided as described in **Section B6**.

It shall comprise beside the required components also a small building for the pumps and the local electrical panels. The basins will be concrete structures and the building shall be a concrete /block work structure.

The plant shall be designed to ensure that the effluents will have the quality which is required to allow the re-use for irrigation.

For this purpose the water shall be stored in a storage basin of suitable size with overflow to the central effluent monitoring sump CEMS. The water will be removed periodically by means of tank truck.

2.3.4.6 Fire water retention, if applicable

Spent fire fighting water shall be contained. The required retention volume shall cover the total water amount of the connected systems during defined operation time. This shall be achieved by respective thresholds and other up stands to form a containment of sufficient volume. Furthermore the rain water and fire fighting water retention basin shall be used to collect fire water from the drains of sealed outside areas.

The total fire water retention volume shall be based on the fire fighting water demand and duration according to NFPA 850.

Tanks with flammable or hazardous content shall have a bund structure creating sufficient retention volume. In the assessment of the total fire extinguishing time where such tanks are involved in the fire, account shall be taken of the collecting capacity present in this area including the volume of oil discharged in the event of a leakage.

2.3.5 Coal and ash handling and storage facilities

2.3.5.1 Handling facilities

The civil portion of the coal and ash handling facilities consists of foundations. Weather protecting metal roof on steel structures, junction tower, etc., and structures for the hoppers and the like are described in **Section B4**.

2.3.5.2 Coal yard

Coal storage

The coal storage shall be suitable for coal demand of 90days. The final size shall be determined by EPC-Contractor.

The coal yard shall be constructed for 2 x 660 MW. An area for additional coal yard for further extension shall be reserved in Layout.

Soil replacement and ground improvement shall be carried out for the coal storage area to have the required safe bearing capacity with negligible relative and absolute settlement characteristics. The minimum height of storage shall be considered as 13.00 m.

A coverage for the whole coal storage area has to be considered. The coal yard coverage shall be complete in all respects, including foundations and installation of steel structure and metal roof and sheeting. Sand piles and pre-loading of the entire storage area for a period as required may be the most economical and effective way to achieve the required results. The ground improvement work shall be started as early as possible to achieve the required results.

For steel structures, Tubular steel can be used. Usage of intermediate column is dependent on concept for stocking and reclaiming. Collision of equipment with column is not acceptable.

The improved sub grade shall be well compacted to the required lines and levels before sealing it with an impermeable layer of high density membrane. At least 300 mm layer of clay of high plasticity index shall be

laid on the impermeable membrane. The clay layer shall be covered with a minimum 250 mm layer of well graded gravel sub-base. Perforated high intensity pipes shall be recessed into the gravel layer to form a close grid of drainage system. The drainage system shall be prevented from clogging by using suitable geo textile cover or proven filter criteria according Terzaghi. Finally, the gravel layer shall be covered with a layer of minor quality coal of a minimum 200 mm thickness.

For collecting the storm water and spray water from dust suppression a drainage system shall be provided. The drainage system will drain into trenches around each coal pile thus be connected to drain into a separate coal drainage settling pond. The basin shall be founded on well compacted selected soil after removal of the existing top soil and weak subsoil. Complete with fully sealed reinforced concrete lining, the pond shall be constructed at a level that will be best suited for gravity flow of the drainage water. Slope of drainage lines shall consider long term settlement of coal storage area. Suitable removable type covers of the drains shall be provided.

A water spray system for dust suppression shall be provided.

Coal transfer towers/coal crusher building

The civil works for the coal crusher buildings, the coal sampling units and all corner towers and conveyer bridges shall comprise foundations and drainage systems required.

Where necessary, pile foundations or other deep foundations shall be provided.

The system shall be fully enclosed. Proper access shall be provided.

To prevent any dust accumulation, horizontal surfaces shall be avoided.

Provisions for regularly washing of structures and floors shall be made along with proper drainage.

All civil works for the crusher building and transfer towers shall be provided to meet the requirements of the mechanical and electrical installations and as described in **Section B4**.

Measures shall be taken to avoid the transmission of vibrations due to equipment (mainly crushers) to the building structure. These measures shall mainly be separate reinforced concrete foundation to be insulated from the remainder of the structure by vibration control systems consisting of spring elements and viscodampers to prevent the transmission of vibrations.

Unbalanced forces due to equipment shall be considered.

Building description:

- structures: structural steel frame
- foundations: piled foundations for steel columns (see also and the results of the geotechnical investigation results)
- base floor: reinforced concrete with slopes to gullies and drainage, coating according to the regulations
- external walls: 230 mm thick brickwall with plaster finish up to 0,9 m or autoclave aerated concrete blocks from floor level and double skin metal cladding above. Metal cladding from the top to the last operating floor shall be provided.
- roof: galvanized steel structure with metal cladding water proofing.

Coal conveyor

All civil works for the coal conveyors shall be provided to meet the requirements of the mechanical and electrical installations. If for structural reasons required deep foundations shall be taken into account for conveyor belt supports.

The system shall be fully enclosed. Proper access shall be provided.

To prevent any dust accumulation, horizontal surfaces shall be avoided.

Provisions for regularly washing of structures and floors shall be made along with proper drainage.

Coal conveyor bridges

The civil works for the coal conveyer bridges shall comprise foundations, steel structure and drainage systems required.

Where necessary, pile foundations or other deep foundations shall be provided.

The system shall be fully enclosed. Proper access shall be provided.

To prevent any dust accumulation, horizontal surfaces shall be avoided.

Provisions for regularly washing of structures and floors shall be made along with proper drainage.
Structural analysis shall be performed for both conveyors running with 100% loading.

All civil works for the crusher building and transfer towers and coal

conveyor bridges/gallery shall be provided to meet the requirements of the mechanical and

electrical installations and as described in **Section B4**.

Building description:

- structures: structural steel frame
- foundations: piled foundations for steel columns (see also and the results of the geotechnical investigation results).
- base floor: reinforced concrete with foundations, coating according to the regulations
- external walls: 230 mm thick brickwall with plaster finish up to 0,9 m or autoclave aerated concrete blocks from floor level and double skin metal cladding above.
- roof: steel structure with metal cladding water proofing.

Coal stacker/reclaimer

The civil works for the coal stacker/reclaimer shall comprise all foundations and civil works required for the equipment described in **Section B4**. Where necessary, pile foundation or other deep foundations shall be provided.

Construction shall consider all requirements due to long term settlement, e.g. adjustments of the equipment runway.

Covered coal yard

The coal sheds shall be of structural steel columns and roof trusses with a metal roof and metal sheet siding. Foundations with piled foundations for the steel columns, according to the geotechnical investigation. The profile of the roof shall follow the profile of the coal handling equipment. Each coal pile shall be covered separately. The distance between the steel columns shall be approximately 80 m, the height of the roof at about 40 m (for a coal pile of about 50 m width), the two cantilevers connected with a joint at the highest point must not be symmetrically depending on the size of coal handling equipment used. However the size and shape of the coal shed shall be finalized as per the requirement of coal stock pile and subject to BIFPCL approval. It may also be noted that internal column within coal stock pile area shall not be acceptable.

Any collision of the stacking and reclaiming machines with the shed must be safely avoided in any operational case.

The take-out of the coal yard shall be considered as option 4.1, see **Section B4**.

2.3.5.3 Ash pond

An Ash Pond of 25 acre shall be provided exclusively for storage of High Concentrated Slurry Disposal (HCSD).The peripherical structures will require additional area of around 18 acres located around ash pond. The system shall include starter dyke storage lagoons and overflow lagoon dyke construction, ash slurry pipe line, drainage system, ash water recirculation pump house, seepage water pump house and maintenance roads on top of dyke embankment & all around the outer perimeter of dyke at natural ground.

The average ground level on proposed land is RL=1.0m. The height of the starter dyke shall be approx. 5.60 m. Provisions shall be made for construction of further raising dykes to extend the storage volume of ash. The minimum height of storage shall be considered as 13.00 m in center of ash pond.

The starter dyke shall be constructed in such a way to maximize ash storage and considering seismic influence. Ash dyke embankments can be designed as an earthen dam as per relevant code. Depending on the type of the soil for the embankment construction, it may have either of the following sections:

i. a homogeneous section with internal drainage arrangement of sand chimney and sand blanket
ii. a heterogeneous section consisting of an inner impervious core and outer shell of available soil.

Based on the properties of soil and fill material, the stability and seepage analysis shall be carried out. The design shall be done for ultimate height and the unutilized as to be stored. Soil Improvement shall be considered, if required to minimize settlements of the dyke and inside the pond. The bearing capacity in the area shall be as required, but not less than
100 kN/m².

The ash pond shall be provided with impermeable liner in compliance with legal regulations. The liner may be natural or synthetic depending upon the substrata encountered and the permeability of soil. Toe drain shall be provided all around the periphery of outer dyke, where applicable. An RCC peripheral drain shall be provided to guide the seepage water from toe drain into seepage water sump and the same shall be pumped into Over Flow Lagoon (OFL). Toe drain shall be connected to peripheral RCC drain suitably at regular interval.

Water escape structure for decantation, method of discharge and recirculation of decanted water shall be provided as per requirement. For the escape of excess rain water from storage lagoon, spillway type structures shall be provided. The spillways along with energy dissipating device on downstream side shall be designed to discharge the excess rain water from the OFL and storage lagoon.

Height of Overflow Lagoon shall be specified by Bidder/Contractor, approx.4.00m

Internal drainage arrangement and toe drain around the dyke shall also be provided. Suitable Protection measures from back water of river shall be provided all around the ash dyke.

In addition, on downstream (D/S) slope of the embankment, stone pitching with inverted fliter arrangement shall be provided from GL to HFL plus 1.0m height of dyke embankment. Provision shall also be made to protect the upstream slope of embankment. Rock-toe with toe drain shall be provided at the toe of the embankment all around the ash dyke.

Dust suppression system for ash pond shall be provided, as required to ensure IFC guideline requirements.

The overflow of storm water shall be disposed of properly; reutilization in the power plant shall be encouraged as far as possible.

The Contractor shall provide a simple and effective filling concept, which will allow proper settling effect during all stages of the progressing fill of the pond and which shall keep the exposed ash surface to a minimum at all times. In order to monitor the performance of ash dyke during construction and operation, instruments should be installed at suitable locations.

All pump houses shall be protected for flooding, therefore the finish floor level of pump houses shall be the same as for plant levels.

Weighbridge

A weighbridge for weighing bulk goods to be brought in or out of the plant shall be provided in the area of the main entrance/gatehouse, which can be changed during design stage.

The scope of supply includes the design, delivery, installation and commissioning of the mechanical civil and data capturing and transporting system for one weighbridge to be installed at the gate house and consist of the following:

- weighbridge with a length of 12.0 m and 30 tones capacity
- reinforced concrete trough designed to support the weighbridge including drainage provision connected to the sewage system of the plant, all necessary embedded part for anchoring, sleeves, base plates etc.
- accessories including load cells, weigh indicators, arrestors and all devices necessary for proper operation of the weighbridge
- transponder system complete with all accessories
- 2 units of vehicle barriers with all accessories
- outdoor printer complete with printer stand with waybill depository boxes and accessories
- traffic light complete with all accessories
- message sign board to be installed in the gate house
- data processing system and communication equipment complete with computer, data switches and software for the control of weighbridge transactions
- all cabling between the weighbridge and the control desk.

2.3.6 Roads, paving and surfacing

The road system must be arranged in such a way that free- flowing traffic is guaranteed. Wherever possible, cross roads are to be avoided. The following asphalt roads shall be provided:

Road connections to the different buildings are to be provided.

Sidewalks shall be provided from roads to interconnect all facilities and all building doors. The walkways shall be reinforced concrete and shall be prepared with an adequate depth of compacted base course and shall be at minimum of 1.5 m wide. Walkways will be formed with slopes and/or steps at the correct level to drain storm water.

The area around the buildings and outdoor auxiliary plant, which are used infrequently, the lay down areas for small loads, the footpaths, the parking areas, etc. shall be paved with interlocking concrete blocks.

Entire area from transformer yard to chimney shall be provided with paving in combination with interlocking concrete blocks and high wearing resistant concrete. RCC paving of minimum 150 mm thick with C20/25 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 underbed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with selected sand followed by 75 mm thick 1:3:6 PCC (1 part cement, 3 parts sand and 6 parts stone aggregate) with 40mm nominal size aggregate.

Surfaces of unbuilt and remaining areas within the site boundary which are neither built nor paved shall be adequately leveled and covered with topsoil to allow proper landscaping. Road signs, traffic signs, road surface marking and guardrails shall be provided as per authority requirements for traffic in industrial areas.

The works shall include temporary site access roads from the existing outer roads.

After finishing of construction works all temporary site access roads used by the Contractor shall be reinstated to the original standard i.e. the standard after refurbishment.

2.3.7 Landscaping

There shall be comprehensive landscape development in entire Plant area to create a pleasant and healthy environment. The scope of work for landscape and horticulture work shall include supply and planting of trees, shrubs, hedges/edges/borders, grass lawn around different areas, buffer and peripheral plantation etc. The scope shall also include supply and installation of all landscape furniture i.e. park benches, gazebos, landscape fountain and water bodies, landscape pavers/ tiles etc. and all associated electrical and mechanical works/items and all other work required for completion of landscape development.

The landscape design and drawing shall be developed by competent Landscape Architect. The landscape shall use the suitable plants and trees preferably local trees, plants, and shrubs. There shall be provision of pathways in and around the landscaped area, with suitable provision for disabled persons.

Around the pathways and roads, trees shall be planted. Rainwater harvesting for the entire Plant Area shall be integrated within the landscape development. There shall be provision of irrigation system for irrigation of landscaped area. Intense landscape with four water body development shall be provided near the following areas:

- main gate complex
- administration building
- service building
- canteen building.

All other open areas of plant, which are not covered by buildings, structures, roads, lay-down areas, graveled areas, etc., shall be planted with shrubs and grass.

Around the coal yard, trees shall be planted in order to limit dust contaminations.

Landscaping shall be considered within the plant boundary. Entire Plant Area is to be considered for Landscaping with Intensive Landscaping around Entrance Gate, Administration Building Complex, Canteen Building, Service Building and in front of A-row of MPH.

Green belt development outside plant is not in scope of Bidder/Contractor.

2.3.8 Main entrance area outside the plant

In the Area of the main Gate a welcome and waiting complex shall be provided.

The area shall consist as a minimum of:

- 3 helipads
- Restroom, min 30 m²
- 160 car parks, shaded
- 34 truck & trailor parks
- 6 shops
- prayer hall, min 6 m²
- toilet building, min 15 m²

The structures shall fulfill the technical requirements as stated in this specification.

All buildings shall be equipped with electricity, HVAC, telephone connection, etc. Structure shall be designed to fulfill the purpose and follow BNBC

2.3.9 Employer's and Engineer's office (temporary structure)

A temporary Employer˝s and Engineer˝s Office (separate structure) of. 2800 m² for minimum 100 engineers, meeting rooms and social rooms for minimum 50 persons, furniture, copy machine, kitchen shall be provided and maintained throughout the construction period. A combination with other facilities should be avoided. Structures shall not be removed after completion of the works. Area shall be designed as depicted on indicative general layout and as per Bidder/Contractors experience. Proposal shall be submitted by Bidder/Contractor and is subject to approval by BIFPCL during basic/detail engineering phase.

Offices shall be provided for:

- Site Manager (40 m²)
- Discipline Site managers (25 m²)
- Middle level executive offices (10 m²)
- Workstations/Halls.

Every working place shall be equipped with a computer, connected to a local network with common printer.

These offices shall be separate permanent reinforced concrete structures, according to the civil specifications. The offices shall be ready for occupation latest 8 weeks following the commencement of the works at the site.

Kitchen shall be equipped with cupboard, refrigerator and heating plate, or electric oven, china and tools, dish washer, glasses and coffee machine, etc.

Sun shaded car parks, helicopter Pad septic tank and cesspool shall be included as well as a temporary elevated water tank. AC window units and sufficient power supply shall be included.

The following additional equipment shall be made available in sufficient number:

- automatic telephone exchange (domestic/international lines)
- telephone installed in each room
- telefax machine
- CAD work stations
- min 2 colour printer for drawings up to A0 size
- min 10colour printers for documents size A4 & A3 photocopying machines for A4 & A3
- PC‟s with related processor, network for data exchange, storage, •internet browser and standard office software.

This equipment shall be state-of-the-art and furniture shall be of 1st class standard; all are subject to approval by the Engineer. The Contractor shall provide the offices with electricity, water, coolers and refrigerators.

All office supplies, operating and maintenance costs for the offices and the installed equipment shall be at the Contractor‟s expense, for the whole period of contract the full service of the equipment with consumables (toner cartridges, paper, etc.) and the billing cost of telephone, telefax and internet browsing.

Customer will provide clear land for construction of employer‟s office with in project premises.

2.3.10 Living accommodation

The Contractor shall construct living accommodation made of reinforced concrete, according to the civil specifications for the Employer‟s and Engineers site supervision staff. Layout and finishing materials shall be approved by the Engineer.

All accommodation shall be situated close to the construction site and consist of 30 independent houses (each with 3 bedrooms with all required rooms and the consequent floor area) located near the project site.
Customer will provide clear land for construction of employer‟s living accommodation with in project premises.
Location/layout shall be proposed by Bidder/Contractor, and will be subject to approval by BIFPCL during basic/detail engineering.

These houses shall have fully furnished living and bedrooms, kitchen etc. completely equipped (TV, stereo, stove, refrigerator, dish-washer, washing machine, ironing board and kitchen utensils) and bathrooms.
No common recreation facility or separate boundary is required.
They shall be supplied with water, electricity, air conditioning and telephone and connected to a drainage system so as to provide immediate utilization.

All running expenses such as water, electricity, telephone, maintenance, cleaning, etc. shall be at the Contractor‟s expense.

If this accommodation is not available in the specified time, the hotel expenses incurred by the Engineer‟s representatives during the corresponding period shall be at the Contractor‟s expense.

Time period for providing accommodation shall be 8 weeks following the commencement of the works at the site.

These houses shall be for the sole use of the Employer‟s and the Engineer‟s representatives up to issue of the last preliminary acceptance certificate of the power and desalination plant.

Ten houses shall remain available during the warranty period plus 3 months extra period.

2.3.11 Building information management system (BIMS)

A BIMS shall be provided. The BIMS shall be a SCADA system to collect all relevant data from various subsystems to enable a centralized visualization with unified HMI graphics throughout different subsystems.

The system shall support standard interface protocols for signal exchange. The system shall be interfaced to following subsystems: HVAC, Weather station, Fire detection, Access control system, CCTV, Elevator emergency call systems, etc.

The BIMS shall provide functionalities to optimize energy usage and minimize energy consumption of buildings by e.g. lighting and HVAC controls. It shall support automatic or timed control of events (such as switching on/ off dedicated lighting areas, operating shading equipment such as shutters, and similar). It shall ensure a clear and easy operation and support the optimization of the work flow of the building maintenance personnel. The system shall provide alarm and event logging as well as report generating facilities.

One (1) normally unmanned operator station shall be installed in the office of the facility management department. Automatic alarms shall be generated and sent to the maintenance personnel via SMS and/ or e-mail.

2.4 Special Technical Requirements

2.4.1 Basic requirements for all civil works

- The design of all structures under this contract shall be such that differential and total settlements or other movements shall not exceed acceptable limits and full provision shall be made for all expansion and other joints. The design shall be to the approval of the Employer.
- Structural members subjected to flexure shall be designed to have adequate stiffness to limit deflections or any deformations that affect strength or serviceability of a structure adversely. The maximum allowable deflections of structural members shall be in accordance with the relevant design standards and/or the limits prescribed by the machinery manufacturers.
- The superstructures and foundations subjected to vibrations (the primary source of these vibrations being the unbalanced forces generated by rotating or reciprocating equipment) shall be designed such that Vibrations will be neither intolerable to personnel, and will not cause damage to the machine or structure. The natural frequency of the whole of the superstructures and foundations or parts thereof and all structures adjacent thereto shall not coincide with the operating frequency of the vibrating plant.
- The dimensions of all the buildings shall be such as to provide adequate space for the safe installation and proper operation, maintenance and repair of all plant and equipment.
- Throughout the works all floor slabs above rooms containing electrical equipment shall be watertight. No drain pipes or water pipes are permitted to pass through these rooms.
- All materials used in the works shall be of the best quality of their respective kinds as specified herein, obtained from sources and suppliers approved by the Employer.
- The work shall be carried out by competent personnel skilled in their various trades.
- Suitable access to the roofs of the buildings by means of galvanized steel stairs shall be provided for maintenance and firefighting purpose.
- All rooms with fire hazard shall be provided with suitable emergency exits.

Proper access roads with footpaths shall be provided to bring in all the equipment and to take it out in case of maintenance. These access roads shall be suitable for the vehicles which will be used (cars, forklifts, trucks/trailers etc.) to reach up to the point of unloading of the equipment.

- Safe, convenient and straight forward accesses and means are to be provided to take equipment in and out of all rooms, at all levels using suitable stair wells and suitable electric hoists. The dimensions of rooms, stairwells, doors, etc. shall be designed to suit the a.m. transport concept.
- An appropriate serviceable and functional master key system for the whole

plant shall be supplied and installed.

- Before starting of design works, the Contractor shall submit to the Employer for approval a **project design manual** containing the design data, the design criteria and the standards for all civil works. All loadings considered in the design shall be justified with supporting details.

2.4.2 Site organization and preparatory works

2.4.2.1 Site services during construction and testing phases

Contractor's temporary site buildings & accommodation

All buildings and equipment provided in accordance with this requirement shall be made available within 8 weeks following the commencement of the works at the site and must not be removed without the prior approval of the Employer.

All temporary buildings, structures, and equipment must be removed from the site to the Employer‟s approval and the site returned to its original state. All resulting debris shall be removed to an approved dumping area to the Employer‟s satisfaction.

The Contractor shall propose an area to the approval by the Employer for his site organization in the limits allocated for this purpose, for the storage of plant, equipment and materials during the execution of the Contract. The Contractor shall be responsible for the off-loading, transporting and handling of all the plant and equipment and materials needed for the purpose of the Contract.

Within the proposed area the Contractor shall provide and maintain an office appropriate to the efficient management and control of the project by his own staff.

The Contractor is to provide a site first aid station including an ambulance fitted with all essential facilities and the needed medical and paramedical personnel. The station shall be made available for the use of all personnel who shall be employed on the site for overall project works.

Site fire protection

See section Fire Fighting

Temporary latrines and ablutions

The temporary toilets and ablutions shall be provided for the use of the Contractor and his subcontractors.

The Contractor shall also include in his Contract the disposal of the sewage resulting from all temporary toilet and ablution facilities.

Temporary electricity and water supplies

The Employer will provide an interface for electricity demand for the Contract works. The Contractor shall provide the cables and equipment for construction power at Site, together with the supply to the Employer's and Engineer"s site office.

Base case:

Power supply for construction purposes will be provided at 33 kV voltage (2 no. of lines). The same will be extended to the Contractor for him to develop 33/11 kV sub-stations and construction power supply comprising of:

- Two (2) 5 MVA, 33/11 kV step-down transformers,
- Two (2) 11 kV switchgears,
- 11 kV main ring, design according to plant layout, construction requirement and schedule,
- 11kV/415 V step-down transformers (number and sizes as required according to plant layout, construction requirement),
- Two (2) 11 kV feeders (minimum 630 A), for usage of the Employer.

For improved reliability these feeders shall be connected to separate 11 kV bus systems at 33/11 kV sub-stations.

The electricity prices/power tariffs for the case of 33 kV voltage level are defined in the **Annex C**.

Further preliminary details regarding provided construction power system are shown in **Annex C**.

Construction Water:

Supply of construction water is in the scope of Contractor. It is not allowed to use ground water. For construction, only river water suitably treated for his purposes shall be used.

Security fencing including gates and barriers

Main plant and Township Boundary wall will be constructed by Employer. It consists of 3m high, plastered brick work with barbed wire on top. Location and Details are shown in **Annex C**.

All facilities, which are erected outside of the boundary wall, e.g. jetty area, intake structure, etc shall be enclosed by a boundary wall including access gates. The standard shall comply with boundary wall as provided by Employer.

Contractor shall propose suitable arrangement in line with his layout to secure the area from unauthorized access, except in ash pond area, subject to BIFPCL approval.

Watch Towers:

a) Watch towers to be provided at max. distance of 600 m and at every corner/bend.
b) Construction of Tower as per requirements, minimum 3 x 3 m area, 25 m height and external staircase.
c) Watch tower shall be RCC structure.

Fencing round Contractors material storage etc. shall be done by Contractor as required.

Site visit

Site visits by the Bidder are mandatory to.

- get sufficient knowledge about the conditions at the site
- get sufficient knowledge about the reachability of the site
- determine the effort of site investigation to be done by the Bidder.

Site visits have to be announced at least two days before targeted visit at BIFPCL. Transport to the site has to be organized by the Bidder.

Site preparatory works

Site was filled up to RL +5.50m in 2014. RL shall be considered same as M.S.L The surface of filling is uneven (more than +/- 10 cm). Swampy areas at the surface or below may be found. The contractor has to replace the swampy, soft soil with filling material (less than 5% silt).

Consolidation of soft soil/clay and settlement of soil has not finished yet. Required works in respect of leveling, filling, drainage, preloading, etc. shall be considered by Contractor in his work program.

Area of ash pond will not be filled by contractor. After checking the suitability the site the area shall be leveled and compacted by filling and cutting to a final level to be established upon a site survey.

Survey works

The coordinates of the envisaged site location are stated in **Annex C**.

The Contractor shall carry out close grid survey of the site to set up Plant Datum.

Plant elevation shall be defined as follows:

- finished ground level of the plant + 5.00 M above MSL
- plant level (turbine hall plinth level) + 5.60 M above MSL
- final level of road + 5.15 M above MSL
- final level of landscaping + 5.00 M above MSL
- final level of paving of power house block + 5.00 M above MSL.

Finished floors of the power island buildings at ground level shall be fixed at 0.00 m Plant Datum (PD), subject to optimization by the Contractor, and this PD being at least 0.60 m above ground level.

The Employer will furnish to the Contractor site investigations performed prior to the EPC Contract.

Nevertheless the Contractor shall carry out the necessary topographical survey works in order to obtain the following information:

- location of the plant site relative to the existing bench marks of the area
- establishment of site boundaries with site levels
- installation of site bench marks
- preparation of a site survey report, with the description of survey works, methods applied and survey map(s) on scale 1:500, showing the results with the location of bench marks
  The levels have to be given in an adequate scaled grid line system.

Moreover the Contractor shall carry out a bathymetric survey and all investigations required for the intake and outfall structures.

The full responsibility of the investigations to be carried out lies with the Contractor.

Geotechnical investigations

Geotechnical investigation at the site of the works has been carried out for the Employer (see **Annex C**). The investigation comprised boreholes with soil sampling, SPT testing in the main areas of the plant.

Geotechnical investigation data available as of now is of preliminary nature.

The existing information about subsoil conditions, quality of filling, water levels in the ground etc. are for information only, and is not binding during execution phase.

In case the Bidder needs more information for proper calculation of works during bidding process, additional investigations can be performed on his own expense. There are no restrictions about the investigations.

The Bidder/Contractor is responsible for any matter of subsoil, filling and water in the ground.

In general the subsoil conditions can be described as follows: top layer filled sand (with unknown silt content), underlying layers of clay, underlaying fine sand.

Hence, contractor has to carry out detail geotechnical investigation at his own cost. Methodology and Specification of investigation is subject to approval by the Employer Special attention should be paid to Seismic Parameters. Related to Soil Type as identified to Soil Investigation Report, the effect of local soils on earthquake ground motion shall be determined.

For site class S1 and S2, as expected for this project, site specific studies shall be carried out to determine Design acceleration response spectrum.

Seismic Study

The seismic study shall be performed by an accredited consultant with adequate references and experiences in equivalent projects.

Study area

The study area is defined with a radius of 200 km (incl. safe distance) around the power plant location at Mongla.

Geological structure model

The following data shall be obtained for the model:

- large-scale plate tectonic exposure for the study area
- small-scale micro plates are to be described or excluded
- existing faults, dislocations, drops and lineaments in the deeper and shallower subsurface
- lithological as well as stratigraphic structures for the deep subsurface layers up to Holocene boundary.

Based on the information, a litho-stratigraphic 3D model of the subsurface shall be developed up to the Holocene boundary.

Earthquake

All documented earthquakes in the study area shall be listed with their magnitude-height. A differentiation between the respective focal depth and the location of the epicenter (shallow or deep tremor) shall be considered. From the available seismic data, the energy values of the shear waves (maximum and average values) at the construction site shall be derived. Furthermore, the wave intervals between 4.0 s up to 10 min must be taken into account. Subsequently the thus obtained values must be transferred to the soil parameters.

Soil parameters

The grain size distribution, density and water content for the depth profiles of the boreholes and / or soundings shall be described in order to assess the possibility of a tendency to liquefaction of the soil. The soil must be tested for its damping characteristics in the laboratory. Transformations in the geotechnical characteristics must be documented.

All test results have to be evaluated for every individual building component of the proposed power plant complex according to the British Standard or the DIN EN ISO 1998 sheets 1- 6. Based on this evaluation recommendations for the construction of the individual components have to be given.

2.4.2.2 Earthworks

General

This section applies to all earthwork required for the construction of buildings, structures, pavements, road works, landscaping and burying service lines in the ground.

The Contractor shall satisfy himself as to the ground conditions on the site including the nature of the strata to be excavated, obstructions, possibilities of flooding and such like and shall allow for all provisions necessary to carry out the work in the most suitable manner.

Furthermore, this division applies to excavation works in connection with pavement, roadwork and landscaping.

Leveling & grading

Fill materials

The fill materials used are to be examined and approved. Excavated materials can be used if they fulfill the requirements as specified in Tender Documents. Material approval is required on site.
Source for fill material shall be determined by Contractor. All works related to transport and handling of filling material is in the scope of Bidder/Contractor.

- **Select fill**
  Select fill shall have the following properties:
  Well graded, non-cohesive and nearly silt free (silt content not greater than 5%; up to 10% tolerated, except below footings of structures), soils free of organic matter (limit 2%). Decomposing or compressible materials shall not be used.
  The material shall be of such nature and character that it can be compacted to the specified densities. It shall be free of highly plastic clays, of all materials subject to decay, decomposition or dissolution and of cinders or other materials which will corrode piping or other metal. The intention is to use select fill below structures, roads, parking areas etc.

- **Ordinary fill**
  Ordinary fill shall have the following properties:
  Natural inorganic soils: Organic matter less than 3%. For other properties see under 'Select fill'.
  The intention is to use ordinary fill for non-built areas.

- **Special fill**
  Special fill material shall be gravel or crushed rock.
  The intention is to use special fill e.g. as sub-base material for tanks, roads and switchyard areas.

Density requirements for filling shall be as follows:
80% relative density (ASTM D-4253 and D-4254) for free draining soils containing less than 15% by weight finer than 75 micron sieve non plastic material or 95% of the maximum density as determined by ASTM D-1557 for soils containing more than 15% material passing the 75 micron sieve.

Execution

The works shall be excavated either by hand or by use of excavating plant and tools acceptable to the Employer.

Safety precaution

The Contractor shall be responsible for all necessary safety measures. Proper strutting, sheeting and bracing, stabilization and protection of slopes, methods of excavation to reduce risks of slides, etc. shall be to the Contractor's debt.

Over excavation

If somewhere, and for any reason, excavation is executed beyond the established lines and without the Employer's previous approval, the Contractor shall at his own expenses backfill with approved material (including required compaction) or with lean concrete.

Stockpiles and disposal

Excavated material from the Works selected by the Employer for re-use shall be placed immediately in its final position, if possible, or otherwise may be stockpiled or deposited on Site as directed by the Employer.

Contractor shall remove the excess earth and deposit the excess earth at a location outside the plant boundary duly and in accordance with the local and environmental regulations and subject to BIFPCL approval

Preparation of foundations

All surfaces on which or against which concrete is to be poured shall be carefully cleaned and roughened and shall be free of any detrimental impurities, organic matter or unsuitable material to the Employer's satisfaction.

The surface shall be free of oil, stagnant or running water, mud, loose rock, residue and impurities or any other improper material.

Immediately after excavation, all such surfaces shall be moistened and treated as directed by the Employer and then protected by means of a lean concrete layer, 5 cm in thickness. No concrete is to be poured until formation is inspected and approved by the Employer.

Backfilling

Foundations and structures shall be backfilled with approved material compacted in layers by suitable equipment until optimum stability has been obtained to the satisfaction of the Employer. Compacting shall be carried out by means of pneumatic or mechanical rollers or other compactors of a type previously approved by the Employer.
Density requirements shall be as follows:

• under buildings and structure foundations and slabs • under roadways and parking areas • under transformers and other major foundations	85% relative density (ASTM D-4253 and D-4254) for free draining soils containing less than 15% by weight finer than 75 micron sieve non plastic material or 98% of the maximum density as determined by ASTM D-1557 for soils containing more than 15% material passing the 75 micron sieve.
• embankment	80% relative density (ASTM D-4253 and D-4254) for free draining soils containing less than 15% by weight finer than 75 micron sieve non plastic material or 95% of the maximum density as determined by ASTM D-1557 for soils containing more than 15% material passing the 75 micron sieve.

The thickness of fill layers, number of passes and type of equipment to be used shall be proposed to the Employer after compaction tests have been made.

Backfilling of foundation work shall be carried out only after foundations have been inspected by the Employer.

Soil replacement

The material to be used for replacement of soil shall not contain soluble or swelling components such as clays, or organic matters. Sand gravel mixtures of favorable grain size distribution shall be used in exchange.

Prior to the commencement of work, samples shall be taken from the anticipated borrow area and tested in respect of Proctor density, optimum moisture content, grain size distribution and content of soluble matters.

The fill material shall be placed in horizontal layers of no more than 25 cm in compacted thickness. The fill moisture content shall be controlled and adjusted in order to achieve a maximum of compaction.

The fill material shall be compacted by vibratory roller (min. weight 20 t).

Tests and properties

The Control of working and tests operations shall be carried out by the Contractor according to the respective standards in the presence of the Employer.

2.4.2.3 Foundations

General

Foundation design shall be based on approved geotechnical investigation report. The Contractor shall submit a detailed design for the foundation to the Employer for approval. The bid price for the piling shall be lump sum and shall remain firm irrespective of the type design.

Once the final plant layout has been established by the Contractor, he shall carry out a more detailed geotechnical investigation. The scheme of geotechnical investigation shall be prepared by the Contractor and will be subject to the Employer's review and approval

Information from the soil investigation performed in the year 2014 at this site is provided to the Bidders for information. Bidder may note the presence of thick deposit of soft clay as revealed through borelogs attached. The onus of correct assessment/ interpretation and understanding of the existing subsoil condition/data is on the Bidder. The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Employer and that found by the Bidder during additional soil investigation or during execution of works, shall be payable.

A study of soil liquefaction potential shall be performed using parameters from the geotechnical investigation performed by the Contractor and subject to the Employer's review and approval.

Special measures have to be taken if the results of soil and laboratory tests prove chemical aggressive conditions.

The soil conditions met during the foundation works are to be checked by the Contractor's soil engineer, recorded and compared with previous results. If essential differences occur, the Contractor has to inform the Employer and to propose further measures.

Immediately prior to concreting, the Contractor has to verify the specified soil conditions below the foundation level by a sounding.

Design of the foundations shall be in accordance with the latest DIN/Euro codes and/or other approved standards and codes of practice including the following:

DIN 1054	Subsoil: Permissible loading of subsoil; Load Testing of Piles (2005-01, Section 8).
DIN 1626	Welded circular steel tubes subject to special requirements, technical delivery conditions.
DIN 1629	Seamless circular steel tubes subject to special requirements, technical delivery conditions
DIN 4014	Part 1: Bored piles: construction procedure, design and bearing behavior Part 2: Bored piles: large bored piles: construction procedure, design and bearing behavior
DIN 4026	Driven piles: Construction procedure, design and bearing behaviour.

Furthermore, the ICE Specification for Piling and Embedded Retaining Walls (latest edition) shall be observed**.**

From the detailed study of the sub-surface ground conditions, the type of foundations required for each location shall be determined to suit the loads imposed.

The foundation/soil improvement could include any of the following:

- shallow foundations on existing ground/improved ground
- sand piles
- bored cast-in-place concrete piles
- driven piles
- vacuum consolidation.

The Contractor may propose any other type of foundation and ground improvement as required provided the proposal is based on proven engineering and acceptable standards and codes of practice. As a part of the design of the works and after fully detailed ground investigations, the Contractor shall submit for the Employer˝s approval a comprehensive foundation plan for the works proposing the type of foundation for each part of the works.

The mentioned pile capacity (Annex C) shall be read only as assumption and shall be considered for information only. Employer does not take any responsibility for these values.
It is in the scope and responsibility of the Bidder/Contractor to execute a soil investigation and perform his own design with related pile load capacities.
Responsibility related to soil remains with the contractor

The turbine/generator pedestal foundations shall be independent of the enclosing turbine building foundations.

All large tanks shall be dimensioned so that their aspect ratio (height/diameter) is less than about 0.4. The tanks can then be supported on ring type foundation under perimeter walls. The Contractor shall demonstrate the adequacy of the ring beam foundation, without piles, from total and differential settlement and will be subject to Employer's review and approval.

Dewatering
During the foundation works the excavated areas, foundation levels and pits are to be kept free of water down to at least 1.0 m below the foundation level.

Damp proof course and Waterproofing
All foundations, footings and slabs in contact with ground water shall be of water tight concrete in accordance with DIN 1045 or equivalent approved standards and shall be protected against water action and rising damp in accordance with:

- DIN 18195
- DIN 18336.

All foundations, footings and slabs in contact with ground shall receive a bituminous coating.
Damp proof course (DPC) thickness shall be applied to brick and block walls at about 300 mm above ground level to check rising damp. The DPC shall be in accordance with DIN 18195 or equivalent approved standards.

Pitwall stability
The excavated pit sides, walls or slopes have to be stable and established with respect to safety regulations.

Settlement and expansion joints

Joints are to be arranged in such a way that stresses and strains caused by settlements, temperature, differential settlement, etc. do not adversely affect the structures. The settlement joints shall run through the complete structure down to foundation level, the expansion joints however shall stop on the top level of foundations.

The joint width shall be at least 2 cm.

Settlements of all relevant structures shall be measured, recorded and shown in diagrams according to BS EN 1997-1 or other equivalent standards.

Foundations at different depths

Foundations at different levels should be based beyond a load spread angle of 30° (against the horizontal).

Safety against uplift

For all parts of the structures extending into the ground water, safety against uplift has to be guaranteed during all execution stages.

Soil replacement

If unsuitable soils are encountered below the foundation level or basement floor, they are to be replaced by suitable layer-wise compacted material down to the bearing soil.

2.4.2.4 Piling works

These specifications cover the requirements for the materials, the installation and the realization of bored cast-in-place concrete piles with grouting at the base, if required, and driven piles.

The piling works and design shall be in accordance with BS EN 1997-1 or equivalent.

Two types of piles foundation can be proposed and quoted by the Contractor: driven piles or cast-in-place bored piles.

The net vertical pile capacity computed from the soil investigation report is used to determine the maximum test load in case of piles testing.

Bored cast-in-place piles

The piles are drilled up to the depth indicated by the pile drawing submitted by the Contractor and approved by the Employer. For each pile, the Contractor draws up the geo-technical profile of the drilling with description of the strata and samples taken for each stratum as mentioned in the piling record item of these specifications. A representative sample from each stratum will be kept in tight packing until the end of the works.

A suitable type of drilling equipment shall be provided in order to penetrate obstacles (e.g. boulders) which may be met during the execution of the piles.

Generally drilling operations shall be carried out in such a way as to avoid any disturbance of the surrounding soil. A temporary casing shall be installed to the full depth of the borehole. The bottom of the casing shall always be kept sufficiently below the excavated borehole bottom, in order to prevent inflow or loosening of the adjacent soil.

When drilling below the groundwater table inside the casing shall always be maintained above the natural groundwater level by at least 1.5 m, i.e. water has to be added accordingly.

Just before reinforcing and start of concreting the pile foot is to be cleaned out so that no disturbed, loose or weak soil remains below the pile tip.

Driven piles

The weight of the falling mass must always be adequate to take down the piles at the depth defined at the project.

In case of damages to the adjacent piles, for example observation of concrete raising in the neighboring piles, the Contractor must alter the driving sequence.

The pile driving is carried out following a sequence in order to avoid, as much as possible, an increasing of the driving resistance for the last piles. Each pile has to be driven continuously until the specified depth has been reached.

The Contractor immediately informs the Employer in case any unexpected change in driving characteristics occurs and proposes methods to solve the problem. A detailed record of the driving resistance over the full length of the nearest available pile will be taken if required by the Employer.

The Contractor gives adequate notice and provides all facilities to enable the Employer to check driving resistances; a set of blows recordings is taken only in the presence of the Employer unless otherwise approved.

The final set of blows has to be recorded for each pile either as the penetration in millimeters per 10 blows or as the number of blows required to produce a penetration of 25 mm (see item on piling record of these specifications).

Staking out-tolerances

The landmarks to be used for the implementation of the piles must be effective, solid and well protected.

The method of location of the piles is a duty of the Contractor. The setting out has to be carried out from the main grid lines of the respective structures.

The maximum allowed deviation of the piles center from the theoretical location shown on the setting out drawing is 50 mm in any direction. The maximum permitted deviation of the completed pile from the vertical is 20 mm per meter (2.0%).

Cut-off

The piles are to be concreted up to a minimum of 60 cm above the cut-off level. The cut-off must eliminate all polluted or poor characteristics concrete at the top of the pile and should be carried 10 cm into sound concrete.

The concreting of the raft may start only after the cut-off of the pile and after obtaining a satisfactory resistance of the pile concrete.

The cut-off must be carefully performed according to a method approved by the Employer. The concrete in the head of the pile shall be carefully broken away from the reinforcement, which shall then be cleaned and bent as shown on the drawings or as directed. The concrete surface at the cut-off level shall be horizontal, plane and free from all loose aggregate.

Piling Records

For each pile, a piling record book giving the main checked values during execution shall be drawn up and updated by the Contractor with all the work hazards and incidents. That record book shall be submitted daily to the approval of the Engineer as the execution proceeds.

This record book shall include for each pile details on:

- location, reference number (corresponding to the number fixed on the drawing), type and diameter of the pile;
- length of the temporary casing;
- date and hour of start and end of each operation drilling, reinforcement setting, concreting;
- level from which the pile is bored or driven (platform level);
- level at the pile base;
- top level of the concreted pile before the cut-off operation;
- used materials (driving or drilling tools, concreting equipment);
- cleaning results of the bottom of the hole before putting down the reinforcement cage and before concreting;
- nature and description of the encountered soils;
- poured concrete volume and theoretical volume (measured concrete curves);
- behavior, workability, fluidity of concrete, results of the compression tests;
- water level within the hole before concreting;

- for driven piles, the refusals corresponding to the three last sets of blows (10 hammer blows) shall be noted for each pile; for one pile from each 20 piles, a driving diagram shall be drown up;
- type of boring-chisel, lengths of piles where chisel has been used.

Records shall be submitted in duplicate to the Engineer every following working day until 9 a.m.

The Contractor shall submit to the approval of the Employer/Engineer a proposal of piling record sheets including all the details mentioned above.

Pile tests

The Contractor shall carry out pile tests on a minimum of 0.5% of total no. of working piles of each type. The piles to be tested shall be to the approval of the Employer.

The tests shall include as minimum:

- compression load test at piles
- lateral load test at pedestal piles.

In addition, at least one Test Pile for each of the main structures shall be tested and approved before the commencement of the working piles for that structure.

The maximum test load shall be 2.5 times the working load for Test Piles and 1.5 times the working load for tests on working piles.

The loading materials and equipment, the measurement devices and procedures shall all be to the approval of the Employer. All tests shall be carried out only under the supervision of an experienced and qualified supervisor familiar with the test equipment and test procedure. All personnel operating the test equipment will have been trained in that field. The number of increments of load shall be a maximum of 25% of the design load,, with a decreasing of load down to zero after each increment.

In the case of a test failing to meet the set criteria, the Contractor shall propose for the approval of the Employer his plan for the necessary changes in the pile design without any cost implication to the Employer.

2.4.3 Concrete works

2.4.3.1 General

The concrete works shall be based on applicable approved codes and standards.

In general, the concrete for foundations shall be Grade 30. The type of cement to be used shall satisfy the requirements of the relevant international and local Standards or equivalent.

All materials used for concrete and reinforced concrete structures shall be of the best quality and free of defects likely to undermine the strength and shorten the service life of the works. The materials furnished shall comply with the agreed standards with the requirements of the soil investigation report regarding the aggressively of soil and water and with all requirements set out in these Specifications. The high sulfate content according water analysis shall be considered for concrete in contact with sea water.

All materials shall be stored and handled in a manner that will prevent contamination and/or deterioration. Deteriorated and/or contaminated material shall not be used for the concrete and shall be removed from the site at the expense of the Contractor.

All aggregate and sand used in the production of concrete shall be thoroughly tested for silica alkaline reaction, flakiness, aggregate crushing value etc.

The design and execution of the works shall consider a minimum development, the corrosion risks and the durability of the concrete and be based on the latest applicable approved codes and standards as listed in **Section B0**.

2.4.3.2 Materials for concrete

Cement

The cement used for concrete, reinforced concrete, mortar, grout and plaster (acid or see water resistant) works shall be Ordinary Portland Cement unless noted otherwise. The cement shall comply with EN 197-1. The manufacturer's test certificate will normally be accepted as proof of compliance with Specifications but the Employer may order further tests as specified in the relevant standards. The Contractor shall bear all expenses required for the preparation, dispatch, and tests of the samples.

The cement for underground concrete shall be Sulphate resisting type

(cement type V) as per ASTM C150 or equivalent.

All accepted cement shall be delivered to the site in strong, sealed, waterproof containers unless written approval to the contrary is given. All cement delivered shall be marked in accordance with standards, stating the following particulars: type of cement, strength category, manufacturer, weight, quality control marking, date and transport data.

The cement shall be protected against all impurities and dampness during transportation and storage on the site. Sufficient cement shall be stored on site to ensure continuity of the works and to allow testing of any consignment before it is required for use. All cement shall be fresh when delivered. Cements of different types shall not be mixed one with another. Consignments shall be used in order of delivery.

Cement shall be stored in bags or in unopened containers on a dry, raised platform in a well ventilated but watertight building.

Cement shall be kept in the store until actually required for use on the works and any cement temporarily placed near the mixer shall be adequately protected. Cement stored on site for a period longer than two months shall be laboratory tested before use.

Water

The water shall be clean and free of salt, oil or acid, organic material or other matter harmful to the finished product and shall be from a source approved by the Employer. The Contractor shall undertake tests to determine the sulfate content and acidity of the water and make adequate arrangements to deliver and store sufficient water at the work site for use in mixing and curing the concrete. Water shall comply with the requirements of BS EN 1008 or equivalent.

Aggregates

Materials used as aggregate shall be obtained from a source known to produce aggregate satisfactory for concrete and shall be chemically inert, strong, hard, durable, of limited porosity and free from adhering coats, clay lumps or organic impurities that may impair the strength or durability of the concrete. Aggregate shall comply with and be tested in accordance with the requirements of BS 812, BS 882, BS 1199 and BS 1200 or equivalent.

Each size of aggregate shall be separately stored in a manner that will prevent contamination, intermixing and/or segregation. The equipment and methods of handling aggregates shall be such as to prevent deterioration and contamination of the stockpiles.

Frequency of testing the aggregates shall be at least as follows:

Frequency of testing		
Test Type	**Coarse Aggregate**	**Fine Aggregate**
Grading of each	Daily	Daily
Grading of combined aggregates	Daily	Daily
Specific gravity	7 days	7 days
Magnesium sulphate soundness	30 days	-
Clay silt and dust content	Daily	Daily
Shape (elongation and flakiness)	Twice a week	-
Los Angeles abrasion	Initially only	Initially only
Moisture content	2 days	Daily
Drying shrinkage	Initially only	Initially only
Organic impurities	30 days	30 days

Fine aggregate shall be clean natural sand or sand derived by crushing stone and shall consist of hard, dense, durable uncoated particles. Sand derived from stone unsuitable for coarse aggregate shall not be used as fine aggregate.

The grading of the aggregates shall be such as to produce a concrete of the specified proportions, which will work readily into position without segregation and without the use of excessive water content. Grading shall be controlled throughout the work so that it conforms closely to that used for the preliminary tests.

Washing, screening, classifying and other operations on the fine aggregate required to meet this specification shall be done by the Contractor. Washing is required if the content of salt and other impurities adhering to the aggregates exceed the level given in the standards.

Coarse aggregate shall be crushed or uncrushed gravel or crushed stone and shall be free of decomposed stone, clay, earth or other deleterious substances. The specific gravity of the coarse aggregate shall be not less than 2.5 t/m^3. Aggregate of crushed natural stone is deemed adequate if the stone reveals a crushing strength of 1000 kg/cm^2 when tested. Friable, flaky and laminated pieces, mica and shale shall only be present in such quantities as not to affect the strength and durability of the concrete.

The grading of coarse aggregate for concrete shall comply with the requirements of BS 882 or equivalent. Samples of aggregates shall be submitted to the Employer, together with a sieve analysis showing the proportion by weight passing sieves. Should it become necessary to change the source or characteristics of the material supplied, this shall only be done after additional tests.

Concrete additives

If necessary, concrete additives approved by the Employer could be used to improve consistency, workability, quality and strength of the concrete.

Waterproof concrete and mortar shall be used where necessary. Waterproofing shall be achieved by an approved brand of additive, which shall be used in accordance with the manufacturer's instructions.

Plasticizer/ superplasticizer cum water proofing additives of approved make shall conform to BS 934 or equivalent international standard

Accelerating and retarding additives shall only be used in case of necessity and after obtaining the written approval of the Employer.

In addition to the Concrete Additives mentioned in this clause bidder may use fly ash to improve quality of concrete.

Plasticizers and air entraining additives

Plasticizers and air entrainers are intended to reduce bleeding of free water at the surface. It shall only be used after the written approval of the Employer and in accordance with the manufacturer's instructions.

2.4.3.3 Concrete mixes

The mix proportions shall be determined by proper mix design based on the requirements for strength, workability and the particular site in which the concrete shall be placed. The design of mixes shall be based on the principles of BS 5328 or equivalent (e.g. DIN 1045), BS 8500 in addition to BS EN 206 and the British Building Research Station Publication: “Design of Normal Concrete Mixes”.

Before concreting commences, the Contractor shall make trial mixes to determine the mix proportions required to produce the strengths specified for each class of concrete and for each degree of workability required to allow placing transporting and compacting of the concrete. Only materials which the Contractor intends to use for concreting shall be used in the trial mixes.

Test cubes from trial mixes shall be made and tested in accordance with BS 1881 or equivalent (e.g. DIN 1048 Part 2).

The amount of water used in the concrete shall be adjusted as required to ensure such a consistency that it can be readily transported, placed and compacted without segregation of the materials or bleeding of free water at the surface. Addition of water to compensate for stiffening of the concrete before placing shall not be permitted. Consistency of the concrete shall be

checked by slump tests and shall not exceed the values given by BS 5328, BS 8500 in addition to BS EN 206 and BS 1881 or equivalent. Admixture for concrete to achieve requires slump shall conform to BS EN 934.

The cement and aggregate shall be thoroughly mixed in a batch-type pug mill mixer. The capacity of the mixer shall not be less than 1 (one) cubic meter. Partly set or excessively wet concrete shall not be used. No concrete shall be mixed by hand except some small quantities approved by the Employer, the proportion of cement in this case being increased by 10%.

The Contractor shall establish and maintain a field laboratory on the site and this laboratory shall be available at all times to the Employer. The laboratory shall be adequately equipped to ensure that all necessary testing work can be carried out in compliance with the standards.

2.4.3.4 Strength of concrete

All test cubes shall be made and tested for compressive strength in accordance with BS 1881 or equivalent.

The minimum required strength for different classes of concrete is as follows:

Grade	Characteristic strength N/mm^2	Lowest grade for compliance with appropriate use
7	7.0	lean concrete
10	10.0	plain mass concrete
15	15.0	reinforced concrete with lightweight aggregate
25	25.0	reinforced concrete with dense aggregate
30	30.0	reinforced concrete with dense aggregate (in contact with seawater, waste water and below ground level)
35	35.0	reinforced concrete with dense aggregate (Turbine Foundation, Boiler feed Pump Foundation)
30	30.0	pre-stressed concrete with post-tensioned tendons
40	40.0	pre-stressed concrete with pre-tensioned tendons
50	50.0	precast concrete members

The characteristic strength shall be determined from test cubes of 150 mm nominal size at an age of 28 days.

Mass concrete filling	C 8/10
PCC below pilecap/foundations including TG foundations, Fan foundation and all vibratory foundations	C 10/15
Pipe encasement	C 16/20

PCC below Paving incl. plinth protection	C 10/15
RCC in grade slabs	C 20/25
Boiler/ESP area paving	C 20/25
RCC for superstructure works in structural steel Buildings	C 30/37
RCC in foundation and water retaining structures including piles	C 30/37
RCC in superstructure works in RCC buildings	C 30/37
RCC for dynamic foundation including column/deck (TG, Mill, Fan and BFP)	C 30/37
Precast RCC trench covers	C 40/50
Encasement of Base plate/Steel columns/ Wall beams	C 20/25
Drain / cable trench	C 25/30

2.4.3.5 Transport of concrete

Immediately after mixing, the concrete shall be conveyed to the place of use as rapidly as possible using methods, which will prevent the segregation, loss or contamination of materials. The concrete shall be placed and compacted within 30 minutes of the addition of water to the mix. Any concrete left unplaced after this time shall be rejected and removed from the site.

The concrete shall be transported in clean metal buckets, barrows, dumpers, or trucks. Before using concrete pumps, placer pipelines, chutes or spouts it is necessary to have the written approval of the Employer.

2.4.3.6 Concreting operations

All concreting methods shall be subject to the approval of the Employer.

Concrete placing shall not be started until the Employer has approved all preparation of forms, reinforcement, joints and all mixing, conveying, spreading, curing, finishing and protection equipment.

Concrete shall be placed in the forms as close as possible to its final position in a single operation to the full thickness of slabs and beams and shall be placed in horizontal layers, not exceeding 2.5 m height in a single pour in walls, columns and similar members.

The Contractor shall organize the pouring of concrete in such a manner that once concreting of a section has started the operation shall be continuous and each operation shall be completed prior to a stoppage.

Where specified on the drawings, construction, expansion or contraction

joints shall be provided and the concrete shall be poured continuously between two adjacent joints. No other joints than shown on the drawings shall be permitted. Stoppage (cold) joints formed between two concreting operations separated by more than six hours time shall be subject to the same treatment as the construction joints.

Concrete which has partially hardened shall not be exposed to injurious vibration or shock, except for controlled re-vibration where specified. When concreting of a certain large structural element is specified strictly as to be poured continuously, then the concreting operations shall be organized for day and night working, in long shifts, as necessary.

Ultrasonic pulse velocity test shall be carried as per BS EN 12504 for the top decks of all machine foundation viz. TG substructures, BFP foundation, ID, FD and PA FAN and mill foundations to ascertain homogeneity and integrity of the concrete.
As concrete is being placed it shall be compacted by mechanical vibrators, to obtain a dense material free from honeycombing and without water or air holes.

The Contractor shall ensure that the vibrators are used in such reinforcement is not displaced, the formwork not damaged and no segregation caused, but complete compaction of the concrete is achieved.

The concrete face shall have the finishes indicated on the drawings or in the present Specifications. The finished surface of the concrete shall be sound, solid and free from honeycombing, protuberances, air holes or exposed aggregate. No plastering, cement wash, mortar or paint shall be applied to cover defective concrete surfaces.

Construction, expansion and contraction joints

The number of construction joints shall be kept as low as possible consistent with reasonable precautions against shrinkage. Concreting shall be carried out continuously up to construction joints.

Where it is necessary to introduce construction joints, careful consideration shall be given to their exact location, which shall be indicated on the drawings. Alternatively, the location of joints shall be subject to agreement between the Employer and the Contractor before any work commences.

Immediately prior to recommencement of concreting on a joint, the surface of the concrete against which new concrete will be cast shall be free from laitance and be roughened to the extent that the largest aggregate is exposed but not disturbed. Care shall be taken that the joint surface is clean immediately before the fresh concrete is placed against it.

Expansion joints, contraction joints and otherwise permanent structure joints shall be provided at positions shown in the drawings. Joints shall be straight and vertical, except where otherwise specified and concrete surfaces on both sides of the joint shall be flush. Where necessary, water stops of a type approved by the Employer shall be embedded in the concrete. To ensure a good tightness with or without movement of the joints, the PVC water stop shall be provided with anchor parts. The PVC water stops at construction joint shall be 150 mm wide and 6 mm thick and at expansion joint shall be 230 mm wide and 8 mm thick.

In case of expansion joints, preformed bitumen impregnated fibre board shall be used as joint filler. The joints shall be sealed with bitumen sealing compound, however in case of liquid retaining/carrying structures, two parts polysulphide sealant or silicon sealing compound shall be used.

Concreting at night

When approval is given to carry out concreting operations at night or in places where daylight is excluded, the Contractor shall provide adequate lighting at all points of mixing, transportation and placing of concrete.

Concreting in high ambient temperature

For concreting in high ambient temperatures the “ACI Standard 305 – Concreting in Hot Weather” shall apply.

The Contractor shall take special measures in the mixing, placing and curing of concrete; alternatively all pouring and finishing works shall be done at night. These measures shall include the shading of aggregates, spraying of aggregates with water, cooling of the mix constituents (introduction of ice to the mixing water) and reduction of transportation time to the minimum.

During pouring suitable measures shall be provided to prevent setting of concrete placed in contact with hot surfaces. All concreting areas, formwork and reinforcement shall be shielded from the direct sun rays and sprayed with water when necessary.

The temperature of fresh concrete used for top decks of TG foundation shall not exceed 25 degree Centigrade when placed. For maintaining the temperature of 25 degree centigrade in the top decks of TG foundation, crushed ice shall be used in mixing water and cooling of aggregate.

Concrete subject to chemical attack

Concrete with increased resistance to chemical attack shall meet the provisions of DIN 1045 or equivalent. Liquids, soils and vapours aggressive to concrete should be judged in accordance with DIN 4030 and be classified according to 'mild', 'severe' and 'very severe' attacks.

The resistance of concrete to chemical attack depends on its imperviousness. The concrete must be at least sufficiently dense to ensure that the maximum depth of water penetration tested according to DIN 1048, does not exceed 6 mm in the case of mild attack nor 3 mm when exposed to severe attack.

Concrete, which is likely to be exposed to severe chemical attack for a prolonged period shall be suitably protected by an adequate coating system, and this shall be subject to the Employer˝s approval.

All vertical concrete surfaces in contact with soil shall receive two coats of bituminous coating @ 1.7kg/sqm with 1% antistripping compound. Soffit and side of foundations shall be protected by means of suitable membrane installation. For basements of buildings and water tight basins protection of concrete surfaces below ground level shall consist of an approved self-adhesive pressure sensitive membrane. The membrane shall adhere to all concrete surfaces, including undersides of structures and other surfaces where concrete is cast in contact with the membrane. The membranes shall be installed strictly to the manufacturer˝s instructions. The membranes shall extend 150 mm above ground level.

All exposed concrete surfaces above ground (foundations, superstructures, etc.) shall be protected by epoxy coating with a compatible primer penetrating into the concrete. The epoxy coating must be able to bridge the maximum allowable crack width. The minimum thickness of this coating shall be 300 microns.

Alternatively, where appropriate the concrete surfaces shall be protected with approved tiles. In case any structural parts of concrete are likely to be exposed to chemical attack, crack width for such structural parts shall be designed not to exceed the dimension prescribed by the coating manufacturer.

Concreting under water

Underwater placing of concrete may be allowed for un-reinforced components, or as approved by the Employer. The placing being performed exclusively with stationary tremies and shall be in accordance with the requirements of relevant standards.

The min. cement content shall be increased by 50 kg/m^3 for underwater concrete.

Underwater concrete is to be placed continuously without interruption.

The concrete is to be placed in such a way that is does not fall freely through the water. The tremies must at all times dip sufficiently far into the freshly placed concrete to ensure that the concrete emerging from the tremie does not come into contact with the water. All work connected with the placing of concrete under water shall be designed, directed and inspected with due regard to local circumstances and purposes. Work shall not proceed until all phases and methods to be used in the placing operations have been approved

by the Employer.

Protective measures for concrete

In general the cover of rebars shall be as per BS EN 1992-1-1 or equivalent taking into account the site conditions (high temperature, humidity).

Immediately after the compaction of the concrete has been finished, the Contractor shall ensure adequate protection from the weather. Excessive drying can lead to crack formation as a result of plastic contraction. The concrete surface shall be covered with a layer of sacking, canvas, straw mats or similar absorbent material, special protection sprays or a layer of sand kept constantly moist for at least 14 days.

Curing compounds or other methods of preventing evaporation may be used if approved by the Employer.

Where large sections of concrete are poured, special precautions subject to the approval of the Employer shall be taken to reduce and dissipate the heat generated by setting and hardening of the concrete.

Repair of damaged or defective concrete

Concrete which has completed its final setting shall be inspected by the Employer and any cracks, honeycomb areas, segregations, etc. shall be marked. No repairs shall be carried out until so directed by the Employer.

Dimensional tolerances

The permissible tolerances shall comply with the BS 5606 and BS EN 1992-1-1 or equivalent.

2.4.3.7 Finishing of concrete surfaces

The concrete face shall have the finish indicated on the drawings or in the specifications.

All surfaces, which may come into contact with oil or oily water, will have to be adequately protected (paint, etc.). The finished surface of all concrete work shall be sound and free of defects. No plastering, cement wash or mortar shall be applied to cover defective concrete faces.

The fairfaced concrete in superstructure which is placed against shuttering shall be rubbed down with a carborundum stone immediately upon removal of the shuttering to remove fins or other irregularities. The face of the concrete for which shuttering is not provided, other than slabs, shall be smoothed with a wooden flat to give a finish equal to that of the rubbed down face where shuttering is provided. The cavities left by formwork fixing devices shall be made good closing the hole with plastic plugs and epoxy mortar. In watertight concrete structures the formwork fixing devices shall be of such a design as not to leave any holes after removing the shuttering.

All exterior corners of reinforced concrete shall be chamfered at least 25 mm x 25 mm, at stair treads 10 mm x 10 mm.
The top or final surface of all concrete works shall be finished by screeding, or floating, or trowelling or grinding, or tooling as approved by the Employer.

Dry cement or cement and sand shall not be used to dry excess water on the concrete surface.

Floors and slabs, which are required to be finished smooth, shall be trowelled just before the setting of the concrete.

Screeding:	This shall be executed by moving a straight edge or template by hand or by mechanical means immediately after compaction of the concrete.
Floating:	This shall follow screeding, but shall not be started until some stiffening of the concrete has taken place.
Trowelling:	Where specified as necessary, floating shall be followed by finishing until a smooth surface free from defects is obtained.
Grinding and tooling:	Where specified, the methods to produce the desired surface shall be approved by the Employer. Grinding and/or tooling shall not start until the concrete has hardened sufficiently to prevent dislodgment of the aggregate.
Chiseling:	Wherever possible all chiseling works shall be carried out with mechanical devices. Manual chiseling may be required at difficult points.

Exposed concrete surface treatment
Exposed concrete surface of a structure shall be coated with an approved clear silicone water repellent suitable for application on the concrete.

2.4.3.8 Formwork

Design and construction
For the proof of stability and for the type of formwork and support framing used, BS 3809, BS EN 13168:2012+A1:2015 or equivalent shall be used.

The formwork and the supporting structure shall be so dimensioned as to be able to withstand all vertical and horizontal forces safely shall be sufficiently rigid to maintain the forms in their correct position and to be true to shape and dimensions so that the final concrete is within the limits of the dimensional tolerances specified in Clause "Dimensional tolerances" herein.

The Contractor shall submit for the approval of the Employer the calculations, designs and details of the methods adopted and materials proposed for the formwork.

Removable type formwork shall be used for all cast-in-situ concreting works. In case lost formwork shall be used, approval from Client is required.

Forms shall be constructed from steel or from sound timber well seasoned and free from shakes. Plywood lining for forms shall be of timber, which is resin bonded and water repellent. Formwork surfaces in contact with

concrete shall be free from adhering grout, projecting nails, splits or other defects.

Joints shall be sufficiently tight to prevent the leakage of cement grout.

Before concrete is placed, all formwork shall be inspected to see if it is built according to the approved plans and to see if it has been cleaned and is free of sawdust, shavings, dust, mud, earth or other contamination and properly oiled. Contact surfaces of panels shall be treated with a suitable release agent (e.g. non staining mineral oil) where applicable. Surfaces, which are not oiled, shall be wetted thoroughly to prevent warping.

If the formwork for columns is erected to the full height of the columns, one side shall be provided with openings for concreting in order to guarantee a proper compaction of the poured concrete.

Formwork for walls and elsewhere shall be arranged for a as large as possible concreting height of one floor level in a single pour. Where necessary, panel openings shall be provided in the forms for cleaning, inspection, access of vibrators, etc.

Before placing of concrete, bolts, ties and fixings shall be positioned and all devices used for forming openings, holes, pockets, chases, recesses, etc. shall be fixed to the formwork carefully.

Where concrete surfaces will be exposed to view (permanently exposed surfaces) the formwork shall be such as to produce a completely true, smooth surface, free from perceptible irregularities or to show clearly the desired texture. Such formwork shall be marked on drawings as "Fair-faced Formwork".

Internal spacers and ties, if any, shall be so arranged that after removing of the forms no holes shall extend through the concrete, in the case of watertight concrete or be closed by plastic plugs and epoxy mortar in all other cases. All formwork will be inspected and approved by the Employer before concrete placing commences but this shall not relieve the Contractor of any of his responsibilities under the contract.

Formwork shall not be removed until the concrete has sufficient strength to carry its own weight plus any constructional or design loads which it is likely to be subjected to it with a normal factor of safety. It shall be removed in such a manner that no shock or damage shall result to the concrete.

Before removal of the formwork the concrete shall be examined and removal shall proceed only on the instructions and under the supervision of a competent person.

The minimum period for striking the formwork (cast-in-situ concrete made with Ordinary Portland Cement) under specified conditions may be taken as follows:

- soffit formwork to slabs 4 days (*)
- soffit formwork to beams 10 days (*)
- vertical formwork to columns, walls and large beams 1 day
- props to slabs 10 days
- props to beams 14 days
- (*) props left under

Extreme care shall be taken to avoid chipping of corners during removal of formwork.

2.4.3.9 Reinforcing steel

Reinforcing steel used in reinforced concrete shall be of grade B500B conforming to BS 4449 latest.

All reinforcement shall be hammered free of scale, scraped and wire brushed free of all loose rust and after such treatment shall be within the margins allowed by the Standards. The reinforcing steel shall be free of oil, grease or preservative coatings.

The Contractor shall supply the Employer with the manufacturer's certificate stating the process of manufacture and a test sheet giving the results of each of the materials purchased and, when required, the chemical analysis and all tests as specified in the relevant standards.

In particular it shall be possible to derive the following data from the stress-deformation curves:

- ultimate tensile strength

- guaranteed yield stress
- permissible stress
- elongation.

Reinforcing bars shall be transported and stored so that they remain clean, straight, undamaged and free of corrosion, rust or scale.

Reinforcement shall be cut and/or bent in accordance with BS 8666 or equivalent standards.
Reinforcement shall be accurately fixed and secured against displacement in the position shown in the drawings by means of spacers, chairs or other supports in order to maintain the reinforcement in its correct position, within a tolerance of 3 mm. For the distance between the bars (horizontal and vertical distances), the requirements according applicable standards shall be observed. Jointing of reinforcement bars by welding on site shall be avoided if possible, but where necessary the requirements of BS EN 1992-1-1 or equivalent standards have to be observed.

Where reinforcement is to remain exposed to the weather for a prolonged period, a thick cement grout shall be applied to the bars.

Grounding of reinforcement
Reinforcement shall be grounded according to the requirements laid down in other parts of these specifications.

2.4.3.10 Durability of concrete

All measures necessary in the design and selection of materials including the following shall be taken to ensure the required durability of concrete for the various concrete elements:

- Maximum crack width in the design of all reinforced concrete for structures in contact with water or chemicals and for major structures shall be kept below 0.20 mm. This value might have to be varied depending of the required coating system (e.g. stack).
- In general, reinforcement for cast-in-place concrete shall have a minimum cover of 40 mm. However, cover for thin panels like concrete slabs, concrete walls etc shall be 25 mm. For concrete in contact with the ground or sea water, the minimum cover shall be 75 mm.
- specify clearly location of expansion and construction joints and their surface preparation
- specify foundation surface coating and of concrete surfaces above ground
- specify type of cement appropriate for the ground water, the soil conditions and ambient temperatures
- use smaller size reinforcing bars well distributed in the tensile zone
- limit the tensile stress in reinforcement

- ensure adequate slope for concrete surfaces likely to receive rainwater or chemicals
- provide chamfers at all concrete edges
- provide strict measures for concrete curing to prevent plastic shrinkage and thermal gradients resulting from early age heat of hydration of the fresh concrete.

2.4.3.11 Roof -Waterproofing

Roof water proofing treatment shall be as follows:

a) For roofs having structural slope:
Over the top surface of sloped R.C.C. slab extruded polystyrene insulation of 75 mm thickness shall be provided. Top surface of polystyrene block shall be finished with 15mm thick cement plaster (1:4). Over the finished surface PU based water proofing treatment shall be applied. This treatment shall include one coat of polyurethane or any other equivalent material based primer with an application rate of minimum 6 sq.m per litre and two successive liquid coatings of high solids content urethane pre-polymers or equivalent material based finish coats as per relevant ASTM standards to form an elastomeric membrane with overall dry film thickness of 1.5 mm. Top of the elastomeric membrane shall be finished with 25mm thick PCC (1:2:4) cast in panels of maximum 1.2 x 1.2m size and reinforced with 0.56mm dia galvanised chicken wire mesh and sealing of joints using sealing compound. However, chequered concrete tile flooring 22 mm (min.) thick of approved colour and shade shall be provided for path way of 1 meter width for access of personnel and handling of equipment and for the entire area of the roof where equipment like AC /Ventilation plant, cooling towers, etc. are provided in place of PCC wearing course. Equipment shall be installed on raised pedestal of minimum 30 cm height from the finished roof to facilitate maintenance of roof treatment in future.

b) For roofs having no structural slope:
Screed concrete 1:2:4 (1 part cement, 2 part sand, 4 parts of aggregate by volume) having minimum 25mm thickness at the lowest point of the slope shall be laid over R.C.C. Over the top surface of screed extruded polystyrene insulation of 75 mm thickness shall be provided. Top surface of polystyrene block shall be finished with 15mm thick cement plaster (1:4). Over the finished surface PU based water proofing treatment shall be applied. This treatment shall include one coat of polyurethane or any other equivalent material based primer with an application rate of minimum 6 sq.m per litre and two successive liquid coatings of high solids content urethane pre-polymers or equivalent material based finish coats as per relevant ASTM standards to form an elastomeric membrane with overall dry film thickness of 1.5 mm. Top of the elastomeric membrane shall be finished with 25mm thick PCC (1:2:4) cast in panels of maximum 1.2 x 1.2m

size and reinforced with 0.56mm dia galvanised chicken wire mesh and sealing of joints using sealing compound. However, chequered concrete tile flooring 22 mm (min.) thick of approved colour and shade shall be provided for path way of 1 meter width for access of personnel and handling of equipment and for the entire area of the roof where equipment like AC /Ventilation plant, cooling towers, etc. are provided in place of PCC wearing course. Equipment shall be installed on raised pedestal of minimum 30 cm height from the finished roof to facilitate maintenance of roof treatment in future.

2.4.4 Structural steel works

2.4.4.1 Materials

All ferrous materials, their dimensions, forms, weights, tolerances, chemical and mechanical properties, shall be the best of their kind, complying with relevant international Standards.

All structural steel material shall be grade S275-JR+AR for Rolled sections & plates upto 20mm thickness, S275-J0+N for plates above 20mm and S275-J2+N for plates used in Gantry girder as per BS EN10025-2.

In the case of structural steel work, care shall be taken that all parts in the assembly fit accurately together and corresponding parts shall preferably be interchangeable.

The Contractor shall submit to the Employer for approval the country of origin and manufacturer of the steel he proposes to supply.

The structural steelwork and testing shall comply with the relevant clauses of BS 4, BS EN 10162, BS 4360 and BS 6323, BS EN 10025-1:2004, BS EN 10130:2006 or equivalent standards.

Each steel part shall be marked with the manufacturer's name or trademark.

The steelwork shall be manufactured by a specialist firm approved beforehand by the Employer. As much of the work of manufacturing of the steelwork as is reasonably and technically practicable shall be executed in the manufacturer's works, and facilities for inspection by the Employer shall be provided.

All steelwork before and after manufacturing shall be smooth, undeformed, straight and free of cracks, twist and burrs. All steelwork shall be cut and fabricated to a tolerance of ± 1.5 mm in its length. All plates shall be truly at

right angles to the longitudinal axis of the section. No work shall be painted, packed or dispatched from the manufacturer's works until it has been inspected and complies with or has been certified to comply with all the tests and requirements of the standard applicable to the material specified and until it has been inspected and approved.

Tests

The manufacturer's test certificate for all steelwork shall be supplied to the Employer. The certificates shall state the manufacturing process and shall include a test sheet giving the results of the mechanical tests and the chemical composition. The Contractor shall provide free of charge any supplementary tests reasonably required by the Employer. Steel which do not conform to the specified standards shall be rejected at the expense of the Contractor. No steelwork shall be delivered from the manufacturer's works until it has been tested and the results comply with the requirements of the relevant standards.

2.4.4.2 Workmanship

Tolerances

Care shall be taken to ensure that the tolerances specified on the drawings or the relevant standards are worked to. The erection tolerance for cleated ends of members connecting steel shall be not greater than 2 mm at each end. No work shall be painted, packed or dispatched from the manufacturer's works until it has been tested and complies with all requirements of the standards.

Cutting

Cutting may be by shearing, cropping, sawing or machine flame cutting. Hand flame cutting shall be avoided. If rolled products for steel structures under predominantly static loading are cut by flame-cutting or shearing there will generally be no need for a finishing operation if the cut surface is free of defects.

Bolting

The threaded portion of each bolt shall project through the nut by at least one thread. Approved high strength friction grip bolts, preferably the type with indicated load, shall be used where specified and shall be tightened strictly in accordance with the manufacturer's instructions and the relevant regulations. The surfaces in contact shall not be painted and shall be free of oil , dirt, loose rust, burrs and other defects, which would prevent proper seating of the parts or interfere with the development of friction between them. When connections are made using high strength friction grip bolts the relevant standards shall be observed.

Welding

The execution and testing of welding shall be in accordance with BS EN 1011-1, BS EN 1011-2 or equivalent standards.

All welds, unless otherwise stated shall be continuous minimum 6 mm fillet weld and shall be dressed smooth, free of porosity, cracks, holes and finished to match adjacent surfaces. When welding operations are completed, all welding flux shall be removed without delay. Cooling of welds shall not be accelerated by any special measures.
Site welding shall be restricted to the absolute minimum. Site welding is subject to approval by Employer. The examination of welded work and the inspection of welds during and after manufacture shall be carried out by responsible specialist welding engineers. Welding shall be carried out by expert trades men and in strict accordance with the current code of practice.

Painting

Surface treatment and painting before and after delivery to site shall be in accordance with Section B0.

Parts to be encased in concrete shall not be painted or oiled. Surfaces inaccessible after shop assembly shall receive the full-specified protective treatment before assembly.

Erection

The Contractor shall supply all suitable plant, hoisting gears and tackles for the erection of the steelwork and shall provide all temporary baulks, struts, shores, etc.

Steelwork damaged due to inadequate precautions being taken during the storage, transport and erection of the steelwork shall be made good to the satisfaction of the Employer at the Contractor's expense.

All shop connections shall be made by electric welding. All site connections shall be bolted unless otherwise specified in drawings or directed by the Employer.

Encased steelwork and steel in foundations shall be solidly encased in concrete with a minimum cover of 100 mm. Anchors of the required structural strength shall be used as holding down anchors in concrete foundations for columns. Sole plate of the column shall be grouted with low shrinkage grout of 50 mm nominal thickness.

Top of pedestal for building structures will be kept at lower level so that column base plate together with gussets and stiffeners remain below FFL.

The column bases as well as column section shall be encased in concrete above FFL as per following:

a) Open area :300mm above paved level
b) Covered area : 150mm above FFL
c) Stair and ladder pedestal will be kept 200mm above FFL.
d) Pedestals to steel column for equipment structures:
   i) Equipment in open area : as required (minimum 300mm)
   ii) Equipment in covered area: as required (minimum 150mm)

The grout shall be shaped with an inclination of 45°from the lower edge of the sole plate to avoid stagnant water.

Rejection

Any steelwork, which in the opinion of the Employer is not in accordance with the requirements of the standards or with the specifications, shall be mandatory rejected and removed from the site at the Contractor's expense.

2.4.4.3 Small non-structural steel parts

General

This Clause refers to the specifications covering the provision of all materials and labor in relation to supply and manufacture on site of articles made of steel or cast iron.

All steel structures and parts specified under this clause shall be hot dip galvanized and painted according to **Section B0.**

The list of small items to be furnished shall contain but not be limited to the following:

- steel sections, bent plate sections and square bars for construction of:
  - metallic stairs, platforms and walkways
  - railing for stairs, platforms, walkways and protective around floor openings
  - corner and edge protection for concrete steps and concrete
  - structural parts such as columns, beams, removable cover slabs, etc.
  - support of any equipment foundation
  - joint covers
  - anchors, ties, hangers, inserts, slots, embedded steel parts, etc.
- steel pipes and plain round bars for making guardrails and ladders
- steel plates, chequered and/or flat, for fabrication of removable covers
- open steel grating for metal steps, platforms, and walkways.

Materials

The requirements for materials of structural steel specified herein are applicable to all steel sections, bars, plates, pipes and any sections as far as their quality, source, dimensions, mechanical characteristics and their delivery, handling, storage and tests on site are concerned.

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2.4.4.4 Roof and wall cladding

Metal cladding

The insulated sandwich roof and wall construction shall consist of a double skin construction, rear ventilated and comprising the following:

Internal liner profile: trapezoidal profile min. 0.75 mm thick.

The internal sheet shall be a multilayer, protected metal system consisting of a trapezoidal galvanized steel substrate, heavy epoxy base coat and an internal decorative coat as follows:

Substrate

Hot-dipped galvanized steel substrate, with a minimum zinc coating weight of 275 g/m^2 total both sides. The steel substrate shall be min. 0.75 mm thick.

Pre-treatment

After cleaning, a ”chemical conversion” of the zinc coating to a non-metallic surface with corrosion inhibiting and adhesion additives shall be applied.

Primer

Nominal 8-micron thick anti-corrosive pigmented epoxy primer applied to both sides of the sheet.

Epoxy barrier coat

Nominal 70-micron thick TF Epoxy Barrier coat with special flexibilizer compounds applied to both sides of the sheet and baked to a hard corrosion resistant finish.

Internal decorative coat of the interior profiled liner

Nominal 20 micron stoving polyester decorative finish on inner exposed face of the sheet.

External weathering profile: trapezoidal profile min. 0.75 mm thick

The sheeting unit shall be a multilayer, protected metal system consisting of a trapezoidal galvanized steel substrate, heavy epoxy base coat and a high build weather coat of polyurethane as follows:

Substrate

Hot-dipped galvanized steel substrate, with a minimum zinc coating weight of 275 g/m^2 total both sides. The steel substrate shall be min. 0.75 mm thick.

Pre-treatment

After cleaning, a ”chemical conversion” of the zinc coating to a non-metallic surface with corrosion inhibiting and adhesion additives shall be applied.

Primer

Nominal 8-micron thick anti-corrosive pigmented epoxy primer applied to both sides of the sheet.

Epoxy barrier coat

Nominal 70-micron thick TF Epoxy Barrier coat with special flexibilizer compounds applied to both sides of the sheet and baked to a hard corrosion resistant finish.

External weather coat

Nominal 40 micron thick urethane exterior coating on outer exposed face of the sheet pigmented in one of the standard colors of the manufacturer's color range.

Insulation core: 60 mm (minimum) thick non-combustible material like glass wool or similar of density not less than 16 kg/m^3.

Requirements for roofs

These requirements apply to all roofs (not only for roof cladding).

The roof construction is to be such that, with due allowance for the climatic conditions and any air conditioning plant installed in the rooms, and with the intended use of the rooms taken into account, no damp will penetrate into the materials used.

All roofs must have a minimum sound absorbing index of 20 dB (A) and a maximum heat transmission coefficient of 0.45 W/m^2K. Appropriate insulation materials will have to be used to achieve the a.m. figures.

Bidder/Contractor shall provide insulation as required to fulfill requirements due to heat insulation or noise restrictions.

Bidder/Contractor shall provide a concept showing the requirements of each building to ensure that the design fulfils requirements of specification, local requirements, related codes and standards and EIA requirements.

Roof surfaces are to be designed with a min. slope of 3% for concrete roofs and 5% for metal roofing.

All roofs shall be suitable constructed to serve for PV-Modules. The roofs shall be able to mount the supporting structure and provide sufficient arrangements for operation and maintenance.

Requirements for walls

These requirements apply to all walls (not only for wall cladding). External walls are to be constructed that, taking into account the climatic conditions and any air conditioning plant installed in the rooms as well as the manner of use of the rooms, no damp will penetrate the walls. All external walls must have a minimum sound-absorbing index of 20 dB (A) and a maximum heat

transmission coefficient of 0.75 W/m^2 K. Appropriate insulation materials will have to be used to achieve the above mentioned figures.

Bidder/Contractor shall provide insulation as required to fulfill requirements due to heat insulation or noise restrictions.

Bidder/Contractor shall provide a concept showing the requirements of each building to ensure that the design fulfils requirements of specification, local requirements, related codes and standards and EIA requirements.

The walls shall not allow the passage of rain or moisture into the building. The walls shall be provided with all necessary horizontal and vertical damp-proof courses and flashings.

2.5 Masonry works

Autoclave aerated concrete (AAC) block masonry conforming to Category I of BS EN 771-4:2011+A1:2015 shall be used for external/internal masonry works. All external walls shall have a minimum sound-absorbing index of 20 dB (A). All external walls shall have a maximum heat transmission coefficient of 0.75 W/(sqm K). Autoclave aerated concrete (AAC) block masonry shall have minimum compressive strength of 4MPa.

Masonry work with brickwork shall be conforming to relevant BS code.

Encasement of structural member shall be done by brick/AAC block masonry work around flanges, webs etc. and filling the gap between steel and masonry by minimum 12mm thick mortar. Encased members shall be wrapped with chicken wire mesh with a lap of 50mm.

2.6 Plastering

The mix for plastering shall be as follows:

1. Outside plaster : 18mm thick in two coats in cement mortar 1:6
2. Inside plaster : 12mm thick in cement mortar 1:6
3. Concrete ceiling plaster: 6mm thick in cement mortar 1:4

Parapet, Chajjas over window and door heads, architectural facias, projections etc shall be provided with drip course in cement sand mortar 1:3.

2.7 Finishing works

Floor and wall finishes

The finishing works to be applied for the buildings and structures of the plant are listed below. Buildings or rooms not included, or special items, must be agreed with the Employer.

Floor finishes (typical)

Room	Floor Finishes
Switchgear rooms	Epoxy screed (trowel applied minimum 5 mm thick) and epoxy seal coat
Neutralisation pit	115 mm thick Acid Resistant bricks over 6 mm thick under bed of potassium silicate mortar
Pump house floors, cable vaults	Cement concrete flooring with metallic hardener
Rest room, toilets, kitchen mess room	Glazed non-slip fully vitrified ceramic tiles (7 mm thick).
Offices	Vitrified ceramic tiles (10 mm thick)
Corridors, stairs, landings	Vitrified ceramic tiles (floor tiles with epoxy grout) (7 mm thick)
Battery rooms	Acid resistant tiles (20 mm thick)
Control room, relay rooms, electrical equipment	Heavy duty PVC(2mm thick) sheeting on false floor (if required) Vitrified ceramic tiles in main control rooms
A/C Plant rooms	Carborundum (25 mm thick heavy duty cement concrete tiles)
Instrument/electrical workrooms	Heavy duty PVC tiles (6.5 mm thick)
Stores workshop, mechanical work room and store room	Carborundum (25 mm thick heavy duty cement concrete tiles) with oil resistant epoxy coating (150 micron thick)
Transformer pits	Oil-proof hard-wearing epoxy coating (150 micron thick)

- Total Floor finish (including underbed of cement mortar and top finish) shall be 50mm thick.
- Granite stone shall be 18 mm thick of approved color.

Internal Finish

Area/Location	Internal Wall finish	Ceiling finish
Control rooms, LVAC rooms, computer rooms, restroom, administration areas, offices and similar rooms, corridors, instrument and electrical workrooms, mechanical workroom and storeroom.	Plaster, two coats of acrylic emulsion paint over polymer based putty	Acrylic distemper where no false ceiling is provided For control room of Power House, combination of glass fiber gypsum plaster board (GRG) (12 mm thick) and pre coated (color) Aluminum false ceiling
Switchgear rooms, HVAC mechanical plant rooms, stores, pump houses, compressor house, air washer, Air handling room, cable vault and workshop	Fair faced block/brick work, cement wash (2 kg cement mixed to 1 Liter of water), two coats of acrylic distemper	Acrylic distemper
Toilets, washrooms, locker rooms, kitchen, etc.	Glazed ceramic tiles upto a level of 2.3m. Plaster and two coats of acrylic emulsion paint over polymer based putty in the remaining height	Acrylic distemper
Lead acid Battery room, waste treatment plant, laboratory, rooms where any chemicals are stored, handled or prepared.	20 mm thick Acid resistant tiles over potassium silicate based cement mortar upto 1.2m height. Plaster and two coats of chlorinated rubber acid resistant paint over chlorinated rubber zinc phosphate primer in the remaining height	Two coats of chlorinated rubber acid resistant paint over chlorinated rubber zinc phosphate primer
Oil canal, oil room and other areas where oil spillage is likely to occur	Plaster and Epoxy based oil resistant paint (150 micron thickness) over epoxy primer upto 1.2 m height. Acrylic distemper on the remaining height	Acrylic distemper

External Finish
The external finish of buildings with Autoclave aerated concrete blocks masonry (where no metal cladding or Aluminum composite panels are required as per the individual building description given above) shall be two coats of acrylic based weather coat paint.

2.8 Sanitary installations

The Western WCs closet seats and covers are to be of plastic of a color to match the tiles. The WCs shall be provided with hand spray with angle valve and hand trigger, 100 cm long hose, toilet roll holders made of chromium-plated brass to be fitted within convenient reach.

The Asian Squatting WCs are to be white ceramic plates (500 x 400 mm approx.) with raised treads for flush installation at floor level. The WCs shall be provided with hand spray with angle valve and hand trigger, 100cm long hose, toilet roll holders made of chromium-plated brass to be fitted within convenient reach.

Washbasins, minimum size 58 x 45 cm, are to be provided with a mixing tap. Above each washbasin is to be provided one mirror, minimum size 70 x 50 cm and one soap dispenser for fluid soap.

Bowl urinals are to be fitted with flushing devices.

Each toilet is to be equipped with one push button operated hot air hand dryer provided with overheating protection.

All rooms where leakages of liquids may occur (pump rooms, wash rooms, toilets, shower rooms, battery rooms, etc.) are to be provided with adequate floor drains, even if this does not result from the relevant civil drawings and/or from the written part of the specification.

2.9 Doors

Metal doors
All internal and exterior and safety doors shall be made of 45 mm thick flush design with double steel sheet walls, insulated with mineral wool.

Minimum nominal dimensions of doors shall be as follows:

Single leaf doors:	width 1.01 m x height 2.135 m
double doors to rooms housing valves pumps and similar equipment:	width 2.2 m x height 2.135 m
double doors to rooms housing electrical equipment:	width 2.2 m x height 2.5m

Steel parts of the doors shall be protected in accordance with the relevant section of the specification for coating of steel surfaces. All doors shall be fitted with approved locks and self closing mechanism.

Fire rated doors shall be all in accordance with the applicable regulations and standards and shall have glazing panel of the same fire resistance as that of the door: G30 or G90 to match T30 or T90.

All doors and gates shall be installed such that rain water penetration is avoided.
All doors shall meet the requirements of the applicable standards/ Bangladesh National Building code

Wooden doors shall be solid core flush door shutter having 35mm thick homogenous particle board conforming to Bangladesh National Building Code

Aluminum doors and windows shall be anodized and electro color coated as per relevant BS code.

Aluminum composite panel shall be of 4 mm total panel thickness with PVDF based coating.

All toilet doors shall be 25 thick PVC doors.

Roller-shutter doors

Large openings to buildings shall be fitted with electrically operated rolling shutters as appropriate. An escape door shall be provided next to each rolling shutter. The shutters shall be of double walled hollow sections of galvanized steel protected with coating in accordance with the **Section B0**.

Hand crank with continuous chain reel shall be fitted to operate the door by hand in case of emergency.

2.10 Windows

All windows shall be aluminum with double glazing which meet the requirements of the applicable standards/ Bangladesh National Building code. Each window shall have side and bottom sash fitting and shall safely absorb an impact force of at least 7.5 kN. Scissor type stay shall be designed to prevent the sash from dropping in case of malfunctioning.
The windows shall be resistant to pelting rain. Approved sunshade system shall be provided for windows facing east, west and south.

Window sill shall be of aluminum matching in color with that of the window on the outside and with the color of the room on the inside. Fastening devices for safety harness shall be provided on the exterior of the building for windows which cannot be cleaned from inside the building or from the floor outside.

Glazing

1. Glazing of doors and partitions shall be done with 5.5 mm thick clear float glass. However, 12mm thick BWP particle board shall also be provided in some locations. However, the external doors shall have Hermetically sealed double glazing of of 6mm thick clear toughened glass on inner side and 6mm thick reflective toughened glass on outer side
2. Hermetically sealed double glazing of 4 mm thick float glass shall be used for windows located in ground floor and at accessible floors.
3. Windows and ventilators located at higher elevation where frequent replacement is not feasible, shall have hermetically sealed double glazing of 6mm thick clear toughened glass.
4. For glazing between Air Conditioned and Non air conditioned areas composite double glazing shall be 24mm thick consisting of 6mm thick clear toughened glass on inner side and 6mm thick reflective toughened glass on outer side. The two glasses shall be separated by 12mm air-gap and hermetically sealed by beading of anodized aluminum with outer edge sealed with silicon sealant.
5. 4mm thick single glazing of ground glass shall be provided for toilets.

2.11 Aviation warning lights

Aviation warning lights shall be provided for the stack and on all tall buildings and structures in accordance with the aviation safety requirements.

2.12 Earthing and lightning protection

All buildings and structures shall be provided with an adequate earthing and ightning protection system (see **Section B7**).

2.13 Roads and surfacing

General

The actual thickness of road-courses shall be calculated based on the results of the soil investigation, loads, intensity of traffic, design life, etc. the thickness of road-courses shall be in no case less than those of the existing roads in the zone of the plant.

The design of all pavements shall conform to the requirements of the American Association of State Highway and Transportation Officials (AASHTO), and Local Highway Requirements or local standards whichever is more stringent.

Foundation bed

The requirements for the particular road type and the recommendations of the soil investigation report have to be observed.

Wearing course

The requirements for the particular road type have to be observed as per the local standards and codes.

Compaction of sub-grade

The area for the roads shall be cleared of any material or obstructions, which in the opinion of the Employer might adversely affect the stability of the fill or pavement, and the top layer removed to a depth of 300 mm (or more if the design so required).

Any ruts or soft areas caused by improper drainage conditions, hauling or any other cause shall be corrected and rolled to the required compaction before sub-base is placed thereon.

The formation shall be compacted to a dry density of at least 95% of the maximum dry density.

Tests for sub-grade

The sub-grade compaction test and in-situ dry density tests on each layer of compacted material shall be carried out at an average of not less than 2 per 100 m length of carriageway.

Sub-base

Sub-base material shall be crushed rock or other approved local material having suitable properties and confirming to the following grading:

Sieve [mm]	Percentage by Weight Passing
75	100
37.5	85 - 100
10	45 - 100
5	25 - 85
0.6	8 - 45

Sieve [mm]	Percentage by Weight Passing
0.075	0 - 10

The material shall be spread evenly on the preceding material in layers not exceeding 150 mm compacted thickness.

The sub-base shall be compacted by approved plant to a dry density, which shall not be less than 98% relative compaction until movement of the surface ceases and the surface is closed. The CBR value shall be at least 30% at the optimum moisture content.

Wet mix road base

Wet Mix road base material shall consist of crushed gravel or crushed rock and shall be suitably proportioned to confirm to the following grading as approved by the Employer:

BS Sieve Size [mm]	Percentage by Weight Passing
50	100
37.5	90 - 100
20	60 - 80
10	40 - 60
5.00	25 - 40
2.36	15 - 30
0.600	8 - 22
0.075	0 - 8

The final surface shall be shaped and finished true to line and level within a tolerance of + 10 mm to the levels shown on the drawings.

Placing of road base

The compaction procedure and plant shall be proved by trials at the commencement of the Works.
Road base material shall be placed and spread evenly, without delay, using a paving machine or spreader box, operated with a mechanism which level off the material at an even depth and it shall be spread in layers not exceeding 150 mm compacted thickness. Segregation shall be avoided during transport and placing and any segregation evident after compaction shall be corrected by vibrating in non-plastic fines or made good by removing and replacing with properly graded material.

The road base shall achieve a minimum dry density of 98.1% of the maximum laboratory dry density.
Before placing the next construction layer or applying prime coat, the road base shall be mechanically swept, then cleaned with compressed air to remove loose material. As soon as possible after cleaning of the surface, the oad base shall be sealed by the application of a prime coat as specified.

Chlorides and sulphates

The level of chlorides and sulphates in the sub-base and wet mix road base shall be within the following limits:

	Maximum by weight	
	Sub-base	**wet-mix road base**
Acid soluble chloride (NaCl)	3.5%	0.5%
Acid soluble sulphate (SO_3)	2.0%	0.5%

Hard shoulders

The material used for any hard shoulders shall comply with the specification for wet-mix road base.

Segmental Concrete Paving Block Surface

For the stipulated requirements of the laying of the segmented concrete paving block surface, it is assumed that the sub-grade or sub-base has been properly constructed, that there are no soft or unstable areas and that the sub-grade or sub-base has been trimmed to within ±10mm of the specified level.

Laying Pattern

Unless otherwise approved, all blocks shall be laid in herringbone pattern. The blocks shall be laid against the edge restraint shown on the plans in order to prevent the outward migration of blocks. Areas against kerbs, manholes, etc. requiring infilling and which exceed 25% of a full block unit shall be filled with units cut to size using a mechanical or hydraulic guillotine, bolster or angle grinder. Infill areas constituting less than 25% of a full block area and of 25 mm minimum dimension shall be filled with

25 MPa concrete. Smaller areas shall be filled with cement mortar having proportions of 1 sack cement to 130 litre of good quality mortar sand.

Bedding Sand

Except for mine sand, sand for the bedding layer shall comply with the following grading limits:

SIEVE SIZE (mm)	% PASSING
9,52	100
4,75	95 -100
2,36	80 - 100
1,18	50 - 85
0,600	25 - 60
0,300	10 - 30
0,150	5 - 15
0,075	0 - 10

Mine sand may be used where experience has shown it to be satisfactory. The moisture content of the sand shall be 5 - 8%. Bedding sand shall be maintained in a loose condition and protected against pre-compaction. Any pre-compacted areas shall be removed and replaced. The loose sand-bedding layer shall be evenly laid and shall not be used to fill hollows in an uneven subgrade or subbase surface. The compacted sand layer shall have a thickness of not less than 15 mm and not more than 35 mm.

Block Laying

All blocks shall be laid true to line and level. Full blocks shall be laid first, care being taken that joint lines are straight and square. Disturbance of laid blocks shall be prevented and any areas distorted or damaged shall be lifted and re-laid by the Contractor. The maximum joint width shall be limited to 5 mm.

Compaction of Blocks

After laying the blocks, a mechanical flat plate vibrator shall be applied to the surface of the blocks to bed them. For block thicknesses up to and including 80 mm the vibrator shall be capable of producing a centrifugal force of approximately 7 to 16 kN at a frequency of approximately 75 - 100 Hz, the plate area being between 0,2 m² and 0,4 m². For greater thicknesses the required centrifugal force shall be 16 - 20 kN at a frequency of approximately 75 - 100 Hz, the plate are being between 0,35 and 0,5 m². Compaction of blocks shall follow block laying as closely as possible, but shall not be attempted within 1 m of the laying face. At the end of each day compaction must be completed up to within 1 m of the working face. All blocks damaged during the compaction process shall be removed and replaced. Sufficient passes shall be made to compact the block pavement fully and to produce an even surface. The number of passes shall, however, not be less than two.

Jointing Sand

Joints between blocks shall be filled with a 50-50 sand-cement mixture. The jointing sand shall pass a 1,18 mm sieve and contain 10 - 50% material

passing the 75 μm sieve. The sand shall be free of soluble salts or contaminants likely to cause efflorescence or staining. After initial vibration, joint filling sand shall be uniformly distributed over the surface of the pavement and brushed into the joints. Further passes of the plate vibrator shall be made to fill the joints, more sand being spread over the surface if required.

Excess sand shall be removed before the pavement is opened to traffic.

Surface Tolerances

Surface tolerances on the finished paving are based on the layer directly below the bedding sand complying with:

a) maximum deviation in surface level from the true surface level to be ±10 mm;
b) maximum deviation from a 3 m straight edge placed on the surface to be 10 mm, except where vertical curves necessitate a greater deviation;
c) the finished paving shall be so laid as to create a regular and smooth appearance.
d) Surface tolerances shall be as follows:

- maximum deviation in surface level from the true surface level to be ±10 mm, except immediately adjacent to gullies, where the tolerance shall be +3 mm and 0 mm
- maximum deviation from a 3 m straight edge placed on the surface to be 10 mm, except where vertical curves necessitate a greater deviation
- levels of adjacent blocks shall not differ by more than 3 mm
- the line of the pattern shall not deviate more than 15 mm from a 3 m straightedge.

Site Clearance

Before the pavement is opened to traffic the area shall be cleared of all debris and other waste and left in a tidy condition.

Weed/Ant Poison

An weed and ant poison approved by the Employer, shall be applied to the sand layer strictly in compliance with the manufacturer"s specification prior to block laying.

Gravel Wearing Course Surface

For this type of road surface, the road base shall be of an approved Gypsum gravel with a grading complying with a G4 quality natural gravel, the finished surface of which acts as the wearing course surface.

New and existing pavement joints

Where new bituminous pavement is required to join into existing road construction, each layer of existing bituminous course shall be cut back to a clean vertical face and coated with hot bitumen of a grade suitable for the

purpose immediately before laying the new bituminous material.

The existing pavement layers shall be cut back to form a stepped pattern. The lower layers of bituminous courses shall be prepared to receive the new covering coats by removal of dust and deleterious materials by air jetting or other approved means, and shall be coated with bituminous tack coat.

Exposed existing road base surfaces shall be scarified then re-compacted and sealed with bituminous prime coat in accordance with road base specification.

Bitumen macadam

Aggregate shall be hard, clean, durable crushed rock or gravel, and sand and shall be obtained from approved source which shall not include quarries containing significant proportions of weather bed, decomposed or extensively fractured materials.

Coarse aggregate is defined as that fraction retained on a 3.5 mm sieve. It shall have physical properties, which do not exceed the following test values:

	Wearing course	Base course
Aggregate crushing value	20%	25%
Flakiness index	25%	30%
Elongation index	25%	30%
Water absorption	2%	2%

Separate coarse and fine aggregate fractions shall be tested for soundness.

Wearing course shall be of min. 40 mm finished thickness; the aggregate grading shall be as follows:

Test Sieve [mm]	Grading (20mm nominal size) % by weight passing
28	100
20	95 - 100
14	70 - 90
10	55 - 75
6.3	40 - 60
3.35	25 - 40
1.18	15 - 30
0.075	2 - 6

Composition of bitumen macadam

Mixes shall be submitted for approval and proved by means of laboratory, plant and field trials.

The designed mixes shall comply with the following:

	Binder Course	Wearing Course
Voids in mix [%]	7 - 10	5 - 8
Voids in mixed aggregate [%]	14 - 20	14 - 20
Minimum stability [kg]	750	1000
Flow (mm)	2 - 4	2 - 4
Minimum stability flow ratio [kg/niTn]	270	320
Bitumen content [% of total mix]	3.3 - 4.0	3.5 - 4.2
Voids filled with Bitumen [%]	48 - 60	48 - 60

Mixing and laying

The aggregate and bitumen shall be mixed in an approved plant of the batch type. Constituents shall be proportioned by weight; the bitumen may be proportioned by a metering pump.

Bitumen and aggregates shall not be heated to above 150°C and 170°C, respectively, and the temperature difference between them at the time of mixing shall not exceed 15°C. The mixing temperature shall be established from the bitumen viscosity/temperature graph. Approved facilities for continuous measurement of temperatures shall be provided.

Bitumen macadam shall be transported in clean vehicles. Dust, coated dust, oil or water may be used on vehicle bodies to facilitate discharge, but the amounts shall be kept to a minimum and any excess shall be removed by tipping or brushing.

Immediately after arrival at the site, the macadam shall be supplied continuously to the paver and placed without delay.

Joints in wearing course shall be offset by at least 300 mm from parallel joints in the layer beneath.

A priming coat of petroleum/bitumen shall be applied to the road base at the rate of 0.55 to 7 l/m², before placing macadam. The binder course shall not be laid until the priming coat has been cured.

The binder course shall be prepared to receive the wearing course by removal of dust and deleterious materials by air jetting or other approved means.

Interlocking paving blocks

Footpaths and areas to be paved with interlocking concrete blocks shall be excavated and placed with 300 mm depth of compacted material at the exact levels and falls required for the finished work.

If parts of the base are found to be unstable the Contractor shall excavate further to a firm bed and fill with layers of fine crushed rock or aggregate, thoroughly compacted. The upper surface of the base shall reflect the exact profile, fall or contour of the final paving, irregularities shall not be

compensated by varying the depth of sand bedding.

Compaction of formation and base for interlocking concrete slabs shall be as Clauses (Compaction of Sub-Grade), (Road Base), (Tests on Sub-Base and Road Base).

A stable edge shall be provided to retain the paving units and sand bedding by means of pre-cast concrete edging unit or kerbs set in-situ concrete. The sand bedding shall be a fine, well graded sand in a dry to moist condition and laid to an uncompacted thickness of 50 mm.

The mix for paving blocks shall contain a water-repelling additive.

The paving blocks shall be laid in accordance with the manufacturer‟s instructions and shall be compacted at completion of each day‟s work.

The interlocking block shall be a minimum of 80 mm thick and of grade C25/30 and the concrete quantity must be approved by the employer.

Site surfacing

The area of site not covered by buildings, structures, roads and paving, plants, etc. shall be leveled and covered by a single layer of drainage geotextile membrane topped by a layer of 30 mm uniform gauge gravel of minimum 15 cm thickness after compaction.

Kerbs

All roads shall be provided with kerbs.

Kerbs, channels, edgings and quadrants shall be cast generally to BS EN 1343 or equivalent. They shall be cast to the required radius for all curves not less than 10 meters.

Raised kerbs shall be laid with a 6 mm gap and pointed with I to 3 polymer modified cement mortar above road level only. Concrete bedding and backing to kerbs shall be cast in-situ to the dimensions shown on the drawings.

Flush kerbs shall be similarly laid and jointed or may be cast in-situ. The outside comer of the kerbs shall be chambered.

Marginal strips and kerbs shall be protected against covering or splashing with bitumen or cement. Kerbs and manhole frames shall be primed before bituminous macadam is laid.

All raised kerbs shall be alternately painted black and white in the plant area and at junctions.

Traffic signs

Traffic signs shall be reflectorized and shall comply with the latest revision of the latest Bangladesh standard.

Number, type and position of the signs have to be as agreed with the Employer.

Mounting posts shall be of circular hollow steel section structural steel. Single post signs will generally be cast directly into a concrete base.

Guardrails

Guardrails shall be provided where the occupants of a vehicle or passers-by can be endangered by a vehicle leaving the road.

Guardrails are to be used also to protect pipes and structures located at traffic areas and are to be designed to withstand impact forces in accordance to the traffic type and speed.

Railings shall be of galvanized steel, which shall be epoxy-painted in addition. Plastic guideposts with glass reflector elements shall be used where required.

Road drainage system

The drainage system of the roads shall comply with the respective standards.

The arrangement of the drain lines discharge collectors shall suit the traffic requirements, simplicity and reliability, having maintenance facilities to make sure that the system is working properly.

2.14 Fences and gates

The following fences shall be provided:

- internal fences around different plant components (open storage area, switch yard, etc.).

Internal fences

Chain link fences shall be constructed of plastic coated galvanized steel wire and shall be of such manufacture that when any one segment is cut remaining segments within the pattern retain their rigidity.

Overall height of the fencing shall be 2.4 meters (1.8m plastic coated galvanized steel wire mesh + 0.6m barbed wire) above ground level. All mesh shall be of plastic coated galvanized steel wire of minimum 8 gauge (including PVC coating). Line wires shall be of plastic coated galvanized steel wire of the same gauge to adequately support the mesh rigidly. Line wires shall be provided at the top and bottom of the mesh and at two evenly

spaced intermediate levels. The line wires shall be attached to the supporting posts. The top wire shall be doubled, making five line wires in all. Mesh and line wires shall comply with BS 4102 or equivalent standards.

Supporting posts and struts shall be of precast reinforced concrete of grade C40/50. The posts shall be set in concrete in the ground. The posts shall have cranked tops set at 45° outward to the posts, to which shall be attached three strands of galvanized barbed wire. Droppers shall be fitted at the center of each bay of fencing, to prevent the wires bunched together. Intermediate posts shall be provided at centers not exceeding 3 meters. Corner posts and struts shall be provided at all changes in direction.

The fences shall be connected to the earthing system.

Gates

Along the internal fences mentioned above an adequate number of single-leaf pedestrian gates and double-leaf hinged gates shall be provided.

The height of these gates shall correspond to the height of the adjacent perimeter fences.

Gates shall comply with BS 1722 or equivalent standards and shall be constructed of plastic coated galvanized chain link mesh on a plastic coated galvanized RHS or tubular steel frame, with three strands of barbed wire across the top on cranked galvanized extension arms.

Gateposts shall be made of plastic coated galvanized RHS section and set in concrete in the ground. Gate hinges (pivots) shall be heavily galvanized and plastic coated.

All gates shall be provided with locks.

Also the gates shall be connected to the earthing system.

2.15 Intake and pump houses

See **Section B5**.

2.16 Outdoor facilities

2.16.1 Potable water system

Drinking water pipelines shall be constructed to BS 8558, BS EN 806 or equivalent.

For water piping the material listed in BS 3505:1986 shall be used.

For the water storage tank glass-fibre reinforced polyethylene shall be used providing the materials satisfy the requirements of the appropriate standards. Any material used shall meet the requirements of the World Health Authority with regard to harmful influences on the drinking water. They shall not promote the formation of algae or the growth of bacteria in water.

The materials used shall be UV-resistant and withstand any climatic conditions to which they are exposed.

The tank shall be covered and provided with sun protection as well as a visible outside water level gauge and automatic float control.

Glass-fibre reinforced material shall meet the requirements laid down in the "Voluntary Product Standard" of the National Bureau of Standards (US Department of Commerce) or other relevant internationally recognized standards.

2.16.2 Storm water drainage

Storm water drainage shall be supplied for all buildings, roads, paved areas etc. in accordance with the local rainfall conditions. If possible by gravity only, lifting or pumping stations shall be avoided.

All storm water and fire-fighting water has to discharge over sand traps to be collected in a retention basin, whether it is polluted or not and send to external disposal or sent to the stormwater pond.

2.16.3 Oily water drainage/separators

The tank farm, the transformer enclosures and the workshop have to have provisions to collect oily water and to treat it in one or more oil separators.

2.16.4 Chemical drainage

The drainage from battery rooms and similar shall not be connected to the storm water systems, but to the chemical drainage system, connected to the neutralization tank tank or to the waste water tanks.

2.16.5 Manholes

Manholes shall be provided for the above-described drainage systems, at each change in gradient or direction, and at maximum intervals of 50 m. The diameter of manhole shall be chosen as a function of the pipe cross section. Either prefabricated or cast-in-situ concrete manholes may be used.

Shaft and manhole covers shall be made from cast iron and reinforced concrete, of watertight construction, to suit local requirements. Shaft and pit covers shall have a test load suited to the traffic conditions. Trash gratings shall be of cast steel.

2.16.6 Piping material for outdoor systems

General

- Tubes and fittings of other materials shall be used only if they are in conformity with local regulations and with the approval of the Employer.
- All materials shall comply with the regulations regarding quality and dimensions and shall be adequate for the required work.
- Materials and structural parts not standardized shall be subject to the approval of the Employer‟s Engineer prior to use.
- All pipes and joints shall be marked indelibly immediately after taking from the moulds.
- The marking shall include:
  - name of manufacturer
  - date of manufacturing and serial number
  - nominal diameter and pipe class.

Unplasticized Polyvinyl Chloride (UPVC) pipes

UPVC pipes conforming to BS 3505:1986 shall be used for water supply and storm water and sewerage purposes. Pipes couplings and pipe fittings of UPVC shall have a uniform dark gray color throughout.

Pipes for rainwater downtake shall conform to Class C as per BS 3505:1986.

UPVC pipes conforming to BS EN 13476 shall be used for sewerage purposes.

2.17 Pipe and cable ducts

The ducts are to be constructed of reinforced concrete and must be watertight. Particular attention must be paid to satisfactory expansion and settling joints. The walls and covers of the ducts must be designed and reinforced to withstand the soil pressure and the relevant traffic loads. The ducts are to be provided internally with hot dip galvanized anchor rails every 1.5 m for the easy attachment of clips and cable racks. All ducts covered by removable covers will have to be provided with metal protection angles.

Pipe ducts shall be big enough for maintenance. Trench and cover shall be designed for the relevant traffic loads.

For drainage purposes the cable and pipe ducts shall be provided with slopes (min. slope 0.3%) towards accessible pump sumps. The pump sumps in which will be frequently water will have to be provided with permanently installed automatic pumps.

2.17.1 Pipe bridges/racks

Structure of pipe bridges shall be of galvanized steel and shall consider reasonable heights for under passing and impact loads due to traffic. Floors and stairs shall be galvanized steel grating. Along the pipe bridge, around the various openings and for the stairs tubular steel railings of galvanized steel shall be provided.

Access shall be made by steel stairs and/or from the various plant items. For escape purposes a clear width of min. 1.00 m and minimum headroom of 2.20 m shall be provided along the pipe bridge. All fittings, apparatus and parts requiring maintenance must be easily accessible via stairs (only in exception cases via ladders) and must be secured by platforms and railings. Minimum headroom of 2.20 m and a clear width of min. 1.00 m must be assured everywhere and no dangerous objects must protrude into the accessible areas. When are crossed, care must be taken to ensure a clear headroom of min. 8.00 m for the main access roads, 6.00 m for any other road and a clear width not less than the road width.

The structure must be sturdy and well founded to enable it to support both, the pipe loads as well as the horizontal and vertical pressures and tensile stresses at the fixed points. Sliding bearings must ensure an adequately long travel without jamming. The settlements of pipe bridges must be kept to a minimum in order to avoid unacceptable stresses in the pipes.

2.18 Synthetic filter fabrics

Where filter membranes or geo-textiles are required, only non-woven needle-punched fabrics shall be used. In this process discrete long fibre is mechanically interlocked by a barbed needle-punching operation. The filter fabrics shall be installed permanently as required.

2.18.1 General requirements

Resistance to chemical attack

The material shall experience no significant change in its physical, chemical or engineering properties under the influence of oil, sulphates, chlorides, acids and alkalis in the forms and concentrations, which are present in soils, brackish water and groundwater to be found at the site.

Resistance to biological attack

The material shall be resistant to bacterial attack, fungus, insects and vermin etc.

Stability under ultraviolet light

The material shall incorporate sufficient resistance to ultraviolet light that its physical properties shall satisfy the specification after exposure for a period of up to 30 days of full sunlight in summer at the site.

The Contractor shall propose for review methods of storage and laying of the material which will ensure that exposure is not more than half of the manufacturer's recommended maximum exposure period for conditions at site.

Drinking water suitability

The material shall be of such quality that drinking water is not affected.

Supply

Filter fabrics shall be supplied in rolls of at least 3.5 m width and shall be jointed in accordance with the manufacturer˝s specification. Roll length of each fabric shall be such as to lay one strip complete in one operation, without jointing, each of the various separate sloping and horizontal lengths involved (e.g. for the shoreline protection, placing direction vertical to the coastline). Rolls of adequate standard lengths shall be supplied for this purpose.

Material approval

The Contractor shall demonstrate before use that the proposed materials, from all the proposed sources of supply, meet the specification. Such demonstrations (laboratory tests) shall be performed or stated by an approved official laboratory for materials testing. The results shall be

summarized and interpreted in a report and presented to the Employer for approval.

Filtration properties and pore size distribution

Filter fabrics shall be permeable and have a mean pore size not greater than 0.3 mm and a pore size for a fraction of 90% not greater than 1.0 mm, retaining at least 50% of material with a particle size in the range of 0.06 mm to 0.2 mm. The pore size distribution shall be determined by appropriate methods in accordance with good engineering practice.

Permeability

The transverse filter fabric permeability range shall be k = 5 x 10 - 4 m/s and 5 x 10 - 3 m/s at a loading of 0.5 bar (50 kN/m^2).

Mechanical and hydraulic filter stability

3 samples shall be taken from the filter fabrics used for every kind of soil to be tested. The fabric shall be fastened as the bottom of at least 15 cm diameter and 10 cm high PVC-cylinders where these tools are filled with 1500 g of dry soil to be tested each. These cylinders shall be submerged 40 cm into water and lifted up reciprocally every 30 seconds for 34 hours. The sand penetrated through the fabric shall be measured after 4, 9, 24, 29 and 34 hours where the penetrated sand shall be not more than 2.5 g in the last 10 hours. The water volume passing the above sample shall also be measured at above intervals. After the end of the test, two fabric samples shall be taken from each cylinder and their reduced permeability shall be measured which might be caused by soil particles penetrated into the fabric. This permeability still shall be more than of the natural soil.

Weight

In respect of hydrodynamic reversing flow conditions the fabric weight shall be equal or greater than l000 g/m^2 (at 20° C and 65 percent humidity) for shoreline protection and scour protection.

2.18.2 Tensile properties of filter fabrics

The tensile strength of the filter fabric shall be verified in any direction (longitudinal and cross) under a uniformly applied load. The following laboratory tests shall be performed on wet samples, which have been fully submerged in water for a period of 48 hours before testing.

Plain strain test

This test shall be carried out according to ISO 13934 but with a 20 cm by 20 cm fabric sample, restrained from reduction in width by laths on the two tensioned sides of fabric with steel pins penetrating fabric. The tensile strength of the material shall not be less than 1.2/1.6 KN over a 200 mm width and the breaking strain shall exceed 50/70%.

"Grab" tensile test

The 25 mm „"grab" tensile strength shall be not less than 1.0 KN. Tests shall be carried out in accordance with ISO 13934.

2.18.3 Testing frequency

The thickness, weight, permeability and tensile properties (plain strain test) shall be carried out once at start of works and then on every 5000 m^2 of each material used. The samples shall be taken from the material at the site and tested by a specialized official institution to be approved by the Employer. More tests may be required if above tests fail or there are doubts about fabric quality.

2.19 Technical schedules

The following technical schedules constitute part of the specification. The data and requirements specified in the respective forms are to be adhered to and the required data of the forms are to be completely filled in. The completed technical schedules are to be submitted with the Bid:

2 TS Technical Schedules

2.20 Other Miscellaneous Works

PVC Pressure release valves and under drainage arrangements shall be provided below the forebay slab of CW pump house and CW water channel to prevent uplift.

Coal Bunker (inside Mill Bunker Building) shall be of MS while the hopper shall be of MS with stainless steel (grade SS 304) lining. The SS lining in hopper portion shall be 6 mm thick, cold rolled, annealed & pickled and skin passed. 308L and 309L electrodes/fillers shall be used for welding stainless steel to stainless steel and stainless steel to mild steel respectively.

Pre-formed flexible open ended bellow strap of neoprene shall be provided between top of bunker and bottom of tripper floor to avoid coal dust leakage / escape. The bellow strap shall be of minimum 200 mm wide under un-stretched condition and shall be of minimum 2mm thick.

2.21 Additional requirement for Green buildings

Green Buildings are to be designed to be compliant to minimum LEEDs Gold rating.
Additional requirements for Green building are as follows:-

- All necessary documentation (certificates, manufacturer declarations) in regards to the recycled content, distance of manufacture, other special requirements for green building etc shall be provided.
- Top 40 cm of fertile soil in areas of green building shall be excavated, stacked separately and re-layed in specified areas post building construction through contour trenching, mulching etc. In case of no fertile soil, soil test report from lab shall be submitted confirming the non fertile nature of soil.
- The cement used for concrete, reinforced concrete, mortar, grout and plaster should be done with Portland Pozzolona Cement with flyash content of minimum 25%. Raw material used in the cement shall be extracted/manufactured within 800 Km distance from the site.
- Course and fine aggregates used in the concrete, grout, plaster etc shall be extracted/manufactured within 800 KM distance from the site.
- Reinforcement shall be with post consumer recycled content of minimum 40%.
- Volatile organic compound (VOC) limits of Adhesives, Sealants and Sealant Primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168. VOC content test certificate or technical specification from manufacturer for adhesives, sealants and sealant primers shall confirm that SCAQMD prescribed testing standards for determining VOC content are followed.
- Source of teak tree and frame manufacturing shall be within 800 Km from site.
- Raw material source and manufacturing of particle board shall be within 800 KMT from project site.
- All composite wood products should not contain urea formaldehyde.
- Raw material used for AAC blocks manufacturing and manufacturing facility need to be within 800 Km from project site.
- VOC of all paints shall not exceed Green Seal Standard GS-11
- Flooring tiles shall be certified by Floor Score standard (except natural stone like kota, granite etc.,)
- Recycled content shall be minimum 20% for tiles with material source and manufacturing within 800 Km from site.
- All carpet shall be CRI certified.
- Adhesives and Sealants VOC content test certificate or technical specification from manufacturer shall confirm that SCAQMD prescribed testing standards for determining VOC content are followed.
- All false ceiling material with material source and manufacturing shall be within 800 Km from site

3. Induced draft Cooling Tower

The major civil works of Induced draught cooling tower are as listed below.

i) Foundation of cooling tower
ii) Basin Wall and Floor
iii) Cells, Distribution System and Stack

iv) Cold Water Outlet Channel
v) Fills
vi) Fills Supporting Structure
vii) Painting To Concrete Surfaces
viii) Stairs
ix) Paving
x) Water proofing of structures and construction joints
xi) Structural steel works
xii) General appurtenant works of a Civil & Structural Engineering nature.

3.1 MATERIALS OF CONSTRUCTION

Reinforcing steel used in reinforced concrete shall be as per equivalent.

Concrete: C25/30 for cooling tower foundation and superstructure
C40/50 for precast elements

The staircase shall be of structural steel. All steel used for walkways and stairways shall be hot dip galvanised and fabrication in accordance with ASTM A123.

3.2 MINIMUM THICKNESS OF STRUCTURAL CONCRETE ELEMENTS:

The actual thickness of the structural elements shall be as per design calculation. However the following minimum thickness shall be followed for the structural concrete elements:

a) Foundations	:	350 mm
b) Louvers and walkway	:	100 mm
c) Basin walls	:	150 mm
d) Pre cast cover slab	:	100 mm
e) Fan cylinder	:	125 mm
f) Hot Water Plank	:	80 mm

3.3 STRUCTURAL ANALYSIS AND DESIGN:

The entire cooling tower is visualized to consist of frames in transverse and longitudinal Directions. The columns at the bottom shall be assumed to be fixed for the analysis of frames. The analysis shall be done for dead, live loads and lateral loads due to wind or seismic forces.

The design of C.W. Basin, outlet channel, sludge pit and Hot Water Basin shall be designed for cracked condition keeping crack width as mentioned below as per BS EN 1992-1-1-2004

The crack width shall be limited to.

a) 0.2 mm for all reinforced concrete structure in contact with water or chemicals.

C.W. basin shall be designed for the following conditions:

(i) Water pressure inside up to the design level and no earth pressure outside

(ii) No water pressure inside and earth pressure outside.

SPECIFIC DESIGN ASPECTS:

CONCRETE WORK

3.4.1. BASIN, WALL AND FLOOR

All walls and slab below ground level shall be of water proof concrete. The floor of cooling tower basin shall be sloped to a silting pit to permit flushing and drainage of the floor area. Cooling tower internal columns and posts shall extend to bottom of the concrete basin.

The floor of the basin shall be sloped to minimum 1 in 80 towards the sludge drains. The required slope shall be achieved by screed. Drainage arrangement of basin shall be provided suitably.

3.4.2 CELLS, DISTRIBUTION SYSTEM AND STACK

Cooling tower cells shall consist of RCC columns, beams and walls. Hot water distribution channel shall also be of RCC and covered with suitably designed precast / cast - in - situ concrete slab.

Cell division partition walls shall be cast - in - Situ RCC.

3.4.3 PAINTING TO CONCRETE SURFACES

All concrete surfaces in direct contact with water/ water spray/moist air shall be applied with two coats of bitumen @ 1.7 Kg/sqm. All concrete surfaces subject to water/ water spray/moist air up to and including Fan Deck slab level including basin slab, inner faces of cladding walls, all faces of cell partition wall, all faces of columns, all faces of beams (both cast in situ and precast), bottom surface of fandeck slab for counter flow tower and both surface of fandeck slab for cross flow tower, inner face of fanstack, all faces of hot water basin (for cross flow tower) etc shall receive the said coating after cleaning and drying of the concrete surface.

All foundations, footings and slabs in contact with ground shall also receive a bituminous coating.

The R.C.C. structure of the Cooling Tower shall be painted on the exterior surface with three coats of waterproof cement paint.

3.4.4 PAVING

Paving shall be provided for a minimum clear width of 2.0 m from the outer face of the HW pipes all around the cooling tower basin. Paving shall also be provided in between the hot water pipes and space available between HW pipes and CT basin wall spray catcher.

3.4.5 WATER PROOFING AND CONSTRUCTION /EXPANSION JOINTS

For water proofing of underground structures including basin slab and hot water distribution channel, water proofing cum plasticizer compound shall be mixed with the concrete. PVC sealing strips shall be used for all expansion joints where water is retained. At expansion joints, joints filler material (preformed bitumen impregnated fibre board) with sealing compound on both sides shall be provided throughout the length of the joint.

The number of construction joints shall be kept as low as possible consistent with reasonable precautions against shrinkage. Concreting shall be carried out continuously up to construction joints.

BANGLADESH-INDIA FRIENDSHIP POWER CORPORATION (PVT.) LTD. (BIFPCL)

MAITREE SUPER THERMAL POWER PLANT
UNITS- 1 & 2 [2 x 660 MW]

VOLUME II-B

CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

SECTION – D

GENERAL TECHNICAL SPECIFICATION

PE-TS-421-600-C001 R01

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

PREAMBLE

VOLUME – II-B

This volume is subdivided into following sections:

Section-A: This section comprises of scope of work.

Section-B: This section comprises of project information.

Section-C: This section indicates the technical requirements specific to the contract not covered in the section-D.

Section-D: This section comprises of technical specification.

Note: In case of any conflict between section–C and section-D, Section C of specification prevails.

SECTION – D comprises of sub-sections as mentioned below:

Sub-section D1: Earthwork in excavation and backfilling

Sub-section D2: Cement concrete (Plain and reinforced) and formwork

Sub-section D3: Carpentry and joinery

Sub-section D4: Roof and underground structures water proofing, insulation and allied works

Sub-section D5: Metal doors, windows, ventilators, louvers etc.

Sub-section D6: Glass and Glazing

Sub-section D7: Rolling Steel Shutter and Grills

Sub-section D8: Miscellaneous Metal

Sub-section D9: Masonry and allied works

Sub-section D10: Finish to masonry and concrete

Sub-section D11: Painting, Whitewashing, polishing

Sub-section D12: Floor finish and allied works

Sub-section D13: Sheet work in roof and siding

Sub-section D14: Suspended ceiling

Sub-section D15: Water supply, drainage & sanitation

Sub-section D16: Road & drainage

Sub-section D17: Fabrication of structural steelwork

Sub-section D18: Erection of structural steelwork

Sub-section D19: Roof decking

Sub-section D20: False flooring

Sub-section D21: Bored cast-in-situ RCC piles

Sub-section D22: Site levelling & grading works

Sub-section D23: Anti-termite treatment

Sub-section D30: Quality Assurance & Inspection

VOLUME: II B

SECTION - D

SUB-SECTION – D1

EARTHWORK IN EXCAVATION AND BACKFILLING

SPECIFICATION NO. PE-TS-421-600-C001

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

C 0 N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.0	SCOPE	3
2.00.00	GENERAL	3
3.00.00	EXECUTION	6
4.00.00	TESTING AND ACCEPTANCE CRITERIA	19
5.00.00	RATES AND MEASUREMENTS	19
6.00.00	INFORMATION TO BE SUBMITTED BY THE BIDDER	20

STANDARD TECHNICAL SPECIFICATION FOR EARTHWORK IN EXCAVATION AND BACKFILLING

1.0.0 SCOPE

This specification covers earth work excavation in all types of soil, soft rock and hard rock including setting out, clearing and grubbing, shoring, dewatering, back filling around foundations/pipelines to grade, watering, compaction of fills, testing, approaches, disposal of surplus earth, protective fencing, lighting etc. relevant to the structures and locations covered under this contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the contractor unless specified otherwise shall include but not be limited to the following.

a) Supplying and providing all labour, supervision services, earth moving machineries, surveying instruments including facilities as required under statutory labour regulations, materials, scaffolds, equipment, tools and plants, transportation, etc. required for the work.

b) Preparation and submission of working drawings showing the approaches, slopes, berms, shoring, sumps for dewatering including drainage, space for temporary stacking of soils, disposal area, fencing etc. and all other details as may be required by the engineer.

c) To carry tests and submit to the Engineer, test results of fill materials and degree of soil compaction of fill whenever required by the Engineer to assess the quality of fill.

d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc. including procurement of necessary licenses from proper authorities.

2.2.0 Work to be provided by others

No work under this specification will be provided by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

2.3.0 Codes and Standards

All works shall be carried out as per this specification and shall conform to the latest revision and/or replacements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL unless specified otherwise.

In case of conflict between this specification and relevant BS Standards or equivalent International standards approved by BIFPCL/BHEL, the former shall prevail. In case any particular aspect of work is not covered specifically by this specification/relevant Codes, any other standard practice as may be specified by the engineer shall be followed.

2.4.0 Conformity with Designs

The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.

2.5.0 Materials

2.5.1 General

All materials required for the work shall be of the best commercial variety and approved by the engineer.

2.5.2 Material for Excavation

For the purpose of identifying the various strata encountered during the course of excavation, refer clause no. 3.4.0 for the classification of earth strata.

2.5.3 Material for Filling

Material to be used for back filling shall be free from vegetations, roots, salts, rubbish, lumps, organic matter and any other harmful chemicals etc. and shall be got approved by the engineer. Normally excavated earth shall be used for back filling. In case such earth contains deleterious salts, the same shall not be used. All clods of earth shall be broken or removed. Where the excavated material is mostly rock and if filling with the same is permitted by the engineer in writing, then the filling with rock shall be done in the following manner. The boulders shall be broken into pieces not exceeding 150mm size in 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 therefrom shall not affect the terms of the contract. The Contractor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and / or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction likely to come up during the execution of the contract so that he may evolve a realistic programme of execution.

3.0.0 EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and back filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of slopes, shoring, approaches, dewatering, drainage, berms etc. for the approval of engineer.

3.1.0 Setting out

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the same shall be rectified by the contractor at his own risk and cost.

3.2.0 Initial Levels

Initial levels of the ground either in a definite grid pattern or as directed by the Engineer will be taken by the Contractor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-sections for volume measurement or for cross-checking the depths obtained from tape measurements. All records of levels, measurements etc. and also any drawing, cross-section etc. made therefrom, shall be jointly signed by the authorised representative of the contractor and the Engineer before the commencement of work and they shall form the basis of all payments in future.

3.3.0 Clearing and Grubbing

The area to be excavated shall be cleared out of fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Trees up to 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 chiseling, 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 semidetached 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 or unstable in the opinion of the engineer shall also be promptly and satisfactorily removed.

The rough excavation may be carried out up to 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 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., 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 of Bangladesh. 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 14 or as allowed by Bangladesh statutory norms 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 license from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per relevant Explosives Rules of Bangladesh up to 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 shall any person be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

3.5.4.3 Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

3.5.4.4 Use of Explosives

The contractor shall appoint an agent who shall personally superintend the

firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his responsibilities.

Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc. and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot

firer shall be present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc. shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc. shall be taken during blasting operations.

3.5.4.5 Restrictions in Blasting

a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.
d) No large scale blasting operations will be resorted to when the excavation reaches the last one metre and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
e) The last blast shall not be more than 0.50 m in depth.
f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiselling or any other suitable method as approved by the engineer.

3.5.5 Disposal

The excavated spoils shall be disposed of in any (or all) of the following manner as directed by the engineer.

a) By using it straightway for backfilling.

b) By stacking it temporarily to use for backfilling at a later date during execution of the contract.

c) i) By either spreading
or
ii) By spreading and compacting at designated disposal areas.

a) By selecting the useful material and stacking it neatly in designated areas as indicated by the engineer for use in backfilling by some other agency.

3.5.6 Disposal of Surplus Materials

All surplus material from excavation shall be removed and disposed of from the excavation site to the designated disposal area indicated by the engineer. All good and sound rocks obtained from excavations and all assorted materials of dismantled structures are the property of the owner and if the contractor wants to use it, he shall have to obtain it from the engineer at a mutually agreed rate. All sound rocks and other assorted materials like excavated bricks etc. shall be stacked separately.

3.5.7 Protection

The contractor shall notify the engineer as soon as the excavation is expected to be completed within a day so that he shall inspect it at the earliest. Immediately after approval of the engineer, the excavation must be covered up in a shortest possible time. But in no case the excavation shall be covered up or worked on before approval by the engineer. Excavated material shall be placed 1.5m or half the depth (of excavation) whichever is more from the edge of the excavation or further away if directed by the engineer. Excavation shall not be carried out below the foundation level of the structure close by until the required precautions are taken. Adequate fencing is to be made enclosing the excavation. The contractor shall protect all the underground services exposed during excavation. All existing surface drains in the work area shall be suitably diverted by the contractor before taking up excavation to maintain the working area neat and clean.

3.5.8 Dealing with Surface Water

All working areas shall be kept free of surface water as far as reasonably practicable. 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 up to a height of 300mm or the diameter of the pipe whichever is more above the crown of the pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock or ash as per the availability at site and shall be filled in compacted layers not exceeding 150mm. The remaining filling shall be done in layers with the mixture of boulders (of size not exceeding 150mm) and fine material as specified elsewhere in the specification. Each layer shall be watered, rammed and compacted to the required degree and to the satisfaction of the engineer.

3.7.5 Filling in Disposal Area

Surplus materials from excavation which are not required for backfilling shall be disposed of in the designated disposal areas. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250mm thick when loose, watered and compacted with the help of a compacting equipment as per the directions of the engineer. In wide areas, rollers shall be employed and compaction shall be done to the satisfaction of the engineer at the optimum moisture content which shall be checked and controlled by the contractor. In certain cases the engineer may direct the contractor to dispose the surplus materials without compaction which can be done by tipping the spoils from a high bench neatly maintaining a proper level and grade of the bench.

3.8.0 Approaches and Fencing

The contractor should provide and maintain proper approaches for the workmen and inspection. The roads and approaches around the excavation should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the project. Sturdy and elegant fencing is to be provided around the top edge of the

excavation as well as around the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.

3.9.0 Lighting

Full scale area lighting is to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the fill.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 Excavation

On completion of excavation, the dimension of the pits will be checked as per the drawings after the pits are completely dewatered. The work will be accepted after all undercuts have been set right and all over excavations are filled back to the required lines, levels and grades by placing ordinary cement concrete of 1:4:8 proportion and/or richer and/or by compacted earth as directed by the engineer. The choice of the grade of concrete will be a matter of unfettered discretion of the engineer. Over excavation of the sides shall be made good by the contractor while carrying out the backfilling. The excavation work will be accepted after the above requirements are fulfilled and all the temporary approaches encroaching inside the excavation have been removed.

4.2.0 Backfilling

The degree of compaction required will be 85% relative density (ASTM D-4253 and D-4254) for free draining soils containing less than 15% by weight finer than 75 micron sieve non plastic material or 98% of the maximum density as determined by ASTM D-1557 for soils containing more than 15% material passing the 75 micron sieve and the actual method of measuring the degree of compaction will be as decided by the engineer. The work of back filling will be accepted after the engineer is satisfied with the degree of compaction achieved.

5.0.0 RATES AND MEASUREMENTS

5.1.0 Rates

a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding section in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the

technical specification.

b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way from those shown on the tender drawings.

c) The unit rate quoted shall include minor details which are obviously and fairly intended and which may not have been included in these documents but are essential for the satisfactory completion of the work.

d) The bidder's quoted rate shall be inclusive of supplying and providing all labour, men, materials, equipments, tools and plants, supervision, services, approaches, schemes etc.

f) In case blasting in hard rock is envisaged, the unit rate quoted for earth work shall include the cost of storage and safety arrangements for the materials required for blasting. No separate payment will be made on this account.

5.2.0 Measurements

Method of measurements are specified as below:

a) The length, breadth and depth shall be measured correct to the nearest centimeter if measurements are taken by tape. Rounding of numerical shall be as per relevant BS Standards or equivalent International standards approved by BIFPCL/BHEL. 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/ pile caps/ drains/ cable trench/ pipe trench/ sub soil beams etc.) up to the depth of 2.0 metres from ground level, all-round 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/excess excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for item of work on excavation, backfilling, carriage, dewatering etc. Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in the quoted rates in the schedule of quantities.

d) In case of open footings (Rafts/ pile caps / drains/ cable trench/ pipe trench/ sub soil beams etc.) at a depth of more than 2.0 metre from ground level, all-round 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/excess excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for item of work on excavation, backfilling, carriage, dewatering etc. Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in the quoted rates in the schedule of quantities.

e) 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.

f) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rock so arrived shall be taken as soil.

g) The authorized quantity (calculated on the basis of authorized width/ working space under clause no. 5.2.0 c & 5.2.0 d) or those actually excavated, whichever, are less, shall be measured for payment.

h) 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.

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, backfilling 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.

VOLUME – II B
CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-421-600-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

CLAUSE NO.	DESCRIPTION	SHEET NO.
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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 Relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL shall be complied with unless permitted otherwise. All codes and Standards shall conform to its latest revisions. A list of 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 BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL shall apply.

2.00.00 General

2.01.00 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified shall include but not be limited to the following

a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportations, etc. required for the work.

b) Prepare bar bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.

c) Prepare working drawings of formworks, scaffolds, supports, etc.

d) Prepare shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedments, hangers, openings, frames etc.

e) Prepare detailed drawings of supports, templates, hangers, etc. required for installation of various embedments like inserts, anchor bolts, pipe sleeves,

frames, joint seals, frames, openings etc.

As decided by the Engineer some or all of the drawings & schedules prepared under item (b) to (e) above will have to be submitted for approval.

f) Submit for approval detailed schemes of all operations required for executing the work, e.g. material handling, concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.

g) Design and submit for approval concrete mix designs required to be adopted on the job.

Furnish samples and submit for approval results of tests of various properties of the following:

i) The various ingredients of concrete

ii) Concrete

iii) Embedments

iv) Joint seals

i) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications.

j) For supply of certain materials normally manufactured by specialist firms, the Contractor may have to produce, if directed by the Engineer, a guarantee in approved Performa for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the Contractor, jointly and severally.

2.02.00 Work by others

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Information to be submitted by the Tenderer

2.03.01 With Tender

The following technical information's are required with the tender:

a) Source and arrangement of processing of aggregates proposed to be adopted.

b) Type of plant and equipment proposed to be used.

c) Names of firms with which association is sought for to execute the special items of work in the contract.

d) Types of formwork proposed to be used.

2.03.02 After Award

The Contractor shall submit the following information and data including samples where necessary, progressively during the execution of the contract.

a) Programme of Execution

Within 30 days of the award of contract, the Contractor will submit a Master Programme for completion of the work.

This Master Programme may have to be reviewed and updated by the Contractor, quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.

Detailed day-to-day Programme of every month is to be submitted by the Contractor before the end of the previous month.

b) Samples

Samples of the following materials and any other materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities free of cost, for approval. The Engineer for future reference will preserve approved samples. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying materials of specified qualities:

i) Coarse and fine aggregates.

ii) Admixtures.

iii) Plywood for Formwork.

iv) Embedded and anchorage materials as may be desired by the Engineer.

v) Joint sealing strips and other*waterproofing materials.

vi) Joint filling compounds.

vii) Foundation quality Rubber Pads.

c) Design Mix

Design mix as per specification giving proportions of the ingredients, sources of aggregates and cement, along with test results of trial mixes as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL unless-stated otherwise and be of best approved quality.

2.05.02 Cement

Portland cement of grade-42.5 as per EN 197-1: latest or equivalent shall preferably be used in for concrete, reinforced concrete, mortar, grout and plaster (acid or see water resistant) works for all areas other than for the critical structures identified below.

The cement used for concrete, reinforced concrete, mortar, grout and plaster for buildings designed as green buildings to comply to minimum LEED's Gold rating should be done with Portland Pozzolona Cement with flyash content 25% or more than that. All necessary documentation (certificates, manufacturer declarations) shall be provided.

However, other types of cement such as Portland cement, Portland slag cement conforming to EN 197-1: latest or equivalent can be used under special circumstances. Cement used in all concrete mixes shall be in general of grade 32.5/42.5 unless design requires a higher grade. Portland cement shall be used for following structures.

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 C25/30 and above.

In special cases, Rapid Hardening Portland Cement, Low Heat Cement, Sulphate resistant cement, high strength Portland Cement etc. may be permitted or directed to be used by the Engineer.
For Brickwork, plaster, flooring and other finishing works, Portland cement of 32.5/42.5 grade shall be used.

2.05.03 Coarse Aggregate

Aggregate with larger aggregate sizes D greater than or equal to 4 mm and d greater than or equal to 2 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 BS EN 12620: latest or equivalent. Only Coarse Aggregate from, approved quarries and conforming to BS EN 12620: latest or equivalent 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 sizes with D smaller than 4 mm and within the grading limits and other requirements set in BS EN 13139: latest or equivalent & BS EN 12620: latest or equivalent are termed as Fine Aggregate. Only Fine Aggregate from approved sources and conforming to the above BS Specifications 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 BS EN 12620: latest or equivalent. For plaster and masonry work, it shall conform to BS EN 13139: latest or equivalent.

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. Acceptance of water shall be as per BS EN 1008: latest or equivalent.

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 BS EN 934: latest or equivalent 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.

2.05.07 Reinforcement

Reinforcement shall be as per relevant 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 up to-date accounts of receipt, issue and balance (stack wise) of all materials. Storage of materials shall conform to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

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 BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL.
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 BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL.
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 relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL and 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 relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 BS EN 206: latest or equivalent. Grade of concrete to be used in different parts of work shall be as shown on the drawing. In case of liquid retaining structures, BS EN 1992: latest or equivalent will be followed. Minimum cement content shall be as per BS EN 206: latest or equivalent.

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 C12/15 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 BS EN 206: latest or equivalent 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 BS 8500: latest or equivalent in addition to BS EN 206: latest or

equivalent. 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 Portland Cement or Portland Blast furnace slag cement is used, shall be as per BS EN 206: latest or equivalent. All other relevant clauses of BS EN 206: latest or equivalent shall also apply.

3.06.00 Minimum Cement Content

The minimum cement content for each grade of concrete shall be as per BS EN 206: latest or equivalent. 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 BS EN 206: latest or equivalent.

c) The Engineer will always have the unquestionable right to revise the minimum cement content as decided above, if, in his opinion, there is any chance of deterioration of quality on account of use of lower cement content or any other reason.

3.07.00 Water-Cement Ratio

The choice of water-cement ratio in designing a concrete mix will depend on:-

a) The requirement of strength.

b) The requirement of durability.

3.07.01 Strength Requirement

In case of "Design Mix Concrete" the water-cement ratio of such value as to give acceptable test results as per BS EN 206: latest or equivalent, will be selected by trial and error. The values of water-cement ratios for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Engineer. Frequent checks on test will have to be carried out and the water-cement ratios will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the Contractor's responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered.

In case of nominal mix concrete, the maximum water-cement ratio for different grades of concrete is specified BS EN 206: latest or equivalent and no tests are necessary. The acceptance test criterion for nominal mix concrete shall be as per BS EN 206: latest or equivalent.

3.07.02 Durability Requirement

Tables F.1 BS EN 206: latest or equivalent give the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to different exposure classes. Impermeability may also be an important consideration.

Whenever the water-cement ratio dictated by Durability consideration is lower than that required from strength criteria, the former should be adopted.

In general the water cement ratio between 0.4 and 0.45 will be desirable to satisfy the durability requirement and from the consideration of impermeability of concrete. The contractor may propose lower water cement ratio as mentioned above by addition of a suitable plasticizer/super-plasticizer. Trial mix shall be carried out accordingly. However, the contractor has to propose specifically along with field trials in the event of lower cement content if found suitable along with a plasticizer.

3.08.00 Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. The Consistence suitable for different uses of in-situ concrete shall

be as per Table A.18 of BS 8500-1: latest or equivalent.

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 BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 25°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 25°C, crushed ice shall be used as mixing water. The ice shall be formed of water conforming BS EN 1008: latest or equivalent. The Contractor shall establish the quantity of crushed ice to be mixed in order to achieve the limiting temperature of 25°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 BS ISO 18650: latest or equivalent on all mixers employed at site only those mixers whose efficiencies are within the tolerances specified in relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL will be allowed to be employed.

Batching Plant shall conform to relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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 BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 code for any particular aspect of work, any other standard code of practice, as may be specified by the Engineer, will be adopted. Concrete may have to be placed against the following types of surfaces:

a) Earth foundation

b) Rock foundation

c) Formwork

d) Construction joint in concrete or masonry

The surface on or against which concrete is to be placed has to be cleaned

thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping, sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. are to be removed by air water jetting or water at high pressure. Earth foundation on which direct placement of concrete is allowed, will be consolidated as directed by the Engineer such that it does not crumble and get mixed up with the concrete during or after placement, before it has sufficiently set and hardened.

Formwork, reinforcement, preparation of surface, embedments, joint seals etc., shall be approved in writing by the Engineer before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Engineer.

Rock foundation or construction joint will be kept moist for at least 72 hours prior to placement. Concrete will be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Engineer will have to be adopted.

Formwork will be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement.

A layer of mortar of thickness 12 mm of the same or less w/c ratio and the same proportion as that of the concrete being placed or cement slurry will be spread thoroughly on the rock Foundation or construction joint just prior to placement of concrete.

After concrete has been placed, it shall be spread, if necessary & thoroughly compacted by approved mechanical vibration to maximum, subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL of Practice: In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibrators the contractor may have to employ form vibrators conforming to relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL. For slabs and other similar structures, the contractor will additionally employ screed vibrator as per relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts,

fixtures, reinforcement, and formwork are not displaced or distorted during placing & consolidation of concrete.

The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green Concrete, which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete.

Slabs, beams, and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Mouldings, throating, drip course, etc., shall be poured as shown on the drawings or as directed by the Engineer. Holes shall be provided and bolts, sleeves, anchors, fastenings, or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the Engineer. Any deviation there from shall be set right by the Contractor at his own expense as instructed by the Engineer.

In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same -at the Contractor's expense.

The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement.

Once the concrete is deposited, consolidated and finished in its final position, it shall not be distributed.

3.13.00 Construction Joints and Cold Joints

3.13.01 Construction Joints

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete certain predetermined stages. These joints will be formed in a manner specified in the drawings/Instruction.

Vertical construction joints will be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12.

Where the location of the joints are not specified, it will be in accordance with the following:

a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.

b) Concrete in a beam shall preferably be placed without a joint, but if Provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span.

c) A joint in a suspended floor slab shall be vertical and at the middle of the span and at right angles to the principal reinforcement.

d) Feather-edges in concrete shall be avoided while forming a joint.

e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.

f) In case the Contractor proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Engineer for study and approval without which no construction joint will be allowed.

3.13.02 Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it:

a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.

b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 *mm* in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.

c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not raise inspite of extensive vibration, the joint, will be left to harden for at least 12 - 24 hrs. It will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12.

3.14.00 Repairs, Finishes, and Treatment of Concrete surfaces

3.14.01 Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing, and consolidation by experienced workmen.

Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork, poor workmanship and protection will not be accepted and will have to be dismantled, removed and replaced by sound concrete at the Contractor's cost. The Engineer may, at his sole discretion, allow to retain concrete with minor defects provided the Contractor is able to repair it by approved methods at no extra cost to the Owner, All concrete work shall be inspected by the Contractor immediately after the forms are removed & he will promptly report occurrence of any defects to the Engineer. All repair works will be carried out as per the instructions and in the presence of the Engineer or his representative. Generally, repair work will consist of any or all of the following operations:

a) Sack rubbing with mortar and stoning with carborundum stone.

b) Cutting away the defective concrete to the required depth shape.

c) Cleaning of reinforcement & embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement.

d) Roughening by sand blasting or chipping.

e) Installing additional reinforcement/welded mesh fabric.

f) Dry packing with stiff mortar.

g) Plastering, guniting, shotcreting etc.

h) Placing and compacting concrete in the void left by cutting out defective concrete.

i) Grouting with cement sand slurry of 1:1 mix.

j) Repairing with a suitable mortar either cement or resin modified mortars.

k) Polymer modified patching and adhesive repair& mortar for beams & columns.

3.14.02 Finishing unformed Surface

The contractor shall provide normal finishes in unformed surfaces which can be achieved by screeding, floating, trowelling etc. A few typical and common cases of treatment of concrete surface are cited below

a) Floor

Whenever a non-integral floor finish is indicated, the surface of reinforced concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance. No over trowelling, to obtain a very smooth surface, shall be done, as it will prevent adequate bond with the subsequent finish. If desired by the Engineer, the surface shall be scored and marked to provide better bond.

Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes, ripples, and trowel marks.

A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface.

To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowelling.

b) Beans, Columns & Walls

If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the Contractor shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop. Pattern, adequacy, and details of such hacking shall meet with the approval of the Engineer, who shall be informed to inspect such surfaces before they are covered up.

3.15.00 Protection and Curing of concrete

Newly placed concrete shall be protected by approved means from rain, sun, and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days, or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive 'Loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, hessian, canvas, or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of the arrangements made by the Contractor. Quality of water for curing shall be as per BS EN 1008: latest or equivalent.

If permitted by the Engineer, liquid curing compound may be used for prevention of premature water loss in concrete and thereby effecting curing of concrete. This type of curing compound shall be sprayed on newly laid concrete surfaces to form a thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall be emulsified paraffin based and shall comply with the requirements of relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL for acceptance.

The curing compound shall be applied following the final finishing operation and immediately after disappearance of water from concrete surface. It is important not to apply the curing compound when standing water is still present on concrete.

The contractor shall arrange for the manufacturer's supervision at no extra

cost.

The Contractor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Engineer's decision regarding the adequacy of curing is final. In case the Engineer notices any lapse on the part of the Contractor, he will inform the Contractor or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the Contractor within 3 (three) hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and recover the cost thereof from the Contractor, or deduct certain amount from contractor's payment for the part where inadequate curing was noticed entirely at the discretion of the Engineer.

3.16.00 Reinforcement

Mild steel round bars, TMT bars, Hot rolled deformed bars or cold twisted deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc, will be used as reinforcement as per drawings and directions. In an aggressive environment an anti-corrosive coating on the reinforcement may be provided as per relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL, as shown on the drawing or as directed by the Engineer.

3.16.01 Bar Bending Schedules

The Contractor shall prepare Bar Bending Schedules as per BS 8666: latest or equivalent standard showing clearly the arrangements proposed by the Contractor to match available stock of reinforcing steel, progressively, starting within one week of receipt of approval on corresponding design of RCC structure. As decided by the Engineer, some or all the detailed drawings and schedules will have to be submitted for approval. Approval of such detailed drawings by the Engineer shall not relieve the Contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the contract. The contractor for record and distribution shall submit six prints of the final drawings & schedules with one reproducible print.

3.16.02 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete.

3.16.03 Bending

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in BS 8666: latest or equivalent standard 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

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 Standards for welding of mild steel bars used in reinforced concrete construction as per BS EN 1992-1-1: latest or equivalent. 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 BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL. Welding of High yield strength deformed bar shall not be allowed.

3.16.06 Control

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars shall be in accordance with BS EN 1992-1-1: latest or equivalent, 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 relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL.

3.18.00 Hot Weather Concreting

When depositing concrete in very hot weather, the Contractor shall take all precautions as per relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL 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

Underwater placing of concrete may be allowed for un-reinforced components, or as approved by the BIFPCL/BHEL. The placing being performed exclusively with stationary tremies and shall be in accordance with the requirements of relevant standards.

The min. cement content shall be increased by 50 kg/m3 for underwater concrete.

Underwater concrete is to be placed continuously without interruption.

The concrete is to be placed in such a way that is does not fall freely through the water. The tremies must at all times dip sufficiently far into the freshly placed concrete to ensure that the concrete emerging from the tremie does not come into contact with the water. All work connected with the placing of concrete under water shall be designed, directed and inspected with due regard to local circumstances and purposes. Work shall not proceed until all phases and methods to be used in the placing operations have been approved by BIFPCL/BHEL.

3.20.00 Form Work

3.20.01 General

If it is so desired by the Engineer, the contractor shall prepare, before commencement of actual work, designs and working drawings for formwork and centring and get them approved by the Engineer. The formwork shall conform to the shape, grade, lines, levels and dimensions as shown on the drawings.

Materials used for the formwork inclusive of the supports and centring shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.

The centring shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Rakers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight and horizontal pressure of the concrete as a liquid as well as the working load. In case the contractor wishes to adopt any other design criteria, he has to convince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel and concrete of adequate strength shall be used. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from

honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified as directed by him.

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all column forms are in true plumb and thoroughly cross-braced to keep them so. All floor and beam centring shall be crowned not less than 8 mm in all directions for every 5 meters 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.

For the proof of stability and for the type of formwork and support framing used, BS 3809, BS EN 13168:2012+A1:2015 or equivalent shall be used.

3.20.02 Cleaning and Treatment of Forms

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, sawdust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil or other compound before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary.

3.20.03 Design

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns, and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork.

Removing any props or repropping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of

concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.

3.20.04 Inspection of Forms

Casting of' Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

3.20.05 Removal of Forms

Formwork shall be kept in position after casting of concrete for a minimum period as mentioned in relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL, however the period of retaining form in position can be extended as per drawing, instruction of Engineer or as required for satisfactory completion of work without any extra cost. Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if the Engineer so desires.

The Contractor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed there from and have this record checked and countersigned by the Engineer regularly. The Contractor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him without any extra cost to the Owner, The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

If any other type of cement other than ordinary Portland cement and Rapid hardening cement is used, the time of removal of forms shall be revised such that the strength of this cement at the time of removal of forms match with strength of Portland cement at the time of removal of form.

3.20.06 Tolerance

The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings.

The permissible tolerances shall comply with the BS 5606 and BS EN 1992-1-1 or equivalent.

The tolerance are applicable for local aberrations in .the finished concrete surface & should not be taken as tolerances for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

3.20.07 Re-use of Forms

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used if declared unfit or unserviceable by the Engineer.

3.20.08 Classification

Generally, the "ordinary" class formwork shall be used unless otherwise specified.

a) **Ordinary:** These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber.

b) **Plywood:** These shall be used in exposed surfaces, where specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilization of used plywood for the "ordinary" class, if it is still in good condition.

c) **Ornamental:** These shall be used where ornamental and curved surface are required and shall be made of selected best quality well-seasoned timbers or of plywood, which can be shaped correctly.

3.21.00 Opening, Chases, Grooves, Rebates, Block outs 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 BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL, of approved manufacture and to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to paint with one coat of approved anti- corrosive paint and/or bituminous paint without any extra cost to the Owner. If welding is to be done subsequently on the exposed surface of embedded material, the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Engineer.

Items to be embedded

a) Inserts, hangers, anchors, frame around openings, manhole covers, frames, floor clips, sleeves conduits and pipes.

b) Anchor bolts and plates for machinery, equipment and for structural steel work.

c) Steel structurals to be left embedded for future extension, special connection etc.

d) Dowel bars, etc. for concrete work falling under the scope of other contractors.

e) Lugs or plugs for door and window frames occurring in concrete work.

f) Flashing and jointing in concrete work.

g) Any misc. embedments and fixture as may be required.

Correct location and alignment, as per drawings/instruction of all these embedded items shall be entirely the responsibility of the Contractor.

3.23.00 Expansion and Isolation Joints

3.23.01 General

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter. In case of liquid retaining

structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Contractor to get them tested in an approved laboratory free of cost to the Owner. Joints shall be formed true to line, level, shape, dimension, and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work.

3.23.02 Bitumen Board/ Expanded Polystyrene Board

a) Bitumen Board

Bitumen impregnated fibreboard of approved manufacturer as per relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

b) Expanded Polystyrene Boards

If required, commercial quality of expanded polystyrene products commonly used for thermal insulations may also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.

3.23.03 Joint sealing strips

Joint sealing strips may be provided at the construction, expansion, and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure. The sealing strips will be stainless steel strip either metallic like G.I., Aluminums, or Copper, or non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal joint and will be procured and installed in largest practicable lengths having a minimum number of transverse joints. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. The Contractor is to supply all labour and material for installation -including the material and tools required for jointing, testing, protection, etc. If desired by the Engineer, joints in rubber seals may have to be vulcanized.

a) Metal Sealing Strips

Metal sealing strips shall be either G.I., Aluminium or Copper and formed straight, U shaped, Z shaped or any other shape and of thickness as indicated in the drawing. The transverse joints will be gas welded using brass rods and approved flux and will be tested by an approved method to establish that it is leak proof. If required, longer lap lengths and different method of brazing which will render it leak proof, will be adopted by the Contractor. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

i) Stainless steel strip shall be of 3 mm thick in matt or buff finish and minimum width 100 mm at the expansion joints from reputed manufacturers to contain the filler material and/ or to exclude passage of water or any other material into or out of the structure. The standard of SS strip shall be as per relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL.

ii) G.I. Strips

G.I. strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The standard of Galvanizing shall be as per relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL for heavy-duty work. At the joints, the overlapping should be for a minimum length of 50 mm.

iii) Aluminium Strips

Aluminium strips shall be minimum 18 SWG thick and 300 mm wide unless specified otherwise and shall conform to relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL. A minimum lap of 50 mm length is required at the joints.

iv) Copper Strips

The Copper strips shall be minimum 18 SWC in thickness and 300 mm width unless specified otherwise and shall conform to the relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL. It should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm in length is required at the joints.

b) Non-metallic Sealing Strips

These will be normally in Rubber or P.V.C. Rubber or P.V.C. joint seals can be of shape having any combination of the following features:

i) Plain

ii) Central bulb

iii) Dumb-bell or flattened ends

iv) Ribbed and Corrugated Wings

v) V shaped

As these types of seals can be easily handled in very large lengths unlike metal strips, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer. The method of forming these joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Engineer taking particular care to match the central bulbs & the edges accurately.

c) Rubber Sealing Strips

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion, and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer:

Specific Gravity	:	1.1 to 1.15
Shore Hardness	:	65A to 75A
Tensile Strength	:	25 - 30 N/Sq.mm

Maximum Safe Continuous

Temperature	:	75°C
Ultimate Elongation	:	Not less than 350%

b) P.V.C., Sealing Strips

The minimum thickness of P.V.C. sealing strips will be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion, and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly

Specific Gravity	:	1.3 to 1.35
Shore Hardness	:	60A to SOA
Tensile Strength	:	10 - 15 N/Sq.mm
Maximum Safe Continuous Temperature	:	70 Deg.C
Ultimate Elongation	:	Not less than 275%

3.23.04 Bitumen Compound

When shown in drawing or directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL.

3.23.05 Isolation Joints

Strong and tough alkathene sheet or equivalent, about 1 mm in thickness and as approved by the Engineer shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

3.23.06 Pad

Vibration damping resilient pads shall be of minimum 25mm thickness and shall be provided on/around foundation of vibrating equipment and at other locations as shown in drawing including supply and installation all complete

as per manufacturer's recommendations, relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL.

Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness - 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

3.24.00 Grouting under Machinery or Structural Steel Bases

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Contractor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stone chips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If specified on drawings, admixtures like Aluminium powder, "Ironite" etc. may have to be added with the grout in required proportions. Premixed non-shrink grout of approved manufacture having proper strength shall be used with Engineer's approval for important machineries.

3.25.00 Precast Concrete

The Specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose. This yard shall be dry, properly levelled and having a hard and even surface. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 (seven) days of curing and can be removed for erection after 28 (twenty-eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal. The yard shall preferably be fenced.

Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling, and plumbing shall be done as per instructions of the Engineer. The Contractor shall render all help with instruments, materials, and men to the Engineer for checking the proper erection of the precast units.

After erection and alignment, the joints shall be filled with grout or concrete as per drawings. If centrings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement: sand mortar where called for in the drawings.

3.26.00 Waterproofing of Concrete Structure

3.26.01 General

Where required, waterproofing of concrete structures shall be ensured internally by suitable design of the concrete mix, addition of suitable admixtures in the concrete or mortar at the time of mixing and/or installing water bars at the joints. In addition to the above measures, the structures shall be made watertight by adopting "structural waterproofing" as per specification. The design, material, and workmanship shall conform to the relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If desired by the Engineer, test certificates for the materials and samples shall be submitted by the Contractor free of charge. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

3.26.02 Water Bar/Seal/Special Treatment of Construction Joint

Water bearing structures and underground structures may have water bar/seals installed at the joints. They may be metallic, rubber, or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction joint shall be provided as per clause 3.13.1 with or without water bar/seal as shown on the drawing. In case of water bars being used at the construction joint, fixing of the same has to be done carefully, so that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods.

Method 1: A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form

depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting. In case of walls, the above bonding agent will be mixed with water, which will be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor joint, however, after washing of retarder a solvent free two-component epoxy resin-bonding agent will be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days

Compressive strength	-	55 to 60 N/Sq.mm
Flexural strength	-	5 to 30 N/sq.mm
Tensile strength	-	15 N/Sq.mm (approx.)
Bonding strength to concrete	-	3 N/Sq.mm (approx.)
Bonding strength to steel	-	20 N/Sq.m (approx.)

The whole operation shall be done as per manufacturer’s 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 relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL. The admixture shall not cause decrease of strength of concrete/plaster at any stage and it shall be free from chlorides and sulphates. The admixture shall not affect the setting time by more than

5%. The maximum permissible dosage of admixture will be 3% (three percent) by weight of cement, but a lower dosage will always be preferred. The product shall be stored in strong moisture proof packings. However, in case of important structures where M25 or higher grade concrete is specified, the use of melamine based, high range water reducing concrete admixture shall be used to provide a waterproof concrete, For achieving high strength concrete having cement content around 400 kg/cu.m. a melamine based super plasiticizer will be preferable.

a) In concrete: The admixtures shall be procured from reliable and reputed manufacturers and approved by the Engineer. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer. The Contractor shall have the services of the manufacturer's supervisor at no extra cost to supervise the work, if desired by the Engineer.

b) In Plaster: The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturer's supervisor at no extra cost. On completion, the plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

3.26.04 Structural waterproofing

a) Nozzles spaced as required after the concrete is completed shall be drilled into surfaces to be rendered watertight. Non-shrink cement grout with waterproofing compound as per manufacturer's specifications shall be injected under pressure to seal all voids. Special care shall be taken at joints by providing additional nozzles. The pressure grouting shall be done on the internal surface.

b) External Treatment

Two layers of (1:4) plaster of 12 mm thick each with waterproofing compound as per manufacturer's specification shall be provided on outer surface of concrete underground structures.

3.26.05 Protective coating on Inside Surface.

Two coats of cement based two components polymer modified flexible protective and waterproofing slurry having 1 mm thick for each coat shall be

applied on the walls/floor after proper surface preparation as mentioned above. The slurry shall be applied by brush.

3.26.06 Bitumen Felt: Application for Tanking

This specification shall cover laying the waterproof course on the outside and inside of the walls and bases of structures.

The materials and workmanship shall conform to relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL. The bitumen felt should be hessian base and/or fibre base as specified in Drawing. If required by the Engineer, tests as specified in relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL shall be arranged by the Contractor without charging any extra to the Owner.

The Contractor shall execute this work in direct collaboration with one of the well-known specialized firm approved by the Engineer.

Cleaning the surface, keeping it dry, providing, necessary corner fillets and cement rendering and cutting chases, etc. shall be done as per drawings and/or instructions. If any protective brickwork on/against concrete sub-bases or walls are required, the same shall be provided. A twenty (20) years guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub-contractor jointly and severally, for this work. Free rectification of any defects noted in the work within this guarantee period will be carried out by the Contractor even if it is beyond the specified maintenance period of the contract as a whole.

3.26.07 Polyethylene Films: Application in Walls or base of structures

Waterproof treatment shall be applied as outlined and as per sequence given hereunder

i) The concrete surface shall be made smooth with 12 mm cement plaster 1:6.

ii) Apply hot bitumen 80/100 grade (relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL) at the rate of 1.0 Kg/Sq.m minimum

iii) lay black polyethylene film 250-micron (relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL) 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 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) at 1.0 Kg/Sq.m dusted with fine sand.

x) Protecting with a layer of 75 mm plain cement concrete M-10, or a layer of brick laid in cement mortar 1:6 in case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortar as shown on the drawing.

3.27.00 Protective Coating on Concrete Surface

3.27.01 On Foundation

The outside faces of foundation of important structures will be protected from adverse effect of soil/underground water, if shown on drawing by using rubber/bitumen emulsion protective coating of approved manufacturer.

4.00.00 SAMPLING AND TESTING

4.01.00 General

The Contractor shall carry out all sampling and testing in accordance with the relevant relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL 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 test 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 BS EN 196: latest or equivalent. 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 BS EN 932, 933, 1097, 1367, & 1744: latest or equivalent. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL.

4.04.00 Water

Sampling and Testing of water being used for concrete works as per BS EN 1008, BS EN ISO 9963: latest or equivalent will be carried out by the Contractor at regular intervals and whenever directed by the Engineer.

4.05.00 Admixture

4.05.01 Air Entraining Agents

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cylinder cube crushing strength vis-a-vis quantity of A.E.A. used for all types of concrete will be established by the Contractor by carrying out sufficiently large number of tests. After that, at regular intervals and whenever directed by the Engineer, the Contractor will check up the actual percentages of air entrained and corresponding crushing strengths to correlate with the earlier test results.

4.05.02 Other Admixtures

Tests for establishing the various properties of any other admixtures, which may be required to be added, shall be carried out by the Contractor.

4.06.00 Concrete

The sampling of concrete, making the test specimens, curing and testing procedure, sampling procedure, frequency of sampling, test specimen and acceptance criteria etc. shall be in accordance with BS EN 206: latest or equivalent. Normally, only compression tests shall be performed but under special circumstances the Engineer may require other tests to be performed in accordance with BS EN 206: latest or equivalent. To control the consistency of concrete from every mixing plant, slump tests shall be carried out by the Contractor every two hours or as directed by the Engineer. Slumps corresponding to the test specimens shall be recorded for reference. Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Contractor at his own cost. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, free of charge by the Contractor, to the satisfaction of the Engineer.

5.00.00 ACCEPTANCE CRITERIA

5.01.00 Standard Deviation

Standard deviation shall be based on test results and determination of Standard deviation shall conform to relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL.

5.02.00 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL.

5.03.00 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL.

5.04.00 Load Test

Load tests of structural members as per relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL may be

required by the Engineer, when the strength of test specimen results falls below the required strength.
If the member shows evident failure, the Contractor shall make the structure adequately strong free of cost to BHEL.

The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification. The entire cost of dismantling and replacement and restoration of the site being borne by the Contractor.

If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same will be made good, free of charge by the Contractor to the satisfaction of the Engineer.

6.00.00 RATES AND MEASUREMENTS

6.01.00 Cast-in-situ Concrete

6.01.01 Rates

a) The unit rates shall include the cost of labour, materials, equipment, handling, transporting, botching, mixing, placing in position, vibrating, compacting, finishing, curing, testing, etc. at all elevations. This shall include the cost of curing by regular wetting or by using curing compound.

b) The unit rates shall include for all working conditions including at locations under water, liquid, mud, in or under foul positions and extreme weather conditions.

c) The unit rates for exposed concrete works (including machine foundations) shall include all incidentals, rendering, smoothening with carborandum stone, finishing with a paste of cement sand mortar, curing, etc.

d) The unit rates shall include all arrangement for maintaining stability of structure during execution.

e) Nothing extra shall be payable for the handling/mixing of extra cement on account of any reason or pouring of second stage concrete.

f) Nothing shall be payable to the Contractor on account of facilities and arrangement provided by him for conducting ultrasonic pulse velocity (UPV) tests or other relevant tests to ascertain grade and quality, etc. of the concrete in case the concrete quality is in doubt and contractor has to establish the quality by further tests. In case of any defects, the Contractor shall rectify the same by cement/epoxy grout at his own cost.

However, mandatory UPV test as specified in the drawings shall be carried out including arrangement of all its facilities, staging, etc. and shall be payable to the contractor as per BOQ item.

g) The unit rates for controlling of the temperature of concrete shall include storing and mixing of ice, water, cooling of aggregate etc.

h) The quoted rate shall include the cost of MIX design, making of all trial mixes using admixtures and mixing in concrete etc. complete.

6.01.02 Measurements

a) Actual volume of concrete work as executed or as per drawings issued, whichever is less shall be measured in cubic meters to the nearest two decimals.

b) No deductions shall be made for the following:

i) Ends of dissimilar materials embedded inside for example, beams, posts, girders, rafters, purlins, trusses, corbels and steps upto 500 sqcm in cross section;

ii) Opening upto 0.1 sq.m.

iii) Volume occupied by reinforcement, sleeves, anchor bolts, and similar items.

iv) Volume occupied by pipes, conduits, sheathing, etc. not exceeding 100 sq.cm. each in cross sectional area.

c) The concrete works of different grades; below and above ground floor finished level shall be measured separately, unless otherwise specified in the schedule of items. Accordingly rates shall be applied for concrete in foundation for concrete below ground floor finished level and concrete in superstructure for concrete above ground floor finished level.

d) For temperature control measures, measurement shall be done in terms of quantity of concrete in cum. in concreting of which the ice have been used or cooling of aggregates has been done to keep the temperature of freshly laid concrete to less than 25^0C.

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, bending, binding with annealed wire, welding, tack welding, placing the reinforcement modification of already embedded reinforcement, if required, due to faulty fabrication or placement and other cost of tools and plants, materials, labours, return of unused steel to the store, etc.

c) However, lap welding of reinforcement steel if permitted shall be paid under separate item as provided in the BOQ.

d) No extra shall be paid for preparing and getting approved bar bending schedules (including all revisions).

e) Generally members are straight and have straight edges. However, for bending, binding, placing of reinforcement in any curved member in length or cross section or both, no extra payment shall be made.

6.02.02 Measurements

a) Bar or any other type of reinforcement used like hard drawn steel wire fabric etc. for reinforced concrete shall be measured by weight in tonnes. The weight shall be arrived at by multiplying the actual or theoretical length measured along with standard hooks, cranks, bends, authorized laps, etc. whichever is less by the sectional weights. Claims for payment for this item shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be as per relevant BS Standards /Specifications or equivalent international standards approved by BIFPCL/BHEL. Nothing extra will be payable to the Contractor on account of, difference in weight, if any, due to different methods adopted for issue and measurement.

b) Standard hooks, cranks, bends, authorised laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tonnes.

6.03.00 Formwork and Staging

6.03.01 Rates

a) The unit rates shall be inclusive of all staging, scaffolding, making the formwork watertight, etc. for all elevations and in all types of works.

b) No separate payment shall be made for providing fillets, for rounding or

chamfering at junctions, comers, etc.

c) The unit rates shall include the cost of labour, materials etc. and the extra time, which shall be required for the removal of shuttering/ support for satisfactory completion of work.

d) No extra payment shall be made on account of difficulty, wastage etc. for placement/removal of formwork between the network of closely placed steel beams or for the lacing/bracing portions and ribbed slab constructions.

e) Payment for curved shuttering shall be made for curved members/wall whose Centre line 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 up to 0.1 sq.m or boxing left for inserts etc. for facility of Contractor's work, shall be neglected as if nonexistent for the purpose of formwork measurement of surface in which the openings occur.

For suspended floor, no deduction shall be made for flange area of secondary steel beams.

d) No measurement shall be taken for the formwork in pockets, openings, chases, blockouts, etc. in concrete, the contact surface area is less than or equal to 0.1 sq.m. in each case.

e) For pockets, if the contact surface area is less than or equal to 0.1 sq.m. in each case, measurement shall be done under item for providing formwork in pockets.

e) Formwork, if required, for joints shown on drawing or instructed by the Engineer, shall be paid for the 'leading side' only.

6.04.00 Embedded Parts

6.04.01 Rates

a) The unit rate for erection of embedded steel parts, supplied by Engineer

shall include transportation from Owner's store to the place of work, erection & installation including setting material in concrete, etc. complete.

b) The unit rate for MS pipe embedments and PVC pipe embedments shall include cutting, welding, fabrication, erection, embedding, and transportation to site. Unit rate shall also include the cost of the pipes.

c) Rate for expansion fasteners shall include cost of fasteners, installation, and fixing including cost of washers and nuts and site testing if required.

6.04.02 Measurements

a) The measurement of the embedded steel parts fabricated and installed by the Contractor shall be based on the calculated weight of steel sections in tonne corrected to second place of decimal.

b) Embedded steel parts supplied by Owner and installed by Contractor Measurement shall be done for the net weight of the embedments installed in tonnes correct to second place of decimal.

c) For PVC pipes/conduits, measurements shall be in quintals correct to second place of decimal for the net weight.

d) For mild steel pipes, measurement shall be in quintals, correct to second place of decimal, for the net weight of the steel pipe supplied, fabricated, and installed.

e) The lugs shall be measured in Kg. correct to second place decimal for the net weight.

f) The expansion fasteners shall be measured in number according to tension capacity.

g) The rails shall not be treated as embedded steel part and the track shall be measured in running meter 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 up to the top surface of foundation concrete and shall be calculated from the dimensions shown on the drawings.

c) Measurement for underpinning shall be by volume between the top surface of the foundation concrete and the underside of the base plate, the plan dimensions being as indicated on the drawings.

d) No deduction shall be made for shims, bolts, shear keys and such other embedments.

f) Pressure injection grouting with cement based grout if required as per drawing shall be applied at appropriate spacing to cover the desired surface area and measurement shall be made for the surface area grouted in sqm as per BOQ item. However in water retaining structures, the structural grouting if required to ensure water tightens shall not be payable separately as deemed to be covered in water retaining concrete item of BOQ.

6.06.00 Joints

6.06.01 Rates

The unit rate shall include all the activities described in the schedule of items.

6.06.02 Measurements

a) Bitumen Board/Expanded polystyrene.

The measurement for bitumen board shall be based on actual finished surface area in square meters nearest to second decimal, for the specified thickness.

b) Water Stops

The measurement for water stops shall be in running meters of actual length of the joint covered, for specified thickness, width, and shapes. No separate measurement shall be made for laps/splices for cross-joints and mitered joints.

c) Metal Cover Strips

The measurement for Metal Cover Strips shall be based on actual finished

surface area in square meters for the specified thickness.

d) Vibration Damping Resilient Pads

The measurement for this item shall be in square meters for the specified thickness, measured correct to the second place of decimal, of the actual finished surface area.

6.07.00 Dismantling/Demolishing Work – RCC and PCC and Chipping of Concrete

6.07.01 Rates

The unit rates shall include the cost of all necessary propping, shoring, underpinning scaffolding, safety measures, temporary enclosures, disposal/ stacking of serviceable/unserviceable materials, etc. for all types of work and for all grades of concrete.

In the case of dismantling/demolishing work, the cutting of reinforcement shall also be included in the rate.

In the case of chipping work, the cutting of reinforcement shall be paid separately.

If the serviceable material including reinforcement steel from dismantled structure is allowed to be used/taken out by bidder, suitable rebate shall be given by bidder.

6.07.02 Measurements

a) Dismantling of PCC and RCC work shall be measured in cu.m separately. Measurement of all work, except hidden work shall be taken before execution of work and no allowance for increase in bulk shall be allowed. Specifications for deductions of voids, openings etc., shall be done on the same basis as that applied for construction work.

b) Chipping of concrete, making holes/pockets etc. shall be measured in cubic decimeters (i.e. 0.001 cu.m.).

c) Cutting of reinforcement in chipping work for making of pockets and openings shall be measured in sq. cm. of cross-sectional area.

6.08.00 Precast Concrete

This clause shall be read in conjunction with relevant provisions specified elsewhere for cast in-situ Concrete.

6.08.01 Rates

a) The unit rate shall include cost of preparation of casting yard, formwork, concrete and its casting, finishing as specified, setting filling of gaps between adjacent pre-cast concrete units with concrete, or cement mortar, curing, handling, erection, grouting, welding, preparation of supporting surface, etc.

6.08.02 Measurements

The measurement of pre-cast concrete members shall be on the basis of volume of concrete in cubic meters 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.

VOLUME: II B

SECTION - D

SUB-SECTION – D3

CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-421-600-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	CODES/STANDARDS	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 BS 1203: latest or equivalent.

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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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 BS 1203: latest or equivalent. The thickness shall be as specified.

e) Panel Doors

Panel door shall be of teakwood shutter frame, unless otherwise noted and panels with teakwood/commercial ply/teakwood particle board. Other considerations shall be as mentioned in item (d) above.

f) Windows, Ventilators

Windows and ventilators shall made of teakwood shutter frame, unless specified otherwise and glazing of specified thickness shall be fixed with wooden beadings.

g) Fixtures

Fixtures for doors, windows, furniture etc. shall be as shown on drawing or specified.

2.02.00 Workmanship

2.02.01 General

The work shall be done by skilled carpenters as per details shown on drawing or instructed by the Engineer.

Framing timber and other work shall be close - fitting with proper wood joinery, accurately set to required lines or levels and rigidly secured in place. The surface of frames etc., which will come in contact with masonry after fixing, shall be given two coats of approved paint before fixing. Mastic caulking shall be done after fixing external door and window frames. Special care shall be taken to match the grain of timber or plywood, which will be subsequently polished. Screwing or nailing will not be permitted to the edge of plywood and particle board. The edge of all plywood, blackboard and particle board shall be finished with teakwood lipping unless otherwise shown on drawings.

Fixing to frames and partitions shall generally be with 40 mm x 6 mm x 300 mm long M.S. holdfasts bifurcated at end and grouted with 1:2:4 cement concrete. The gap between masonry and external door and window frame shall be caulked with polysulphide mastic. M.S. grills or guard bars shall be provided to windows where called for in the drawings.

2.02.02 Finish

All carpentry work after finishing shall be sand papered smooth. A prime coat paint shall be given after inspection of the Engineer to all surfaces other than those, which shall be subsequently polished or covered with laminated plastic sheet.

2.02.03 Surface Treatment

When shown on drawings or called for, decorative ply or laminated plastic sheets shall be bonded under pressure to the surface to be finished. The adhesive used shall be of brand and brought to site in sealed containers. The rate of application and the length of time for which the pressure is to be applied shall be as per the manufacturer's instructions. The edge of sheets shall be protected by teak lipping or bevelled as shown on drawings.

3.00.00 ACCEPTANCE CRITERIA

3.00.01 Door and Window Frames

All frames shall be square and flat at the time of delivery and shall be checked for dimensions and corner angles. After fixing they shall be on a fine vertical plane. All external door and window frames shall be caulked with mastic.

3.02.00 Door and Window Shutters

All doors and window shutters shall be of proper size, shape, and design and free of warp. When fixed to frames, these shall operate smoothly without jamming and all latching or locking devices shall engage properly without undue pressure.

3.03.00 Partitions, Panelling, Pelmets, Furniture, etc.

3.03.01 General

These shall conform to drawings in all details. No unsightly nail marks etc. shall be permitted. Plywood grains shall be matched to give a uniform and pleasing appearance.

3.03.02 Partition

Shall be checked for rigidity of fixing, plumb and horizontal as well as vertical alignment.

3.03.03 Pelmets

Shall be checked for rigidity of fixing and adequate clearance of fixture.

3.03.04 Cupboard Shutters

Shall operate smoothly without jamming and locks, bolts and double ball catches shall engage securely. Single ball catches shall not be used.

3.03.05 Drawers

Shall operate smoothly and have backstops to prevent them from being pushed too far. Locks shall engage securely.

3.03.06 Loose Furniture

When placed on a level surface, table tops etc. shall be horizontal and the pieces stand stably on legs or supports.

4.00.00 CODES/STANDADRS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall include of all activities mentioned in "Schedule of Item" for completion of the work. No separate payment shall be made for fixing, caulking, application of primer coat, polishing, providing of butt hinges, holdfasts, sliding/tower bolts, door stoppers, door closers and other fittings and fixtures.

5.02.00 Measurement

Measurement shall be done in Sqm for doors, windows, ventilators, shutters, partitions etc.

Measurement for wooden frame shall be in CuM.

Pelmets shall be measured in RM.

VOLUME: II B

SECTION – D

SUB-SECTION – D4

ROOF AND UNDERGROUND STRUCTURES WATER PROOFING, INSULATION AND ALLIED WORKS

SPECIFICATION NO. PE-TS-421-600-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	12
4.00.00	CODES AND STANDARDS	12
5.00.00	RATES AND MEASUREMENTS	13

ROOF AND UNDERGROUND WATER PROOFING, INSULATION AND ALLIED WORKS

1.00.00 SCOPE

This section covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of roof and underground water-proofing, insulation and allied works for buildings and at locations covered under the scope of this package.

2.00.00 INSTALLATION

2.01.00 GRADING UNDERBED

The surface to receive the underbed shall be roughened and thoroughly cleaned with wire brush and water. Oil patches if any shall be removed with detergent. The surface shall be soaked with water and all excess water removed just before laying of the underbed.

The underbed shall not be laid under direct hot sun and shall be kept in shade immediately after laying so as to avoid quick loss of water from the mix and separation from the roof surface. The underbed shall be cured under water for at least 7 days.

The underbed shall be laid to provide an ultimate run off gradient not less than 1 in 120 and as directed by the Engineer. Up to an average thickness of 25mm the underbed shall usually be composed of cement and sand plaster. For higher thickness the underbed shall be made with cement concrete. The underbed shall be finished to receive the waterproofing treatment direct or insulation as the case may be.

2.01.01 Cement Mortar Underbed

The underbed grading plaster shall be average 25 mm thick maximum. It shall consist of cement and coarse sand in the ratio 1:4 nominal by volume. The sand and cement shall be thoroughly mixed dry and then water added. Each batch of mix shall be consumed before the initial set starts.

The plaster shall be fully compacted to the desired grade in continuous operation. The surface shall be even and reasonably smooth.

2.01.02 Cement Concrete Underbed

The underbed cement concrete shall be used where the subgrade is more than average 25 mm thick. It shall consist of cement concrete 1:2:4 nominal mix

by volume with 12 mm down stone chips and coarse sand. The aggregate shall be mixed dry and minimum quantity of water shall be added to make the mix workable.

The mix shall be laid to proper grade, fully consolidated and surface shall be smooth and even.

2.02.00 INSULATION

The Tenderer shall, along with the tender, send specifications of insulating materials he proposes to use and the proposed method of laying. Before bulk supply, the contractor shall send samples of insulating material to the Engineer, and after approval of the samples, the Contractor shall procure and transport the bulk material to the site. Whenever asked by the Engineer, the Contractor shall furnish test certificates from testing laboratory on the insulating and other properties of the materials.

After laying the insulation, the surface shall be made ready as required to receive the waterproofing treatment. If any plastering is used it shall be not leaner than 1:4 cement sand by volume and not thinner than 12 mm and it shall be cured for seven days.

2.02.01 Foam Concrete

This shall be of lightweight foam concrete of average 50 mm thickness or as specified or as shown on drawings. This may be laid in situ in suitable panels or precast blocks. The insulating properties shall be such that the thermal conductivity shall not exceed 0.125 Kcl/sq.m. hr degree C. Before starting the laying of foam concrete samples shall be prepared at site and got tested for approval of the Engineer.

The foam concrete laid shall be sufficiently strong to withstand the usual workload and standard loads expected on the roof. Any damaged portion shall be removed and replaced forthwith. Approval of the Engineer shall be taken before laying the waterproofing over the insulation.

While laying the foam concrete, samples from each batch of the mix shall be kept for test if so desired by the Engineer.

2.02.02 Expended Polystyrene Blocks

The expanded polystyrene block Insulation shall be fire retardant quality and shall have a maximum thermal conductivity of 0.026 Kcl m/sq.m h °C. It must be strong enough to withstand without any deformation under the workload and standard loads expected on the roof.

The Contractor shall lay the expanded polystyrene block as per manufacturer's approved specification. Only specifically experienced workers shall be used for this work. If the Engineer is not satisfied about the efficiency of the workers the Contractor shall secure manufacturer's 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 Bangladesh National Building Code or equivalent. Bitumen felt and Bitumen primer shall conform to Bangladesh National Building Code or equivalent.

The bonding materials shall consist of blown type or residual bitumen conforming to relevant Bangladesh National Building Code 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 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)

3) Hessian base self-finished felt, type 3, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)

5) 20 mm thick pressed precast concrete tiles with 15 mm, thick 1:4 cement-sand mortar underbed.

b) Heavy Treatment - Seven Courses

With Hessian base felt

1) Primer coat conforming to Bangladesh National Building Code or equivalent applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

3) Hessian base self-finished felt, type 3, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

5) Hessian base self-finished felt, type 3, grade I.

6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With fibre base felt

1) Primer coat conforming to Bangladesh National Building Code or equivalent applied at the rate 0.27lits/sqm min.

2) Not applied bitumen at the rate of 1.2 kg/sq.m (Min.)

3) Fiber base self-finished felt, type 2, grade 2.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

5) Fiber 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 fiber based felt

1) Primer coat conforming to Bangladesh National Building Code or equivalent applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

3) Fiber-base self-finished felt type 2, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m (min.)

5) Fibre base self-finished felt type 2, grade 1.

6) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

7) Fibre base self-finished felt type 2, grade 1.

8) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

9) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With Hessian base felt

1) Primer coat conforming Bangladesh National Building Code or equivalent applied at the rate 0.27 lits/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 relevant ASTM standards or equivalent 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 relevant ASTM or equivalent 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 forming a perfectly smooth permanently flexible seamless membrane which should have good adhesion to roof substrates (RCC, tiles, brick, and metals), having a minimum life of 10 years. It should also be resistant to acid (mild concentrated), alkalies

and have a very low water absorption rate (0.5%) max. at ambient temp. after 7 days.

The pack shall not be older than 9 months after the date of manufacture and packing.

b) Primer coat

It shall consists of polyurethane (P.U.) or any other equivalent material. Primer coat shall be a special blend of moisture curing urethane pre-polymers in solvent. A single coat of this primer shall be applied by brush over the prepared bed as an adhesion coat of an application rate of minimum 6 sq.m per litre.

The primer shall be allowed to dry for minimum of 2hrs. time before the successive finishing coats of P.U. liquid membrane are applied.

c) Finishing coats :

The finishing coats shall consist of two successive liquid coatings of high solids content urethane pre-polymers or equivalent material to form an elastomeric membrane. The overall dry film thickness shall be 1.5mm subject to minimum 500 gm per sq.m per coat application rate.

Each coat shall be allowed to dry for minimum 12 hours before applying the next coat. The surface should be dry and smooth before application.

The coating shall be continued up the parapets/walls for a minimum of 150mm over the finished roof surface. It shall be continued into rain water pipes by at least 100mm.

The final coat of P.U. liquid when tacky shall be sprinkled with the sand.

For edges, expansion joints and any vulnerable points a later of polyscrim cloth /fabric to be embedded between 2 finishing coats.

d) Surface Finish :

Areas of roof treatment which are vulnerable to accidental damage shall be provided with wearing course consist of minimum 20 mm thick PCC of Grade C12/15 (using12.5mm size aggregate) cast in panel of maximum size of 1.20m x 1.20m and reinforced with 0.56mm diameter galvanised chicken wire mesh and sealing of joints using sealant or elastomeric compound.

When the roof surface is subjected to foot traffic or used as a working area, a cement mortar (1:4) shall be applied over the top most layer of roofing treatment. Over this, a layer of chequered cement concrete flooring tiles shall

be provided in place of stone grit and cement painted. The chequered cement concrete flooring tile and it's laying shall be as per Bangladesh National Building Code or equivalent.

2.04.03 Waterproofing By Epoxy Resin Based Application

Exposed surfaces of cement concrete, lime concrete or brickwork to be treated for waterproofing by the resin-based application shall be thoroughly cleaned and the epoxy resin based material to be applied as directed by the manufacturer. The material shall not have any adverse effect on the surface on which it is applied and must stick to it uniformly to make a strong durable bond. It shall not be affected by short duration fire, sun exposure, and light duty traffic. The application shall be resistant to growth of fungus and proof against saltpetre action. If desired by the Engineer, a sample shall be prepared in advance and tested for waterproofness for 48 hours under 300 mm depth of standing water. The Contractor shall arrange the demonstration by providing free the materials and labour for the application as free of cost to Owner. This item shall carry a guarantee as specified.

2.04.05 Flashing

Unless otherwise stated flashing shall be done in the same way as the waterproofing except that the last layer shall be finished with two coats of bituminous primer. The flashing shall be extended up the vertical surfaces as shown on drawing. The flashing shall end in grooves in vertical walls. The grooves shall be at least 65 mm deep and caulked with waterproof mastic cement. The minimum overlap with horizontal roofing felt shall be 100 mm.

Where specified or directed by the Engineer, metal flashing shall be provided. The materials shall be 18 Gage or 22 G G.I. sheets, as specified or as directed by the Engineer.

2.05.00 WATER-PROOFING OF UNDERGROUND STRUCTURES

Basements, ducts, pits, tunnels (excluding tanks) etc. below the ground water table and in contact with soil are covered under this. Bonding material shall be blown bitumen of 65/25 grade conforming to Bangladesh National Building Code or equivalent.

Waterproofing shall be provided on the outside of walls and top of RCC slab and shall be carried out up to 150mm above ground level. The number of layers of bitumen felt to be used for walls and floor unless otherwise shown in the drawing shall be:

a) 2 layers - for depths up to 5m below ground level

2.05.01 Method of laying the bitumen felts and workmanship shall be as per Bangladesh National Building Code or equivalent. 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 Bangladesh National Building Code or equivalent.

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 Bangladesh National Building Code or equivalent.

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 (C12/15) 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 CODES AND STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of Bangladesh National Building Code or equivalent.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be for complete work, including the cost of all materials and labour, as detailed in the specification unless any portion is specifically excluded in the "Schedule of Items".

No extra shall be paid for finishing around opening, sleeves, pipes, ducts, inserts, etc.

No separate payments shall be made for cleaning of surface, treating of cracks and surface preparation.

5.02.00 Measurement

The finished work shall be measured in Sqm of actual surface area for the purpose of payment.

No deduction shall be made and no extra shall be paid for openings up to 0.4 sqm.

VOLUME: II B

SECTION - D

SUB-SECTION – D5

METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

SPECIFICATION NO. PE-TS-421-600-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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2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	8
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5.00.00	CODES/STANDARDS	10
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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 partitions, etc. The scope of work shall also include the assembly and erection of all doors, windows, louvers, glazed partitions, etc. Supplying and/or fixing of all door and window accessories and hardware are also included in the scope.

2.00.00 INSTALLATION

2.01.00 Materials

Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in Bangladesh National Building Code or equivalent or as specified.

Steel sheets for frames, shutters, louver blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating doors, windows, partitions etc. shall be extruded sections conforming to Bangladesh National Building Code or equivalent or as manufactured by Indian Aluminium Company Limited or approved equivalent. Aluminium door, windows and ventilator shall be fabricated as per Bangladesh National Building Code or equivalent. The alloy used shall conform to Bangladesh National Building Code or equivalent.

Hardware and fixtures shall be as specified and the best quality from approved manufacturers shall only be used. The tenderer shall specifically state the particular manufacturer's materials he proposes to use. Improper alignment or faulty operation due to inadequate strength of hardware or fixture shall entirely be the Contractor's responsibility.

All hardware and fixtures shall be able to withstand repeated use. Door closures shall conform to Bangladesh National Building Code or equivalent and shall be suitable for doors weighing 61-80 Kg. unless otherwise stated. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or shall be replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance Requirements and endurance test stated in Bangladesh National Building Code or equivalent. The Contractor shall submit samples of each type of hardware to the Engineer. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the Contractor towards end for incorporation in the job. The mastic for caulking

shall be of best quality from a manufacturer approved by, the Engineer. In general, mastic for fixing of metals frames shall be as per Bangladesh National Building Code or equivalent 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 hard wares where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown drawing, provision shall be made for fixing glazing, vision panels, louvers etc. glazing mouldings shall be of 18 G steel or extruded aluminium sections and suitable for fixing 6 mm. glass. Louvers blades shall be V or Z shaped and made out of 16 G sheets.

c) Single Sheet Door Shutters

Single sheet doors shall be made from best quality 18 G mild steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with semi tubular edge and central stiffening rail, which shall convey the lock and other fixture. The frames shall be made from best quality, 16 G mild steel sheets.

Wherever required, provisions for fixing glass panes, louvers etc. shall be made.

The manufacturing shall be done as specified in 2.02.01 (b) "Double Plate Flush Door Shutters."

d) Sliding Door

Sliding doors shall be either double plate or single plate Construction made out of 18 gauge steel sheets with adequate stiffeners. The contractor shall specify the weight of the door in his shop and submit the manufacturer's catalogue of the sliding gear he proposes to use. Where called for the Contractor shall make provision for openings to the door for monorail beams. Doors shall close positively to exclude rainwater from seeping in. When called for, sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions.

e) Door Threshold

Door threshold shall be provided. Doors without threshold shall have bottom tie of approved type.

f) Steel Windows, Sashes, and Ventilators etc.

These shall conform in all respects to Bangladesh National Building Code or equivalent latest editions. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, and pivot arrangements for ventilators, etc. or as called for. All welds shall be dressed flush on all exposed and contact surfaces. Where composite unit openings are required the individual window units shall be joined together with requisite transoms and mullions. All windows shall be outside glazed, fixed with putty or metal glazing beads as specified. Where aluminium glazing beads are specified, they shall be extruded aluminium channel 9.5 mm x 9.5 mm x 1.6 mm (Indal Section No. 2209 or equivalent) unless otherwise shown on drawings. Aluminium beads shall be given one coat of zinc chromate primer before fixing to windows.

2.02.02 Aluminium Door, Windows, and Frames

Extruded sections shall have a minimum 3 mm wall thickness. All sections shall be approved by the Engineer before fabrication is taken up. Doors frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating of minimum 15 micron thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent Coating shall be applied to the sections before shipment from the factory.

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce an uniform color throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.03.00 Shop Coat or Paint

The shop Paint for steel doors, windows etc. shall be best lead or zinc chromate primer paint from, approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. that will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.

Where called for, all steel doors, windows, etc. shall be hot dip galvanized to give a coating weight of 1½ - 2 oz. per sqft. One coat zinc chromate primer coat shall then be applied as shop paint.

Portions of aluminium frame, which come in contact with masonry construction shall be (before shipment from workshop) protected with a heavy coat of alkali resistant paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer.

2.04.00 Handling & Storage of Fabricated Material

All metal doors, windows, etc. shall be packed and crated properly before dispatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.

When taking delivery of items supplied by Owner, the Contractor shall satisfy himself that the items supplied are up to the specified standard. Any defect detected shall promptly be brought to the notice of the Engineer.

All metal doors, windows etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.

2.05.00 Assembly & Erection at Site

In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to Bangladesh National Building Code or equivalent. 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 BS EN 1634 or equivalent. Doors shall comply with the testing requirement mentioned in in BS EN 1634 or equivalent. The doors shall be approved by Tariff Advisory Committee and shall have fire proof classification T30/T90 as per drawing.

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 planes, free from warp or buckle.

f) All welds shall be dressed flush on exposed and contact surfaces.

g) Correctness of location and smoothness of operations of all shop installed hardware and fixtures

h) Provision for hardware and fixtures to be installed at site.

i) Glazing beads shall be cut with mitered corners.

j) Glazing clips, fixing devices etc. shall be supplied in adequate numbers.

k) Shop coats shall be properly applied.

l) Exposed aluminum surfaces shall be free from scratches, stains, and discoloration. Anodized surfaces shall present a uniform and pleasing look.

3.02.00 For installed Items

a) Installations shall be at correct location, elevation and in general, on a true vertical plane.

b) Fixing details shall be strictly as shown on drawings.

c) Assembly of composite units shall be strictly, as per drawings with mastic caulking of transoms and mullions, gaskets, weather strips etc. complete.

d) All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry.

e) All openable section shall operate smoothly without jamming.

f) Locks, fasteners etc. shall be engage positively. Key shall, be non-interchangeable.

g) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.

h) Aluminium doors, windows, etc. shall be free from scratches stain or discoloration.

4.00.00 INFORMATION TO BE SUBMITTED

4.01.00 With Tender

a) Names of manufacturers for Doors, windows etc.

b) Manufacturer's catalogue for all hardware and fixtures proposed to be used.

4.02.00 After Award

a) Before starting fabrication of all metal doors, windows, etc. the Contractor shall submit detailed fabrication drawings to the Engineer for approval. The fabrication shall be started only after approval of drawings.

b) He shall submit a programme of work to be done for the approval of the Engineer.

c) Before bulk supply, he shall submit for the approval of the Engineer samples of all bought out items and samples of each type of fabricated

items. The samples shall by retained by the Engineer for comparison of bulk supply and returned to the Contractor towards the end for final incorporation in the job.

5.00.00 CODES & STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of Bangladesh National Building Code or equivalent.

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 aluminium shall be measured in Kgs. Wooden frames shall be measured in Cum. Measurement for aluminium partition frames shall be in Kg. Panelling and glazing shall be paid separately if not covered in BOQ item description.

Measurement for fire proof door shall be in SqM in net area outer to outer of the door.

ANNEXURE-A

SCHEDULE OF FIXTURES

A. TIMBER DOORS

1. For single leaf panel/flush doors

i) 100 mm brass butt hinges with screws	-	3 Nos.
ii) 150 mm brass tower bolts with screws	-	1 No.
iii) 100 mm x 225 mm clear plastic push Plate with counter sunk brass screws	-	1 No.
iv) 30 mm brass ring pull handle with Plates and screws	-	1 No.
v) 150 mm brass coat hook with screws	-	1 No.

vi) Heavy duty, cylinder looks on active leaf - for flush door. For door-closure, see “Door Schedule".

B. ALUMINIUM DOORS

1. For double leaf door

i) Concealed hanging arrangement for door leaves.

ii) Concealed two points bolt encasing simultaneously at head and threshold on inactive leaf, operable from inside.

iii) Heavy duty, cylinder look on active leaf.

iv) Pull handle of approved design on both leaves.

v) Doors stops for both leaves.

vi) Overhead door closure for both leaves.

ANNEXURE-A

C. STEEL DOORS AND WINDOWS

1. Doors

a) Double leaf doors

i) 100 mm butt hinges - 3 Nos. on each leaf.

ii) 300 mm aluminum tower bolt - 2 Nos. (top and bottom) On inside of inactive Leaf. 1. No. (Top only) On inside active leaf.

iii) 200 mm anodized aluminum pull handle - 1 No. of each leaf.

iv) Door stop of approved design - 1 No. of each leaf.

NOTE: For locks, door closure and threshold, see "Door Schedule".

b) Single leaf doors

i) 100 mm butt hinges - 3 Nos.

ii) 300 mm aluminum tower bolt - 2 Nos. top & bottom of Inside face

iii) 200mm anodised aluminum Pull handle - 1 No.

iv) Door stop of approved design - 1 No.

NOTE: For locks, door closures and threshold, see "Door Schedule".

2. Windows, Ventilators, etc.

a) Side Hung Windows

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) 12" peg stays - 1 No. per leaf

ANNEXURE-A

iii) 2 point handles - 1 No. per leaf

b) Top Hung Ventilators (Projecting Out)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Adjustable sliding fabrication assembles - 2 Nos. per leaf.

iii) 2 point handles - 1 No. per leaf.

c) Bottom Hung Ventilators (Projecting in)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Concealed side arms for opening adjustment. - 2 Nos. per leaf.

iii) Spring Catch - 1 No. per leaf.

ANNEXURE-A

D. ALUMINIUM WINDOW, VENTILATORS, ETC.

(As per Bangladesh National Building Code or equivalent)

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-421-600-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	CODES & STANDARDS	4
5.00.00	RATES	5

GLASS AND GLAZING

1.00.00 SCOPE

This section covers supplying and fixing of all glass and glazing including all clips, putty, mastic cement etc. wherever required as per specifications.

2.00.00 INSTALLATION

2.01.00 General

The Contractor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvers, miscellaneous glazing and partitions, from approved manufacturer like Hindustan Pilkinton or equivalent, having uniform refractive index and free from flaws, specks, and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site.

Materials

a) Glare reducing or beat absorbing glass shall be "Calorex" of Hindustan Pilkinton or approved equivalent and special care shall be taken to grind smooth and round off the edges before fixing.

b) Clear glass shall be flat draw float glass and shall be at least 4 mm thick. Float glass for doors shall be minimum 5.5 mm thick.

c) Wired glass shall be thick- rolled glass with centrally embedded 42g wire mesh of Georgian type. This may be of clear or coloured glass, as required.

d) Obscure glasses shall have a cast surface in one side.

e) Coloured and figured glass shall be as per approved sample.

f) In general, the putty shall conform to Bangladesh National Building Code or equivalent and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing.

g) Neoprene gaskets with snap-fit glazing beads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leak proof installation.

2.03.00 Glazing, Setting, and Finish

All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the Contractor.

All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in Bangladesh National Building Code or equivalent, four glazing chips shall be provided per glass pane, except for large panes were six or more clips shall be used as per engineer's instructions. All holes that may be necessary for holding the clips glazing heads and all other attachments shall be drilled by, the Contractor.

Glass panes shall be set without springing, and shall be bedded in putty and back puttied, except where mouldings or gasket are specified, putty, mastic cement etc. shall be smoothly finished to the even line and figured glass shall be set with smooth side out.

Where owner will supply glass, the Contractor shall cut it to size and fix them in the same as specified above.

The Contractor shall supply necessary glazing clips, putty, mastic cement etc.

After completion of glazing, the Contractor shall remove alldirt stains, excess putty etc. clean glass panes and leave the work in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones at the contractor’s own cost.

3.00.00 ACCEPTANCE CRITERIA

a) All installation shall be free from cracked, broken, or damaged glass. Edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped, cracked, or underground edges.

b) Glazing shall be carefully done to avoid direct contact with metal frames.

c) All glass shall be embedded in mastic or fixed by neoprene gaskets to give a leak proof installation.

d) At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer.

4.00.00 CODES & STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of Bangladesh National Building Code or equivalent.

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-421-600-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	CODES & STANDARDS	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 up to 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 centres, 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 centres running horizontally flexible connected with vertical links spaced not more than 200 centres. Alternatively, rolling grills shall be made from perforated slats of approved design reinforced with 6mm dia rods.

c) End locks shall be heavy type M.C.I. /C.I. and shall be provided at each end of alternate slats unless specified otherwise.

d) Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown on drawings, a flexible weather strip shall be applied to make tight contact with the floor.

e) Guides shall be of such depth as to retain the shutter under a wind pressure of 100 Kg/Sq.m.

f) Shafts shall be of steel pipe of sufficient size to carry the tensional load with a maximum deflection of 1/360th of span. Grease packed ball bearings or bushings shall be provided for smooth trouble free operation.

g) Hoods shall be formed of not less than 20 gauge steel, suitable reinforced to prevent sag.

h) Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides. Provision securing hand chain with pad-lock, provision for removable handle for hand cranks etc. shall be made as prescribed by the Engineer.

i) Power unit shall be suitable for 3 phase, 50 cycles, 400-volt A.C. power supply and be either floor or wall mounted unit. The motor shall be of sufficient capacity, to move the shutter in either direction at a speed of 0.3 metres per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building unless otherwise stated in drawing.

It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction.

j) Operating chains shall be of tested quality, heavily galvanized and with all ends rounded to assure smooth operation and hand protection.

k) Reduction gears shall be high strength grey cast iron, machine moulded from machine out patterns.

2.02.00 Manually Operated Shutters/Grills

Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 1.3 metres per second. In general, manually operated shutters shall be push pull type for opening up to 9 Sq. metre in area. Larger shutters shall, be either chain or gear operated or crank and gear operated. The crank handle shall be removable. All shutters shall be lockable from one or both sides as desired by the Engineer.

2.03.00 Power operated Shutters/Grills

These shall be operable from a push button station conveniently located beside the door. One emergency hand chain/crank operation shall also be provided for use in case of failure of the electric system. Where called for, externally mounted shutters shall be operated by control mechanism located inside the building.

2.04.00 Shop Coat

Shutters shall be painted with one coat of red lead or zinc chromate primer. Where specified, doors shall be galvanized and subsequently painted one coat of zinc chromate for adhesion of field coat.

2.05.00 Erection

Door shall be installed by the manufacturer or his authorized representative and all work shall be as per manufacturer’s instructions. Any drilling or cutting

to concrete, masonry etc. shall be made good after erection of shutters and all abrasion to shop coat shall be touched up. All electrical work shall be in strict accordance with the latest Bangladesh National Building code or equivalent.

3.00.00 ACCEPTANCE CRITERIA AND GUARANTEE

3.01.00 Shop Inspection

After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings.

3.02.00 Field Inspection

After installing the shutters, the Contractor shall test the performance of the shutter in the presence of the Engineer. The doors shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault free performance.

3.03.00 Guarantee

The Contractor shall give one year's guarantee for the successful operation of the shutters. This shall be supported by a separate and unilateral guarantee from the manufacturer of the shutters.

4.00.00 CODE & STANDARD

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of Bangladesh National Building Code or equivalent.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates for rolling shutters and grill shall include the cost of the locks, guide channels, cost of drive as specified. In case of electrically operated rolling shutters, the rate shall also include the mounting of controls, wire and wiring from the nearest junction box, conduit and other electrical connections and cost of electric motor.

5.02.00 Measurement

Supply and installation of rolling shutter and grill shall be measured in Sqm in net outer to outer (including frame) area of each type used as described in "Schedule of Items".

VOLUME: II B

SECTION - D

SUB-SECTION – D8

MISCELLANEOUS METAL

SPECIFICATION NO. PE-TS-421-600-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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4.00.00	CODES & STANDARDS	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 BS EN 1011-1: latest or equivalent.

c) Welding of aluminium shall be done accordance with BS EN 1011-4: latest or equivalent. 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 BS EN 1011-1: latest or equivalent for steel and BS EN 1011-4: latest or equivalent 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, than those shown on drawings, shall be made without the approval of the Engineer.

2.02.06 Drifting

Correction minor misfits and a reasonable amount of reading and cutting of excess stock from rivets may be permitted. For this, light drifting may be allowed to draw holes together. Twist drills shall be used to enlarge as necessary to make connections, reaming that weakness the members or make it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins or a moderate amount or reaming and slight chipping and cutting shall immediately be called to the attention of the Engineer-and approval of the method of correction obtained. The use of cutting torches to enlarge or alter rivet holes shall not be permitted.

2.02.07 Spot Painting

All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials and used for the shop paint or equivalent.

2.02.08 Making Good

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.

2.02.09 Grouting

All bearing plates, loose, lintels and beams, etc. shall be set to proper grade and level by the Contractor and the Engineer's approval obtained before proceeding with the grouting. Grouting shall be done in 1:1½:3 concrete with 6 mm down stone chips or as specified in schedule of items.

2.02.10 Anchor Fasteners

The anchor fasteners shall be of two type viz. light duty for carrying tensile load up to 0.5MT per fasteners and heavy duty for carrying tensile load of 0.5MT to 5.0MT per fasteners. These anchor fasteners shall be fixed into concrete. The Contractor shall submit the Manufacture’s literature showing the average pull out and average shear value for anchor of various sizes. Anchors shall be fixed in position strictly as per the manufacturer’s instructions and as approved by the Engineer.

Heavy Duty Anchor Fasteners

The safe tensile load carrying capacity of the anchors shall be arrived by providing the minimum factor of capacity of 2.5 for the characteristic load of the anchor. Minimum size of anchor shall be M8 (8mm). All anchors shall be from the approved manufacturers like HILTI or equivalent.

a) Anchor fasteners shall be supplied and fixed in position by the contractor. Anchor fasteners can be of mechanical bonding or chemical bonding.
b) Capacity of the anchor shall be established after considering the effect of concrete grade, embedment depth, concrete thickness, anchor spacing and edge distance from the concrete edge.
c) The selection for the particular type of bonding for the anchors shall be made after considering the concrete grade, available embedment depth,

load to be transferred, space available for installing anchors.

d) The mechanical bonding anchor are torque controlled anchors made from carbon steel of grade 8.8 as per BS EN ISO 898: latest or equivalent. Anchors in bolt as well as nut version are acceptable. The bolt version anchors consists of bolt washer, sleeves, plastic section, expansion sleeves and a cone. Nuts version anchor consists of nuts, threaded rod, washer, sleeves, plastic section, expansion sleeves and a cone. All steel component of anchor shall be electro galvanised to minimum 5 micron coating thickness. The plastic section shall be of polyacetal Derlin 100 or equivalent.

e) Chemical bonding anchor shall consist of foil capsule and threaded rod. The foil capsule shall contain the resin and hardener. The threaded rod shall have chiselled tip. The behaviour of anchors under fire shall conform the heating curves as per BS ISO 834: latest or equivalent. 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 BS EN ISO 898: latest or equivalent. All steel components of the anchors shall be electro-galvanised to minimum 5 micron thickness.

Light Duty Anchors

This anchor shall comprise of stud, nut, washers, expansion sleeve. The one end of the stud shall have thread and the other end shall have cold formed conical head. All steel components of the anchors shall be electro-galvanised to minimum 5 micron thickness. The expansion sleeve shall preferably be of stainless steel of SS316. The anchors shall conform to minimum grade 5.8 as per BS EN ISO 898: latest or equivalent.

2.02.11 Pipe Joints

MS pipes or GI pipes shall be joined by threaded sockets or by welding. Cast iron pipes shall be socket and spigot joined and caulked with hemp and molten head.

2.03.0 FENCING

2.03.01 Chain Link Fencing

The material requirement shall conform to BS 1722-1: latest edition or equivalent. The chain link fencing shall be woven from 3.0mm dia. wire with mesh size of 50mm. The mesh wire shall not vary from specified dia. by more than $\pm$0.05mm. All steel wire shall be hot dipped galvanised wire and plastic coated. The dia shall be measured over the galvanised coating. The line wire shall be 3.15mm dia. mild steel wire with plastic coating. The stirrup wire for securing the line wire to the intermediate post (RCC/structural steel) shall be 2.5 mm diameter mild steel. The tying wire for securing the chain link fencing

to the line wire shall be 2.0mm diameter galvanized steel. Hair pin chain staples for fastening down the bottom of galvanised chain line fencing to the concrete sill shall be 3.0mm galvanized wire. The ends shall be bent outwards for securing anchorage.

Cleat for eye bolts shall be of uniform size and shall consist of mild steel angle of 75 x 50 x 8 mm. The eye bolts strainer shall consist of bolt with welded eye sufficiently threaded and fitted with a nut and washer. Two-way eye bolt strainer shall have suitable ring nuts fitted after the wires have been strained on one side. Stretcher bar shall consist of galvanized mild steel flats 25 x 5.0 mm. They shall be secured to the cleats by steel bolts.

The chain link fencing shall be strained between each pair of straining posts and secured to each straining posts by means of a stretcher bar. Line wires shall be provided at the top and bottom of the mesh and at two evenly spaced intermediate levels. The top wire shall be doubled, making five line wires in all Top line wire shall be threaded through appropriate adjacent row of mesh, care being taken that no meshes in the row are bypassed by the line wire except where deviation is necessary at the straining posts. The intermediate line wires shall be strained in front of the fencing. The fencing shall be attached to the top and bottom line wire by wire ties spaced at 150mm apart and to the other middle line wire by wire ties spaced at 450mm apart.

The bottom of fencing shall be treated as follows:
Continuous concrete sill 125mm wide x 225mm high for full length between posts shall be cast with the top 25mm above GL and 25mm below the chain link fencing. Hair pin staples shall be threaded through the bottom row of mesh at 750mm c/c and set in the sill to a depth of 150mm.

2.03.02 Barbed Wire Fencing

The barbed wire shall be conform to BS EN 10223-1: latest or equivalent. The barbed wire shall be galvanised and galvanising shall conform to the requirement laid down for 'light-coated wire' of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL and it shall be smooth and relatively free of lumps etc. Wire with excessive roughness blisters, salammoniac spots shall be rejected. The barbed wire shall be made from two line wire and two point wire of 2.5 mm thickness each. The barbs shall have four point and shall be formed by twisting two point wires, each two turns, tightly around both or one line wire (Type A - around both line wire, Type B - around one line wire) making altogether four complete turns. The barbs shall be so finished that four points are set and located or locked as far as possible at right angle to each other. The barbs shall project a distance of 12,5 mm ± 3,5 mm from the centreline of the wire. The distance between two barbs shall be 75±7mm.

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 69 M on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3.0m. Struts shall be fitted to all straining posts behind the chain link fabric in the direction of line of fence. There shall be four evenly spaced row of line wire in all. The top line wire shall be doubled, making five line wire in all. The bottom wire shall be closed to the ground. Each line wire shall be strained tightly by means of eyebolts strainers or winders at each straining points. Each line wire shall be secured to each intermediate post by a wire stirrup passed through a hold in the post and secured to the line wire by three complete turns on each sides of the post. The barbed wire shall be fitted with one dropper at the centre of each bay, secured to the wire so that they could not be bunched together. Droppers for barbed wire shall be of mild steel of not less than 25 x 4.75 mm thick with 38 x 4.85 mm half round staples for fastening the barbed wire to them. Bracing for the rows of barbed wire shall be approved by the Engineer.

3.00.00 ACCEPTANCE CRITERIA

a) All items shall be correct shape, size, weight etc. shown on drawings and schedule of items.

b) For installed items, the tolerances shall be as follows

   i) Permissible deviation from, straightness – 1 in 1000.

   ii) Seats, stiffener connections etc. shall be as per approved drawings and shall not interfere with architectural clearances.

c) All castings shall be free from blowholes, cracks, and other blemishes.

d) All MS wire fencing shall be in true vertical plain, and shall not bulge.

4.00.00 IS CODES

BS 4102 Steel wire for general fencing purposes.

BS 1722-1 Specification for chain link fences.

BS EN 10223-1 Zinc and zinc-alloy coated steel barbed wire.

5.00.00 RATES AND MEASURMENTS

5.01.0 Rates

Rates shall include supply, fabrication and installation for misc. metals works as required for completion of works like gates, fencing, handrails, ladders, hangers, anchors etc., unless otherwise specified in Schedule of Items.

Rate for fencing shall also include excavation, concreting and supply, erection & fabrication of post (post made of either structural steel or reinforced cement concrete), unless any specific item is excluded.

5.02.0 Measurements

Measurement for MS gates shall be in MT.

Measurement for galvanised MS wire fencing shall be in Sqm.

Measurement for Anchors shall be in nos. for the type as specified in schedule of items.

Measurement of other misc. metals shall be done in MT unless otherwise specified in schedule of items.

VOLUME: II B

SECTION - D

SUB-SECTION – D9

MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-421-600-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.
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4.00.00	CODES & STANDARDS	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 category I with minimum compressive strength 7.5 N/mm^2 as per BS EN 771-1: latest or equivalent of nominal dimensions as per standard specification under BS EN 771-16: latest or equivalent, well burnt, of uniform size, shape and color, 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 shall be measured as per BS EN 771-21: latest or equivalent for 24 hours immersion in cold water. Dimensional tolerance shall for bricks shall be as per BS EN 771-1: latest or equivalent. 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. The water absorption of stone shall be as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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 Portland cement or Portland Slag Cement or Portland Pozzolana Cement conforming to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 BS EN 12620: latest or equivalent, 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 BS EN 12620: latest or equivalent and shall be such as to produce a dense concrete or the specified proportions and strength and of consistence that will work readily into position without segregation.

Aggregates shall be stored on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass, or any other injurious substances at any stage.
Aggregate of different size shall be kept in separate stacks. If so desired by the Engineer aggregate from different sources shall be stacked separately with proper care to prevent intermixing.

e) Sand

Sand shall be hard, durable, clean, and free from adherent coatings or organic matter and shall not contain clay balls or pellets. The sand shall be free from impurities such as iron pyrites, alkalis, salts, coal, mica, shale or other laminated materials in such forms or quantities as to affect adversely the hardening, strength, durability or appearance of mortar, plaster or concrete or to cause corrosion to any metal in contact with such mortar, plaster or concrete. All sand shall be properly graded and shall be as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. Sand for concrete shall conform to BS EN 12620: latest.

f) Water

Water shall be clean, fresh and free from organic matters, acids or soluble salts and other deleterious substances which may cause corrosion, discoloration, efflorescence etc.

g) Reinforcement & structural steel

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust, oil and grease or other coatings, which may impair proper bond. Structural steel shall conform to BS EN10025-2 or equivalent. Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement, Cold twisted steel bars, Hand drawn steel wire fabric shall conform to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. Hexagonal wire netting shall conform to IS: 3150. All steel bars including and above 10 mm diameter shall be of tested quality. All wire netting shall be galvanized.

Reinforcement bars shall be stored off the ground and under cover if so desired by the Engineer. If necessary, a coat of cement wash shall be given to the bars to guard against rusting.

3.00.00 INSTALLATION

3:01.00 Soling

3.01.01 Brick Soling

The ground shall be dressed, consolidated by ramming, or by light rolling and a 12 mm thick cushion of sand laid. On the sand cushion the bricks shall be laid with fine joints and placed firmly in position by hammering with wooden mallet. The surface shall be free from undulations. The 'frog' side shall be on the underside. The joints shall be broken the in all direction and bricks cut as required. The pattern of laying and number of layers shall be as per Schedule of item. Orientation shall be as desired by the Engineer. After laying of each layer of bricks sand shall be spread over and worked into the joints to pack the bricks tight.

3.01.02 Stone Soling

The stones for soling shall be selected on the basis of thickness of soling specified in the Schedule of Items. The larger stones shall be laid and the gaps filled by smaller stones. The interstices shall then be firmly packed with sand by flooding with water.

3.02.00 Brick-on-Edge

Excavation shall be done close to the brick dimensions and in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be acceptable to the Engineer.

3.03.00 Masonry

3.03.01 General

All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings.

3.03.02 Cement Mortar

Cement mortar shall be prepared with materials specified in clause 2.00.00. Sand for masonry mortar shall conform to BS EN 13139: latest or equivalent. Cement and sand in the specified proportion shall be mixed dry thoroughly and minimum water added to attain required workability.

Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with fresh mortar if permitted by the Engineer who may direct addition of additional cement without any extra payment. No mortar, which has stood for more than half an hour, shall be used.

3.03.03 Brick Masonry

Bricks shall be soaked by submergence in clean water for at least two hours in approved vats before use. Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing.

Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickworks two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

3.03.04 Exposed Brickwork

Brickwork in superstructures, which is not covered by plaster, shall be as shown on drawing and executed by specially skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule, and string. All brickwork shall be cleaned at the end of days' work. If face bricks are specified, the brickwork shall be in composite bricks, with face bricks on the exposed face and balance in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean, and pointed as specified. Where face bricks are used carborandum 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 specially skilled mason. Stones used for exposed face shall be specially selected. All exposed stone faces shall be kept clean and free from mortar and pointed up neatly as the work proceeds in a manner called for in the drawings or instructions. A sample wall, 10 Sq.M. area shall be built and approved by the Engineer and all works shall match with this sample.

3.03.08 Composite Masonry

Where stonework facing with brick masonry backing is specified the bond between them shall be achieved by bond stones of dimensions and frequency as desired by the Engineer.

3.03.09 Expansion & Separation Joints

Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings and specified. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard waterproof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.

3.03.10 Mouldings, Cornices, Drip Course

These shall be made as shown in drawings. Bricks or stone shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with Carborundum stone.

3.03.11 Curing

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days work top surface of masonry shall be

kept wet by ponding.

3.03.12 Embedding of fixtures

All fixtures shall generally be embedded in mortar and masonry units shall be cut as required.

3.03.13 Encasing of Structural Steel

This shall be done by building masonry work round flanges, webs etc., and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh when shown on drawings or instructed by the Engineer. The minimum lap in chicken wire mesh shall be 50 mm.

3.04.00 Damp Proof Course (DPC)

Unless otherwise specified Damp-proof course shall be 40 mm thick 'artificial stone' in proportion 1:1½:3 cement sand stone-chips (10 mm down) with admixture of a waterproofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double chequered and cured by ponding for seven days.

3.05.00 Damp Proof Membrane

Damp proof treatment using fibre or hessian base bitumen felt shall be 6, 8 or 10 course treatment as specified in relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. The number of courses shall be as shown as drawings or as specified. Sequence of work shall be as directed by the Engineer. Extreme care shall be taken to prevent damage to felt during and after laying. The Contractor shall be obliged, at his own expense, to rectify any leakage appearing within 5 years of installation by removing and renewing the coats at the point of leakage.

Where shown on drawing, damp proof membrane with one layer bitumen paper or one layer alkathene sheet shall be laid with minimum 150 mm lap under slabs on grade.

3.05.00 Plinth Protection

Plinth of buildings shall be protected with brick-on-edge paving of minimum 750mm width unless otherwise shown on the drawings. The treatment shall consist of laying bricks in cement mortar 1:6 (1 cement: 6 sand) over a 75mm thick bed of dry graded brick aggregate, 40mm nominal size, grouted with

sand. The top shall be finished with 1:2 cement mortar pointing (1 cement: 2 sand). Plinth protection shall be laid with a minimum outward slope of 1 in 50. The brick aggregate shall be well graded, broken from well burnt or slightly overbumt and dense brickbats. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt or any other foreign matter.

The ground shall first be prepared to the required slope around the building. The high portions of the ground should be cut down; hollows and depressions filled up to the required level from the excavated earth and rammed so as to give uniform outward slope. The bed shall be watered and rammed with heavy iron square rammers. Surplus earth, if any, shall be disposed off beyond a lead of 50m or as directed by the Engineer.

Over this, 75mm thick bed of aggregate of 40mm nominal size, shall be laid with a minimum outward slope of 1 in 50. Aggregates shall be carefully laid and packed, bigger sized being placed at the bottom. The brick aggregates shall be consolidated dry with heavy iron rammers.

The aggregates shall then be grouted evenly with sand at the rate of 0.6 cubic metre per square metre area, adequately watered to ensure filling of voids by sand and again rammed with heavy iron rammers. The finished surface shall give uniform appearance. After the subgrade has been compacted thoroughly, brick flooring with bricks of specified strength in cement mortar 1:6 (1 cement: 6 sand) shall be laid.

The bricks shall be laid on edge in Diagonal/Herring Bone Bond or other paftem as specified or as directed by the Engineer. Bricks shall be laid on 12mm thick mortar bed and each brick shall be properly bedded and set home by gentle tapping with handle of trowel or wooden mallet. Its inside face shall be buttered with mortar before the next brick is laid and pressed against it. On completion of the portion of flooring, the vertical joints shall be fully filled from the top with mortar. The surface shall present a true plain surface with the required slope.

The pointing shall be done in cement mortar 1:2 (1 cement: 2 sand). The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the bricks so as give a smooth appearance. The edges shall be neatly trimmed with a trowel and a straight edge. The mortar shall not spread over surface of the masonry.

Brick flooring & pointing shall be kept wet for a minimum period of seven days. These shall be protected from rain by suitable covering when the mortar is green.

4.00.00 CODES & STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise.

5.00.00 RATES AND MEASUREMENTS

5.01.00 Rates

Unit rate for masonry work shall include the following:

a) Raking out joints for plastering or pointing or finishing the joint flush as the work proceeds.

b) Preparing top sand sides of existing wall for joining old with new work.

c) Providing, dismantling and removing the scaffolding.

Unit rate for DPC shall be inclusive of formwork and bitumen painting.

5.02.00 Measurement

Brickwork in wall of half brick thickness shall be measured separately in Sqm stating the wall thickness and more than half brick thickness shall be measured by volume. Plaster thickness shall not be considered for computation of volume.

Masonry work in sub structure and super structure shall be measured separately, unless otherwise specified in the Schedule of items.

No deductions shall be made and no extra payment shall be made for following:

a) Opening upto 0.1 Sqm each in area. In calculating the area of the opening lintels or sills shall be included along with the size of the opening.

b) Drainage holes and recesses for cement blocks to embed holdfasts for doors, windows etc.

c) Pipe and fixtures upto 300mm dia. and nothing extra shall be paid for the mortar used for fixing.

d) Ends of dissimilar materials (i.e. joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc); up to 0.1 sqm in section;

e) Chases of section not exceeding 50 cm in girth;

f) Iron fixtures, such as wall ties and hold fasts for doors and windows;

g) Cement concrete blocks as fcr hold fasts and holding down bolts;

h) Wall plates, bed plaros, and bearing of slabs, CHAJJAS and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall;

Reinforcement in masonry work shall be paid separately under respective items.

Damp proof course shall be measured in Sqm. No deduction shall be made and no extra shall be paid for opening upto 0.1 Sqm in area.

Plinth protection shall be measured under respective item of works executed required for completion of the work as specified.

VOLUME: II B

SECTION - D

SUB-SECTION – D10

FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-421-600-C010

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	8
4.00.00	CODES & STANDARDS	8
5.00.0	RATES AND MEASUREMENTS	9

FINISH TO MASONRY AND CONCRETE

1.00.00 SCOPE

This Section covers finishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment.

Before commencing finishing items the Contractor shall obtain the approval of the Engineer regarding the scheduling of work to minimize damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.00.01 INSTALLATION

2.01.00 Preparation of Surface

All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be rushed down with stiff wire brush to remove all loose dust from joints and thoroughly, washed with water. All laitance shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as to the acceptability of the base.

2.02.00 PLASTERING

2.02.01 Mortar

Mortar for plastering shall be as specified.
For sand cement plaster, sand and cement in the specified proportion shall be

mixed dry, on a watertight platform and minimum water added to achieve working consistency. The sand for plaster shall conform to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

No plaster, which has stood for more than half an hour, shall be used; plaster that shows tendency to become dry before this time shall have water added to it.

2.02.02 Application of Plaster

Plaster, when more than 12 mm thick, shall be applied in two coats a base coat followed by the finishing coat. Thickness of the base coat shall be sufficient to fill up all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The lower coat shall be thicker than the upper coat; the overall thickness of the coats shall not be less than the minimum thickness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'.

To ensure even thickness and true surface, patches of plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster, shall be fixed vertically about 2000 mm to 3000 mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the Contractor shall, without any extra cost to the Owner, make up any irregularity in the brickwork with plaster.

All vertical edges of brick pillars, doorjambs etc. shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.

2.02.03 Finish

Generally, the standard finish shall be used unless otherwise Shown on drawing or directed by the engineer. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the engineer regarding the texture, color and finish.

a) Standard Finish

Wherever punning is indicated, the interior plaster shall be finished rough; otherwise the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.

b) Neat Cement Finish

Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1) kg. per Sq.M. and rubbed smooth with a trowel.

c) Coloured Plaster Finish

This shall be done in the same way as specified in Clause 2.02.02 but using Coloured cement in place of ordinary cement. When coloured plastering is specified in more than one coat, the topcoat only shall be made with coloured cement.

Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement at site, as approved by the Engineer. The pigments to be mixed with cement shall conform to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

Samples of colouring material shall be submitted to the engineer for approval and material procured, shall conform in all respects to the approved samples, which shall remain with the Engineer. All coloured cement and/or pigments shall be stored in an approved manner in order to prevent deteriorations.

d) Pebble-dash Finish

Mortar of required thickness consisting of 1 part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering Clause 2.02.02. While the mortar is still plastic small pebbles or crushed stone of size generally from 10mm to 20mm as approved by the Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float or the flat end of oil a trowel, in order to ensure satisfactory bond between the dashing and the mortar.

e) Rough-cast Finish

A wet plastic mix of 3 parts coloured cement 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 as approved by the Engineer) shall be thrown on to the wall by means of a

plaster's trowel and left in the rough condition.

f) Scraped Finish
Ordinary plaster as described under Clause 2.02.02 after being leveled and allowed to stiffen for a few hours, shall be scraped with a steel straight edge to remove the surface skin. The pattern shall be as approved by the Engineer.

g) Textured Finish

Mortar consisting of 1 part cement and 3 parts sand by volume shall be applied in a manner as specified under "Plastering" Clause 2.2.2 Ornamental treatments in the form of horizontal or vertical rib texture fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.

h) Sand Faced Plaster

The plaster shall be applied in 2 coats. The first coat or the scratch coat should be approximately 14mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows, etc. The scratch coat shall be dashed on the prepared surface with heavy pressure, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the finishing coat. The mortar proportion for this scratch coat shall be as specified in the respective item or work. The scratch coat shall be cured for at least 7 days & then allowed to dry. The second coat shall be 6mm thick and it shall not be applied until at least 10 days have elapsed after the application of scratch coat. Before application of the second coat, the scratch coat shall be evenly damped. This coat shall be applied from top to bottom in one operation & without joints; finish shall be straight, true, & even. The mortar of this coat shall be as specified under the respective item of work. White sand for finish shall be used for the second coat & for finishing work. Sand for finish shall be of even coarse size & shall be dashed on the surface & sponged.

2.02.04 Curing

All plastered surfaces after laying shall be watered, for a minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried thoroughly, before applying the next coat.

2.03.00 Pointing to masonry

All Joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finishes with suitably tools to shape as shown on the drawings. Any surplus mortar shall be scalped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.04.00 Plaster with Metal Lath

The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection.

The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two-layers. The mortar for plastering shall consist of 1 part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.02.01. The application, finish etc. shall be as specified under relevant clause above. Where called for a 2 mm Plaster of Paris punting shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.

2.05.00 Lime Punning

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the lime punning. The punting shall be applied by skilled workman and given a smooth and ever finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

2.06.00 Plaster of Paris Punning

Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq.M. areas and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

2.07.00 Stone Facing

Stone facing where specified shall be done as shown on design drawings and approved shop drawings. The stone shall be as specified on drawings. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of shop drawings for the Engineer's approval before commencing the work.

The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable non-corrodible anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanized (weight of zinc coating shall. not be less than 700 gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1 part cement and 3 parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer.

The completed surface shall be neat, or uniform texture and acceptable to the Engineer.

Where pointing is specified on drawings it shall be done by mortar as specified on drawings.

3.00.00 ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply with the Specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawings.

4.00.00 CODES & STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise.

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 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-421-600-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.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA AND TESTING	10
4.00.00	CODES AND STANDARDS	11
5.00.00	RATES AND MEASUREMENTS	12

PAINTING, WHITE WASHING, POLISHING, ETC.

1.00.00 SCOPE

This section covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster of paris, false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items.

Copper, bronze, chromium plate, Nickel, stainless steel and aluminium shall generally not be painted or finished except if otherwise specified.

Before commencing painting, the Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage; disfiguration or staining to work of other trades or other installations.

2.00.00 INSTALLATION

2.00.01 Materials

Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint of one shade is obtained from the same manufacturing batch. Each and every supply of primer, finish paint etc. shall be accompanied by manufacturer’s test certificate. All paint shall be subject to analysis from random samples taken at site from painters bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finished coats to be applied.

All unspecified materials such as snellac, turpentine or linseed oil shall be of the highest quality available and shall conform relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.

a) White Wash/Colour Wash

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the engineer, and shall conform to Bangladesh National Building Code or equivalent. 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 liters 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 Bangladesh National Building Code or equivalent. 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 Bangladesh National Building Code or equivalent. 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 Bangladesh National Building Code or equivalent.

e) Acrylic Emulsion Paint

Shall be water-based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigments and fungicide conforming to Bangladesh National Building Code or equivalent. 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 yellowing and darkening with aging. The paint shall conform to Bangladesh National Building Code or equivalent.

g) Aluminium Paint

Shall be in two pack containers and shall resist weathering. The paint shall conform to Bangladesh National Building Code or equivalent.

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 Bangladesh National Building Code or equivalent.

French polish shall not be used on bare wood it shall only be used as finishing coat on wood after the woods pretreated with a liquid wood filler conforming to Bangladesh National Building Code or equivalent is applied and rubbed out.

j) Bitumen paint (black bituminous anti-corrosive paint)

Bitumen based anti-corrosive paint conforming to Bangladesh National Building Code or equivalent shall be used.

2.00.02 Storage

The Contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement, & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent fire.

2.01.00 Preparation of surface

Before starting the work the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.

2.01.02 Wood

All surfaces shall be free from, dirt and loose or peeling paints. The surface shall be rubbed down smooth. All nails & screws shall be sunk below the surface and filled with putty after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum 2 coats of pure shellace coating applied thinly & extended 25 mm beyond the area. All large, loose, or resinous knots shall be removed and filled with sound wood. All work shall be done as per Bangladesh National Building Code or equivalent.

2.01.02 Masonry, Concrete, and Plastered Surface

Surface shall be free from all oil, grease, efflorescence, mildew, loose paint, or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from, the original surfaces, the resurfaces area shall be treated with minimum one coat of cement primer, which should be continued to the surrounding area for a distance of minimum 100 mm.

Surface with **Mildew or Efflorescence** shall be treated as below:

All mildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7g of copper carbonate dissolved in 80ml liquor ammonia and diluted to water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

2.01.03 Metal

The surface preparation shall be done in accordance with Bangladesh National Building Code or equivalent and as directed by Engineer. All metal surfaces shall be absolutely clean, dry, and free from rust, scales, weld slag, flux deposit, wax, grease, dried soap films, foreign matters like cement mortar etc. and free from existing loose red oxide zinc chromate primer and should be removed by means of wire brushes, hand scrappers, sand paper, emery cloth, emery papers, or by mechanical power tools etc. or as directed by Engineer. For exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanized iron surfaces shall be pretreated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat. The actual painting work should be commenced only after obtaining clearance from the Engineer regarding proper cleaning of the surface.

2.02.00 Application

2.02.01 General

The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the Contractor shall mix different shades and prepare test panels of minimum size 1 meter square as per instruction of the Engineer and obtain his approval prior of application of finishing paints.

Proper tools and implements shall be used. Scaffoldings used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor notes.

Painting shall be done by skilled labours in a workmanlike manner. All materials shall be evenly applied so as to free of sags, runs, crawls, or other defects. All coats shall be of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paint.

All priming undercoat for painting shall be applied by brush only, and rollers spray equipments etc. shall not be used.

No work shall be done under conditions that are unsuitable production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint, which seals the surfaces to moisture shall only be done after the moisture on and below the surface has dried out.

All coats shall be thoroughly dry before succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered property by applying the specified number of coats, further coats shall be applied by the Contractor when so desired by the Engineer.

All primers and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.

Painting on ferrous metal surface shall, be done as per Bangladesh National Building Code or equivalent. The total dry thickness of film should not be less than 120 Micron.

2.02.02 White Washing

The surface where white washing is to be applied shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before white washing.

One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied and in case the Engineer feels that one or more coats are required the Contractor shall do so without any extra cost to the Owner. No brush marks shall show on the finished surface.

2.02.03 Dry Distemper

New plastered surface shall be allowed to dry for at least two months. New lime or lime cement plastered surface shall be washed with a solution of 1 part Vinegar to 12 parts water or 1:50 sulphuric acid solution and for 24 hours after which the wall shall be thoroughly washed with clean water. For cement-plastered surface, the surface shall be washed with solution of 100 gms. of zinc sulphate to 1 litre of water and allowed to dry.

Dry distempering shall be done as per manufacturer’s instruction. In applying the distempers the brush, should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long, otherwise brush marks may result.

2.02.04 Oil bound washable distemper

The distemper shall be applied after surface is primed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per manufacturer's instruction.

2.02.05 Waterproof Cement Paint

Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours) the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

2.02.06 Acrylic Emulsion Paint

Paint shall be applied after providing one coat of cement primer solvent of approved quality and primer shall be conform to Bangladesh National Building Code or equivalent. 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. Subsequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats.

2.02.08 Aluminium Paint

The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction. When more than one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry.

2.02.09 Clear Synthetic Varnish

The Varnish shall be applied on wood surface after (a) filling, (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted.

For the finishing coats of varnish, the surface shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surface as well as from the neighbourhood. Damp atmosphere and draughts shall be avoided, and exposure to extreme heat or cold & dampness shall not be allowed.

The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on white the next section is being laid on excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has begun to set shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh.

The varnish shall be minimum of two coats, with the first coat being a flatting varnish. This shall be allowed to dry hard and be flatted down, before applying the next coat. Sufficient time must be allowed between coats to get a hard dry surface before next coat is applied. All work shall be as per relevant IS Code.

2.02.10 French polish

All unevenness of the surface shall be rubbed down to smoothness with sand

paper and the surface shall well dusted .The pores in the shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt siemme or umber.

After application of the filler paste, the French polish shall be applied with a pad of woollen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles so that the polish is sparingly but uniformly applied over the entire area to give an even surface. A trace of linseed oil may be used on the pad for case of application. The surface shall be allowed to dry before further coats are applied in the same manner. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with methylated spirit, and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss.

2.02.11 Chemical Resistant Paint

For chemical resistant paints, epoxy, chlorinated rubber, or vinyl butryl paint system shall be used. Manufacturer's recommendation shall be followed regarding the paint system, exposed to moderately to severe corrosive condition and subject to acid/alkali spillage & fumes, shall be followed.

2.03.00 Protection

Furniture and other movable objects, equipment, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipment shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

2.04.00 Cleaning up

In addition to provisions in general conditions the Contractor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been splashed or splattered, including all equipment, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.

3.00.00 ACCEPTANCE CRITERIA AND TESTING

a) All painted surfaces shall be uniform and pleasing in appearance.

b) All varnished surfaces shall be of uniform texture and high glossy finish.

c) The colour, texture etc. shall match exactly with those of approved samples.

d) All stains, splashes, and splatters of paints and varnishes shall be removed

from surrounding surfaces.

Testing

a) As, each part of the work is under progress, i.e. preparation of surface, providing primer, providing different coats of finishing paints, it shall be passed by the Engineer. Variation from the drawings or specification or standard etc. shall not be accepted. The Contractor shall ascertain from the Engineer as to which parts will be inspected and passed from time to time. The Contractor shall provide all necessary arrangement for inspection of the painting work during its different working phase. The Contractor shall provide necessary scaffolding, approach for inspection of the above as per direction and satisfaction of the Engineer. All the necessary cost for scaffolding, approach, platform, lighting arrangement testing and inspection shall be borne by the Contractor. Such inspection and testing will not, however, exonerate the Contractor from his responsibilities for proper workmanship, material etc.

b) The Contractor shall carry out all sampling and necessary testing in accordance with the relevant Indian Standards and shall conduct such tests as called for by the Engineer. Where no specific testing procedure is mentioned in the relevant codes, the tests shall be carried out as per the prevalent accepted Engineering practice as per the direction of the Engineer. Tests shall be done in a laboratory, approved by the Engineer, and cost of testing shall be borne by the contractor.

c) Material/workmanship unsuitable for acceptance shall he removed and replaced by the Contractor. The work shall be redone as per Specification of the contract and direction of the Engineer without extra cost to owner.

4.00.00 CODES & STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of Bangladesh National Building Code or equivalent, unless specified otherwise.

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-421-600-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, installation, finishing, curing, testing, protection, maintenance till handing over various types of floor finishes, and allied items of work as listed below

a) In Situ Finishes

i) Integral finish to concrete base

ii) Terrazzo finish

iii) Granolithic finishes

iv) Patent Stone

v) Metallic Hardener like “Ironte”/Hardonate Finish

vi) Mastic Asphalt finishes

vii) Chemical Resistant finish

b) Tiled Finishes

i) Terrazzo tile

ii) Chequered tile

iii) Glazed tile

iv) Tesse rae (Mosaic etc.)

v) Chemical Resistant

vi) Rubber, Vinyl etc.

vii) Stone Slab including Kota Stone.

1.01.00 Base

The base to receive the finish is covered under other relevant specifications.

1.01.01 Sequence

Commencement, scheduling and sequence of the finishing works shall be planned in detail and must be specifically approved by the Engineer in view the activities of other agencies working in that area. However, the Contractor for the finishing items shall remain fully responsible for all normal precautions and vigilance to prevent any damages whatsoever till handing over.

2.00.00 INSTALLATION

2.00.01 Special Materials

Basic materials are covered elsewhere under the Specification. In general, all such materials shall be as per relevant Codes where available. In all cases these materials shall be of the best quality available indigenously unless specified otherwise.

The materials for finishing items must be procured from well-reputed specialized manufacturers and on the basis of approval of samples by the Engineer. The materials shall be ordered, procured and stored well in advance to avoid compulsion to use substandard items to maintain in the construction schedule.

2.00.02 Workmanship

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 50 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 vary 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 acc ate the specified thickness. All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.

b) Mix

i) Underbed

The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 parts cement, 1½ parts sand and 3 parts stone chips by volume. For vertical surfaces the mix shall consist of 1 part cement to 3 parts sand by volume. The sand shall be coarse. The stone chips shall be 10 mm down well graded. Only sufficient water to be added to give a workable consistency.

ii) Topping

The mix for the topping shall be composed of cement, colour Pigment, marble dust and marble chips. Proportions of the ingredients shall be such as to produce the terrazzo of colour texture and pattern approved by the Engineer. The cement shall be white or gray or a mixture of the two to which pigment shall be added to achieve the desired colour. To 3 parts of this mixture 1 part marble powder by volume shall be added and thoroughly mixed dry. To 1 part of this mix 1 to 1½ parts of marble chips by volume shall be added and thoroughly mixed dry again.

The pigment must be stable and nonfading. It must be very finely ground. The marble powder shall be from White marble and shall be finer than IS Seive 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 underbeds plus topping.

After laying, the underbed shall be levelled compacted and brought to proper grade with a screed or float. The topping shall be laid after about 24 hours while the underbed is still somewhat “green” but firm enough to receive the topping. A slurry of the mixture of cement and pigment already made shall be spread evenly and brushed in just before laying the topping. The topping shall be rolled f or horizontal areas and thrown and pressed for vertical areas to

extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the underbed. The surface of the topping shall be trowelled over, pressed and brought to a smooth dense surface showing a minimum 75% area covered by marble chips in a even pattern of distribution.

d) Curing

The surface shall be left for curing for about 12 to 18 hours and then cured by allowing water to stand on the surface or by covering with wet sack for four days.

e) Grinding and Polish

When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (no.80) grit blocks, till the marble chips are exposed and the surface is smooth. Then the surface shall be thoroughly washed and cleaned. A grout with already prepared mixture of cement and pigment shall be applied to fill up all pinholes. The surface shall be cured for 7 days by keeping it moist and then ground with fine grit blocks (no.: 120). It shall again be cleaned with water, the slurry applied again to fill up any pinholes that might have appeared and allowed to be cured again for 5 days. Finally, the surface is ground a third time with very fine grit blocks (no.: 320) to get smooth surface without any pinhole. A suitable machine shall do the grinding. Where grinding machine can not be used hand grinding may be allowed when the first rubbing shall be with carborundum stone of coarse grade (no.:60), second rubbing with medium grade (no.: 80) and final rubbing and polishing with fine grade (no.: 120). The surface shall be cleaned with water, dried, and covered with soil free, clean sawdust if directed by the Engineer. The final polishing shall be postponed till before handing over if desired by the Engineer. Just before handing over the surface shall be dusted with oxalic acid at the rate of 0.33 gm. per. Sq.M., water sprinkled on to it and finished by buffing with felt or hessian bobs. The floor shall be cleaned with soft moist rag and dried. However, all excess wax polish to be wiped off and the surface to be left glossy, but not slippery.

2.01.03 Granolithic Finish

Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete.

a) Thickness

The finish shall be average 20 mm and minimum 12 mm thick, unless specified otherwise.

b) Mix

The mix shall consist of 1 part cement: 1 part coarse sand 2 parts coarse aggregate by volume. The coarse aggregate shall be very hard like granite and well graded between 6 mm and 12 mm. Minimum quantity of water to get workability shall be added.

c) Laying of Monolithic Topping

The concrete base shall be laid as per specification "Cement Concrete" and levelled upto the required grade. The form shall remain sufficiently protruding to take the finish.

Within about 3 hours of laying the base while it is still fully -green- the topping shall be laid evenly to proper thickness and grade. If considered necessary the surface ' of the base shall roughened by wire brushing. Unless manual operation is permitted by the Engineer, mechanical vibrators of suitable design shall be used to press the topping firmly and work vigorously and quickly secure full bond with concrete base.

The laitance brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then the lightly trowelled to remove all, marks. When sufficiently set, hand trowelling shall be done to secure a smooth surface without disturbing the stone chips.

For large areas the laying shall be in panels of maximum 25 Sq.M. area. The panels shall be laid in chequered board pattern.

d) Laying of Topping Separately on Hardened Base

The base concrete shall be prepared as stated in clause 2.00.03 and a slurry of neat cement applied just prior to laying the granolithic concrete mix (1:1:2). The method of compaction etc. shall be same as for monolithic topping.

Curing

Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface had hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or pounding of water on the surface. The floor shall not be exposed to heavy traffic during this period.

f) Grinding

If grinding is specified, it shall start only after the finish has fully set. Clause 2.01.02 (e) shall be followed. However, the Engineer shall decide upon the ultimate polish required.

g) Finishing

Where specified, sodium, silicate or magnesium or zinc silico fluoride treatment shall be done. The number of coats to be applied shall be as per approved drawings or as instructed. The concentration and method of application of the solutions shall be as specified in relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

2.01.04 Patent Stone

It shall consist of an underbed and a topping laid on an already laid and matured concrete base.

a) Thickness

The patent stone finish shall have thickness as stipulated under clause 2.01.02 (a) except that the topping shall be 12 mm thick.

b) Mix

i) Underbed

The mix shall be as stipulated under clause 2.01.02 (b).

ii) Topping

The mix for the topping shall consist of 1 part cement and 2 part stone aggregate 6mm nominal size by volume.

c) Laying

The Patent Stone finish including the underbed shall be laid in alternate bays or in Chequered board pattern. No panel shall be cast in contact with another already laid till the contraction of the latter has already taken place.

The maximum area of each panel shall be 3 Sq.M. of which no side shall be more than 2 M. long.

A cement grout shall be applied and worked into the surface to receive the finish; the underbed then laid, compacted, and leveled to proper grade with a screed or float. The topping shall be applied evenly on the underbed while it is not fully set but firm enough and rolled and pressed to get full bond. The topping shall be trowelled to a dense finish to the satisfaction of the Engineer. All trowel marks shall be mopped out with a soft cloth to give a clean smooth surface.

After the surface is sufficiently set, the finished floor shall be kept moist for 7 days for curing. If desired the finish shall be polished as directed by the Engineer.

2.01.05 Metallic Hardener Like 'Ironite'/ `Hardonate' Finish

This will consist of a topping (incorporating iron particles) to bond with concrete base while the latter is `green'.

a) Thickness

Unless otherwise specified the metallic hardener finish shall be of 12 mm depth.

b) Material

The hardening compound shall be uniformly graded iron particles free from non-ferrous metal impurities, oil, grease, sand soluble alkaline compounds or other injurious materials when desired by the engineer, actual samples shall be tested.

c) Mix

Proportion of the metallic hardener shall be as specified or as indicated by the manufacturer. However, in absence of any such direction 1 part metallic hardener shall be mixed dry, with 4 parts cement, by weight. To this mixture 6 mm nominal size stone chips shall be added in proportion of 1 part cement (mixed with hardener) to 2 parts of stone chips by volume and uniformly mixed. Minimum quantity of water shall be added to make it workable.

d) Laying

The concrete floor shall be laid as per specification 'Cement Concrete' and levelled upto required grade. The forms, if any, shall remain sufficiently projecting to make the finish. The surface shall be roughened by wire brash as soon as possible.

The finish shall be laid while the concrete underbed is still very `green' within about 3 hours of laying of the latter. The finish shall be of uniform thickness and even dense surface without trowel marks, pin holes etc. This topping layer shall be pressed firmly and worked vigoursly and quickly to secure full bond with the concrete base. Just when the initial set starts the surface shall be finished smoothened with steel trowel.

The finished floor shall be cured for 7 days by keeping it wet.

2.01.06 Mastic Asphalt Finish

This is a one-layer treatment on concrete or brick base.

a) Thickness

The thickness shall be as specified in the drawing.

b) Materials

Bitumen shall be industrial Bitumen conforming to relevant BS code or equivalent international code approved by BHEL/BIFPCL.

Mineral filler shall be dry stone dust passing through 75 micron IS Sieve.

Fine aggregate shall be crushed and graded natural limestone or other hard work.

Coarse aggregate shall be crushed siliceous stone or other approved aggregate 6 mm stone chips shall be used for finish upto 20 mm thick & 10 mm chips for thicker finish.

c) Composition

Bitumen mastic shall conform IS: 1195 and shall be either brought to site in blocks weighing about 25 Kg or prepared at site. If brought in blocks, these shall be remelted in mechanically agitated mastic cookers and coarse aggregate, preferably preheated fed in successive portions until the complete change is thoroughly, incorporated. At no stage during the remelting and mixing process, shall the temperature exceed 205°C.

d) Laying

The hot mastic shall be laid on dry base surface cleaned thoroughly by wire brushing and sweeping. The mastic shall be leveled and when cooled to some extent shall be finished with a wooden float with addition of small quantity of fine sand if required. No load shall be allowed till the finish has cooled to normal temperature.

The mastic shall be laid in suitable panels of about 1.5 Sq.M. in area each formed by formers. Succeeding panels shall be laid overlapping the finish panel so as to melt its edges and form a continuous finish without joint.

2.01.07 Chemical Resistant in Situ Finish

Chemical resistant in situ finish shall be as epoxy resin with suitable filler material over a primer. The minimum thickness shall be 6 mm. About its performance the Engineer shall have to be fully satisfied by test results and examination of similar treatment already in existence. The contractor shall get it done by a specialized Manufacturer and get guarantee of performance from the organization and pass it on to the Owner in addition to his own guarantee.

2.02.00 Tiled Finish

These shall include finish tiles, stone slabs, and similar manufactured or natural items over already laid and matured base of concrete or masonry by means of an underbed or an adhesive layer.

2.02.01 Terrazzo Tile Finish

The finish will consist of manufacture terrazzo and an underbed.

a) Thickness

The total thickness including the underbed shall be minimum 40 mm for floors 30 mm for walls unless otherwise specified.

The skirting, dado and similar vertical surfaces shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the tiled finish, to accommodate the specified thickness shall be done.

b) Tiles: Terrazzo

The tiles shall, unless specifically permitted in special cases be machine made under quality control in a shop. The tile shall be pressed hydraulically to a minimum of 140 Kg. per Sq.cm.

Each tile shall bear on its back permanent and legible trademark of the manufacturer. All angles of the tiles shall be right angles all arises sharp and true, colour and texture of the wearing face uniform throughout. Maximum tolerance allowance length and breadth shall be ± 1 mm and the thickness ± 3 mm. Face of the tile shall be plane, free from pinholes and other blemishes.

The tiles shall be composed of a backing and topping. The topping shall be of uniform thickness not less than 10 mm.

The total thickness including the topping shall be as specified but not less than 20 mm in any case.

The backing shall be composed of 1 part ordinary gray cement and 3 parts of stone chips by weight mixed with water.

The topping shall be as specified under clause 2.01.02 (b).

The tile shall be cured at the shop for at last 14 days before delivery to the site. First grinding shall be given to the tiles at the shop before delivery. Tiles shall be packed properly to prevent damage during transit and storage. The tiles must be carefully stored to prevent staining by damp, rust, oil, and grease or other chemicals.

Tiles made in each batch shall be kept and used separately so that colour of each area of the floor may remain uniform.

The manufacturer shall supply along with the tiles the grout mix containing cement and pigment in exact proportions as used in topping of the tiles. The containers for the grout mix shall be suitably marked to relate it to the particular type and batch of tiles.

c) Mix: Underbed

The underbed for floor and similar horizontal surfaces shall be 1 part lime putty: 1 part surkhi: 2 parts coarse sand by weight mixed with sufficient water to form a stiff workable mass. For skirting and dado and all vertical surfaces it shall be about 12 mm thick and composed of 1 part cement and 3 parts coarse sand by weight.

d) Laying

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The underbed mortar shall be evenly spread and brought to proper grade and consolidated to a smooth surface. The surface shall be roughened for better bond. Before the underbed had time to set and while it is still fairly moist but firm, cement shall be hand dusted over it or a cement slurry applied and the tiles shall immediately be placed upon and firmly pressed by wooden mallet on to the underbed until it achieves the desired level. The tiles shall be kept soaked for about 10 minutes just before laying. The joints between tiles shall be as close as possible and not more than 1.5 mm wide.

Special care shall be taken to check the level of the surface and the lines of the joints frequently so that they are perfect.

When tiles are required to be cut to match the dimensions these shall be sawn and edges rubbed smooth. The location of cut tiles shall be planned in advance and approval of the Engineer taken.

At the junction of horizontal surface with vertical surface the tiles on the former shall enter at least 12 mm under the latter.

After fixing, the floor shall be kept moist and allowed to mature undisturbed for 7 days. Heavy traffic shall not be allowed.

If desired dividing strips as specified under Clause 2.01.02(c) may be used for dividing the work into suitable panels.

e) Grinding and Polishing

Procedure shall be same as Clause 2.01.02(e). Grinding shall not commence earlier than 14 days after laying of tiles.

2.02.02 Chequered Tile Finish

The finish shall consist of manufactured gray or coloured cement tiles or terrazzo tiles with chequered face and an underbed laid over concrete or brick surface.

a) Thickness

Thickness shall be same as in clause 2.02.01 (a).

b) Tiles: Chequered

The tiles shall have chequers not less than 2.5 cm. c/c and not more than 5 cm. c/c. Depth of grooves shall be not less than 5 mm. The grooves shall be uniform and straight.

The tiles shall conform to clause 2.02.01 (b) except that these may have the topping in terrazzo or plain gray cement or colour pigment added to cement.

c) Under-bed
As per clause 2.02.01 (c).

d) Laying
As per clause 2.02.01 (d).

e) Grinding and Polishing

As per clause 2.02.01 (e) except that the tiles shall be ground and polished by hand and after laying taking special care in polishing the grooves properly and uniformly.

2.02.03 Glazed Tiles Finish

This finish shall be composed of glazed earthenware tiles with an underbed laid over a concrete or masonry base.

a) Thickness

The total thickness shall be between 20mm and 25mm including the underbed.

The tile finish on vertical surface shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the finish, to accommodate the specified thickness shall be done.

b) Tiles: Glazed

The tiles shall be of earthenware, covered with glaze white or coloured, plain or with designs, of 150 mm x 150 mm nominal sizes and 5.5 mm to 6 mm on thick unless otherwise specified. The tolerance shall be ± 1.5 mm for length and breadth and ± 0.5 mm for thickness specials like internal and external angles; beads, covers, cornices, corner pieces etc. shall match. The top surface of the tiles shall be glazed with a gloss or matt, unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures, dense and homogeneous. The tiles shall be strong and free from flaws like cracks, craze, specks, crawlings, etc. and other imperfections. The edge and the underside of the tiles shall be completely free from glaze and the underside shall have ribs or indentations for better anchorage with the fixing mortar.

The coloured tiles, when supplied, shall preferably come from one batch to avoid difference in colour.

c) Mix: Underbed

The mix for the underbed shall consist of 1 part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified.

c) Laying
Same as clause 2.02.01 (d).

e) Finishing

The joints shall be cleaned and flush pointed with white cement and cured

for 7 days by keeping it wet. The surface shall be cleaned with soap or suitable detergent, washed fully, and wiped with soft cloth to prevent scratching before handing over.

2.02.04 Tesserae Finish (Mosaic etc.)

This finish consists of manufactured vitreous, glass, ceramic or similar hard small pieces set in an underbed over a concrete or masonry surface, already laid.

a) Thickness

The total thickness including the underbed shall be between 16 mm & 25 mm.

b) Tesserae Finish

These shall usually be 6 mm thick small piece of ceramic vitreous china, tinted glass, or similar hard wearing, strong, and durable material in desired shapes and sizes and patterns.

The supply shall come in the desired pattern in full or sections conveniently for handling, stuck to pieces of strong thick paper on the surface to be exposed. The gum used for this purpose must be water soluble and non-staining. The sections shall be properly marked to avoid mistakes and master drawing shall be available at the site for guidance.

c) Mix: Underbed
Same as clause 2.02.03 (c)

d) Laying

The specification for laying if given by the manufacturer of the item shall be followed provided it is approved by the Engineer. Otherwise clause 2.02.03 (d) shall generally be followed. However, instead of gray cement the slurry shall be made with white cement to fix the panels. The paper-mounted patterns in sections shall be carefully placed and pressed in position true to lines and levels. Earliest possible the paper shall be peeled off and surface examined and cleaned, joints flush pointed with white cement and cured for 7 days by keeping it wet.**2.02.05** Chemical Resistant Tiled Finish

This shall include all verities of special tiles used for specific chemical resistance function and an underbed over already laid concrete or masonry.

a) Tiles

The chemical resistant tiles shall be of the best indigenous Manufacture unless otherwise specified and shall be resistant to the chemical (both acid and alkali). The tiles shall have straight edges, uniform thickness, plain surface, uniform nonfading colour, and textures.

Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have at least compression strength of 700 Kg/cm2. The surface shall be abrasion resistant and durable.

b) Laying

The mortar used for setting or for underbed these tiles shall be durable, strong and chemical resistant epoxy mortar. The grout, which shall be to the full depth of tile, shall have equal chemical resistant properties. Joints shall be pointed if so desired. The setting and fixing shall be according to the manufacturer's specification approved by the Engineer.

2.02.06 Rubber, Vinyl, or Vinyl Asbestos Tiles Finish

This shall include various types of tiles manufactured from rubber, vinyl etc. set with an adhesive on concrete or masonry base. An underbed may be required to secure desirable surface and grade.

a) Thickness

The thickness of the tiles shall be as incorporated in drawing.

b) Tiles

Unless otherwise desired the tiles shall be squares of approved dimensions. The tolerance in dimensions shall be ± 1.5 mm.

The face of the tiles shall be free from porosity, blisters, cracks, embedded foreign matters or either physical defects which affect appearance or serviceability. All edges shall be cut true and square. The colour shall be nonfading and uniform in appearance, insoluble in water and resistant to alkalies, cleaning agents and usual floor polishes.

Each tile shall be marked on the back legibly and indelibly with manufacturer’s trademark, the thickness, sizes, batch number, and date of manufacturer.

Tiles shall be delivered securely packed and stored in clean, dry well ventilated place at a temperature near about to that the tiles shall be called upon to stand ultimately.

Adhesive to be used for sticking the tiles shall be approved by the tile manufacturer. The adhesive shall have a short drying time and long life in addition to toughness.

c) Mix: Underbed

The underbed where required to make up the specified thickness or to give the required grade or to get the right type of surface shall be composed of 1 part like putty:1 part cement: 3 parts coarse sand mixed with just sufficient water to make it workable.

d) Laying

The tiles shall be kept in the room to be tiled for at least 24 hours to bring them to the same temperature as the room. For air-conditioned space, the air-conditioning shall be completed before tiling is taken up.

The surface to receive this finish shall be firm even textured but not too smooth, without undulations and other deficiencies. If an underbed is laid the same shall be cured for at least 7 days by keeping it moist and then fully dried.

The surface shall be thoroughly cleaned. All loose dust particles shall be removed. Oil and grease if any shall be completely cleaned by use of detergent.

The adhesive shall be applied to fully dry surface in desired thickness uniformly. The adhesive shall also be applied to the backs and edges of the tiles and allowed to surface dry. The tiles shall be placed neatly on the surface exactly to the approved pattern and set with a suitable tool. If the edges tend to curl, weights are to be used to keep the edges down. Special care shall be taken to avoid formation of air pockets under the tiles. The joints shall be very fine. Any adhesive squeezed out through the joints shall be removed immediately.

e) Finishing

If any adhesive mark is there on the surface a soft cloth soaked in solvent shall be used to wipe it off. The surface shall be cleaned with soft soap, dried, and polished with an approved type of polish just before handing over.

2.02.07 Stone Slab Finish: Marble, Stone, and Similar Fine Grained Stone including Kota stone

a) Thickness

The underbed shall be minimum 12 mm and average 20 mm thick. The slabs will be 20 mm thick.

b) Stone Slab

The stone slabs shall be made from selected stock, which is hard, sound, homogeneous and dense in texture and free from flaws. Angles and edges shall be true, square, and free from chipping and surface shall be plane. The slabs shall preferably be machine cut to the required dimensions. Tolerance of ± 5 mm in dimensions and ± 2 mm in thickness will be allowed. Unless specified the slabs shall be minimum 300 mm x 300 mm.

The stone slabs shall come from specific regions and in specified quality with top surface fine chisel dressed. All sides shall also be fine chisel dressed to the full depth to allow finest possible joints.

The slabs shall be delivered to the site well protected against damages and stored in dry place under cover.

c) Mix: Underbed
Same as clause 2.02.01 (c).

d) Laying

The sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand stone and washed before laying.

The underbed mortar shall be evenly spread and brought to proper level on the area under each slab. The slab shall be laid over the underbed, pressed, and tapped down with wooden mallet to the proper level. The slab shall then be lifted and the underbed corrected as necessary and allowed to stiffen a little. Next, thick cement slurry shall be spread over the surface. The edges of the slab shall be buttered with slurry of cement, gray / white / mixed with pigment matching the colour of the stone slabs. The slab shall be gently laid and tapped with wooden mallet to bed properly to a very fine joint and to the required level. All surplus cement slurry shall be removed and the surface mopped clean with wet soft cloth. The laid finish shall be cured for 7 days by keeping it wet.

e) Polishing, Finishing

Fine chiselling shall be done to remove the slight undulations that usually exist at the joints. The polishing and finishing shall be done as specified under clause 2.02.01 (e). However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for.

2.02.08 Stone Slab Finish: Sand Stone and Similar Coarse Grained Stone Finish

Generally clause 2.02.07 shall be followed except that the workmanship and finish shall not be fine as which are explained hereunder.

The slabs shall be rough chiselled or fine chiselled as specified. Tolerance may be allowed upto ± 6 mm for rough finish, but no sharp unevenness and shall be allowed. For fine chiselling the unevenness shall be limited to ± 2 mm. The sides shall be chisel dressed at least to half slab depth so that the maximum deviation from straight line shall be within 25 mm. Beyond this depth the edge may be slightly splayed.

The joint thickness shall be kept limited to 5 mm in case of rough finish and 3 mm in case of fine finish unless wider joints are specified. The joints shall be grouted with white or coloured cement. If fine joints in the flooring are specified, the edges of slabs shall be cut in such a way that it shall form a inverted 'Y'.

3.00.00 ACCEPTANCE CRITERIA

The finish shall be checked specially for:

a) Level, Slope, Plumb as the case may be

b) Pattern and Symmetry

c) Alignment of joints, dividing strip etc.

d) Colour, texture

e) Surface finish

f) Thickness of joints

g) Details at edges, junctions etc.

h) Performance

i) Precautions specified for durability

4.00.00 CODES & STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless

specified otherwise.

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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VOLUME: II B

SECTION - D

SUB-SECTION – D13

SHEET WORK IN ROOF AND SIDING

SPECIFICATION NO. PE-TS-421-600-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	CODES & STANDARDS	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 color 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 BS EN 12056: latest or equivalent.

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. Galvanized trapezoidal profile metal sheet having 0.75mm minimum thickness shall be used on external face (outer face) of cladding system. Weight of coating shall not be less than 275 gm/sq.m total on both sides. After cleaning, a"chemical conversion" of the zinc coating to a non-metallic surface with corrosion inhibiting and adhesion additives shall be applied. Nominal 8-micron thick anti-corrosive pigmented epoxy primer to be applied on both sides of the sheet. Nominal 70-micron thick TF Epoxy Barrier coat with special flexibilizer compounds to be applied on both sides of the sheet and baked to a hard corrosion resistant finish. Nominal 40 micron thick urethane exterior coating on outer exposed face of the sheet pigmented in one of the standard colours of the manufacturer's colour range to be applied.

ii. Galvanized trapezoidal profile metal sheet having 0.75mm minimum thickness shall be used on internal face (inner face) of cladding system. Weight of coating shall not be less than 275 gm/sq.m total on both sides. After cleaning, a"chemical conversion" of the zinc coating to a non-metallic surface with corrosion inhibiting and adhesion additives shall be applied. Nominal 8-micron thick anti-corrosive pigmented epoxy primer to be applied on both sides of the sheet. Nominal 70-micron thick TF Epoxy Barrier coat with special flexibilizer compounds to be applied on both sides of the sheet and baked to a hard corrosion resistant finish. Nominal 20 micron stoving polyester decorative finish on inner exposed face of the sheet to be applied.

iii. The permanent colour coated sheet shall meet the general requirements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL,. 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 non-combustible material like glass wool or similar of minimum thickness 60mm conforming to IS: 8183, having a density not less than 16 Kg/cu.m.

2.02.05 PERMANENT COLOUR COATED (NON-INSULATED) METAL CLADDING SYSTEM

i. Galvanized trapezoidal profile metal sheet having 0.75mm minimum thickness shall be used. Weight of coating shall not be less than 275 gm/sq.m total on both sides. After cleaning, a"chemical conversion" of the zinc coating to a non-metallic surface with corrosion inhibiting and adhesion additives shall be applied. Nominal 8-micron thick anti-corrosive pigmented epoxy primer to be applied on both sides of the sheet. Nominal 70-micron thick TF Epoxy Barrier coat with special flexibilizer compounds to be applied on both sides of the sheet and baked to a hard corrosion resistant finish. Nominal 40 micron thick urethane exterior coating on outer exposed face of the sheet pigmented in one of the standard colours of the manufacturer's colour range to be applied. The sheets shall meet the general requirement of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL,and shall conform to class 3 for the durability.

ii. **FLASHING, CAPS, TRIM CLOSURES ETC.**

All flashings, trim closures caps etc. required for the metal cladding system shall be made out of plain sheets having same material and coating specification as mentioned above for the outer face of the sandwiched metal cladding.

3.00.00 ACCEPTANCE CRITERIA

The installations shall present a neat appearance and shall be checked for water tightness. The following shall be checked:

a) Side and end laps

b) Absence of cracks, holes or damages in sheet

c) Spacing of bolts

d) Provision of double washers (G.I. and asbestos or bituminous washers)

e) Proper installation of flashing.

4.00.00 CODES & STANDARDS

All work shall be carried out as per this specification and shall conform to the

latest revision and/or replacements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise.

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.

VOLUME: II B

SECTION - D

SUB-SECTION – D14

SUSPENDED CEILING

SPECIFICATION NO. PE-TS-421-600-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 maximum 1.2 metre centres. Extra hangers shall be provided at light fixtures that are supported from the ceiling system. The spacing of main and cross runners shall be as shown on drawings. Turnbuckles shall be provided in M.S. rods for adjustment in levels.

2.02.00 Ceiling Panels

2.02.01 Material

Ceiling panels shall be best quality material in thickness and properties called for in the "Schedule of items". The Contractor shall submit test certificates to the Engineer for approval before bulk supply. The ceiling panels may be of following type:

a) Glass fibre reinforced gypsum plaster board (GRG)

b) Mineral fibre tile

c) Calcium Silicate Board

d) Gypsum board plain/perforated false ceiling tile

e) Plaster of Paris board (decorative)

f) Expanded polystyrene insulation board with plastic fascia.

g) Fibre Insulation board.

h) Bonded wooden particle board (Plain and decorative)

i) Glass fibre reinforced polystyrene sheets.

j) Flat asbestos sheets (with plastic fascia).

2.02.02 Installation of Ceiling Panels

Installation of Ceiling panels shall be strictly as per manufacturer's instruction.

For concealed grid system, tiles shall be fixed to the supporting grid in manner shown on drawing or as specified by the manufacturer. Where V joints in tiles are called for in drawings, these shall be in true lines. Where flush surface is required, the joints shall be filled with approved filler material and finished to

give a neat uniform surface. Special care shall be taken to neatly finish the ceiling at junctions with walls, light fixtures, diffusers etc.

2.02.03 Aluminium Lineal Ceiling System

Aluminium lineal ceiling system shall be "Luxalon 84C" or approved equal and the installation shall be strictly as per manufacturer's instruction/ specification subject to approval of the Engineer.

Aluminium lineal ceiling shall comprise of plain panels, 84 mm wide and 12.5 mm deep with a 23.9 mm recessed flange, roll formed out of 0.5 mm thick aluminium alloy panels stove enamelled on both sides, fixed on roll-formed carriers made of enamelled 0.95 mm thick aluminium, 32 mm wide and 39 mm deep with prongs to hold panels in the module of 100mm, at maximum spacing 1.2 M centre to centre. The carriers shall be suspended from roof by 4 mm dia galvanised steel wire hangers with special height adjustment clips made out of spring steel at maximum spacing of 1.2 M c/c. Hangers shall be fixed to roof by 'J' hooks and nylon inserts. 25 mm thick resin bonded mineral wool (spintex 300 or equivalent) insulation bound in polythene shall be laid on top of panels. Lineal ceiling shall be fixed in pattern as per detailed drawings.

3.00.00 SAMPLES

Samples of Ceiling panels and metal suspension system components as noted below shall be submitted for Engineer's approval:

Panels : 3 samples approximately 300 mm square/long each

Suspension System : 3 samples of short length: each of main and secondary system

4.00.00 SHOP DRAWINGS

Shop drawings shall be submitted for approval as required and approval shall be obtained prior to delivery of suspended ceiling components. Shop drawings shall be co-coordinated with all related work and shall show the following information:

a) A reflected ceiling plan of areas indicated to receive the ceiling showing electrical and mechanical features.

b) Typical Intermediate framing for support where required.

c) Hanger fastening details.

d) Panels - unit support at ceiling penetrations.

e) Details of splicing method for main and cross runners.

f) A table indicating load bearing capacity of main and cross runner

g) A note stating that the suspension system member furnished will not deflect more than 1/360 of the span under the indicated loading.

5.00.00 ACCEPTANCE CRITERIA

Finished ceiling shall be at the correct plane and present a pleasing and uniform appearance, free from, sags, warps, disfigured, or damaged board. Cutouts for light fixtures, diffusers etc. shall be of exact dimensions and in exact locations.

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

Rates shall be for the complete item called for in the "Schedule of Items". No extra payment will be made for alignment and adjustment of lighting fixtures, air-conditioning diffusers, access panels etc. The rate shall include all cutting and wastage from standard size sheets, runners/carries etc.

6.02.00 Measurement

Actual area of work shall be measured in Sqm correct to second place of decimal. However, no deduction will be made for opening upto 0.25 Sqm. each in area.

VOLUME: II B

SECTION - D

SUB-SECTION – D15

WATER SUPPLY, DRAINAGE AND SANITATION

SPECIFICATION NO. PE-TS-421-600-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.
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2.00.00	MATERIAL	3
3.00.00	INSTALLATION	6
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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, UPVC pipes conforming to BS 3505:1986 shall be used.

For Roof drainage and building sanitation works following type of pipe are coved in this Section:

a) Cast Iron pipe

b) Steel pipe (lined, coated with bituminous composition, out coated with

cement concrete or mortar or galvanized)

c) Concrete pipe

d) Asbestos cement pipe

e) PVC pipe

f) Stoneware pipe

g) Vitrified pipe

h) Lead pipe (not to be used for portable water)

2.02.01 Fixtures

All material, fittings, fixtures, appliances, accessories shall be of approved quality and shall be procured from reputed brands like Hindustan/Pasriware/ Cera or equivalent or as approved by Engineer. The bidder shall procure the fixtures from the above named reputed manufacturers and shall mention in his bid the type & make of the fixtures he intends to use.

All items brought to the site must bear the manufacturer's identification mark. Procurements shall be made well in advance and should get inspected & approved immediately by the Engineer. All fixtures shall be adequately protected, covered, and plugged till handing over.

All fittings, gratings, fasteners, unless specified otherwise, shall be as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL), 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL) 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL), 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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 glass-fibre reinforced polyethylene of approved brand and make (Syntex or equivalent). Reservoirs made of concrete masonry or fabricated steel shall be covered by respective work specifications.

3.00.00 INSTALLATION

3.01.00 General

Basic layouts may be available in the drawings provided, the details might have to be supplemented by the Contractor and get the approval of the

Engineer before installation. Special attention shall be given to economise the layout. Symmetry of layout is very important. Fittings meant for operation shall be located and oriented to allow easy reach and operation. Maintenance, repairs, and replacements of pipes, fittings, and fixtures must be conveniently possible. All pipe lines, locations of fittings and fixtures, etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry, and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and so located as to allow easy maintenance.

All pipelines, fittings, and fixtures shall be installed leak proof. When the works under scope of this specification linked up with works executed by others, the connections shall be such as to prevent any splashing or spilling or emission of foul odour and gases.

3.02.00 Portable water supply Pipe Lines

3.02.01 Laying

In addition to fulfilling the functional requirements all pipelines shall be laid true to line, plumb and level and shall run on the surface of the walls, ceiling or in chases. Any deviation shall need approval of the Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer.

Pipes shall be laid on continuous unyielding surface or on reliable supports at least one near each joint and spacing as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. All pipes used for water supply should be thoroughly and efficiently disinfected before taken in to use.

3.02.02 Back Flow

The layout of pipe work shall be such that there is no possibility of back flow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. All pipe works shall be so laid or fixed and maintained as to be and to remain completely watertight, thereby avoiding waste of water, damage of property and the risk of contamination of the water conveyed.

3.02.03 Contamination

There shall be no cross connection whatsoever between a pipe/fitting for conveying or containing wholesome water and a pipe/fitting for containing impure water or water liable to contamination or of uncertain quality of water which has been used for any other purpose. No piping shall be laid or fixed so as to pass into or through any sewer, scour outlet or drain or any manhole

connected therewith.

3.02.04 Underground Piping

Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable. The size and depth of the trench shall be as approved by the Engineer. Back filling shall be done with selected fine earth, unless otherwise permitted, in 150 mm layers and carefully consolidated. Special care shall be taken while filling in the vicinity of the pipe to avoid damage. Before backfilling, the laid pipe shall be fully tested and approved.

Where the pipe rests on rock it may be bedded on a layer of fine selected material or concrete to avoid local point support. The trench shall be so treated by gradient and filling in the area that it does not act as a drainage channel.

3.02.05 Concealed Piping

Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the structure. The Contractor may co-ordinate with the building Contractor for leaving the chases, openings, and conduits as necessary. However, the Contractor will rectify if required the chases, openings, and conduits, supplement and make good after laying and testing of the concealed pipelines.

3.02.06 Jointing of Pipes

All pipes shall be properly jointed and made completely water tight and durable. Union joints shall be provided for all required location to facilitate maintenance.

3.02.07 Painting

Where required, underground G.I. pipes shall be given 2 coats of bituminous paint on the outside after laying. When painting is to be done above ground G.I. pipes shall be given one coat of red lead or zinc chromate primer and top coats shall be minimum 2 coats of best quality paint as specified.

3.03.00 RAINWATER DOWN COMERS

3.03.01 Pipes

Rainwater down comers shall be standard Cast Iron or Asbestos Cement Pipes. In case where specifically desired, M.S. pipes may also be used. M.S. pipes shall be painted outside with two coats of anticorrosive paints under a coat of primer.

Rainwater down comers shall run along and be secured to walls, columns etc. Where desired by the Engineer these may have to be installed in chases cut in the structure. All pipes shall be well secured and supported by adequately strong brackets. The brackets may be wrought iron clevis type, split ring type, or perforated strap iron type as approved by the Engineer. For vertical runs each pipe shall hang freely on its brackets fixed just below the socket. Suitable spacer blocks shall be provided against the vertical surface to which the pipe is fixed.

All bends and junctions shall be supplied with watertight cleanouts.

Roof and floor drains and yard gullies shall be installed, if required, by cutting into the structure and grouted with 1:2:4 cement concrete. All gutters shall be provided with removable gratings.

All horizontal pipes shall have a minimum fall of 1 in 100.

3.03.02 Khurras

The khurras shall be constructed before the work in parapet wall is taken up and it shall be 45x45 cm in size, unless otherwise specified and shall be formed of cement concrete of C16/20 grade.

3.03.03 Gutters

The gutters shall be made of G.I. or A.C and procured from reputed specialised manufacturers. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. G.I. gutters shall have the edges strengthened by suitable means.

Unless noted otherwise the gutters shall have a minimum fall of 1 in 120. Adequate number of string supports shall be provided so that there is no sagging even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated M.S. brackets. All junctions shall be thoroughly watertight. The joints may be made by riveting, bolting or soldering. All joints between successive lengths of gutters shall have on overlap of at least 5 cm. The drop in the overlap shall always be in the direction of the fall of the gutter. Ends of gutters shall be closed watertight. Junction with rainwater down comers shall be made fully watertight and secured.

3.04.00 SOIL AND DRAINAGE PIPES

3.04.01 Gradients

If not specified the minimum gradients of soil and drainage pipeline shall be as follows:

100 mm nominal dia	:	1 in 35
150 mm nominal dia	:	1 in 65
230 mm nominal dia	:	1 in 120
300 mm nominal dia	:	1 in 200

3.04.02 Relation with water supply pipelines

Unless specifically cleared by the Engineer, under no circumstances shall drainage and sewer pipes be allowed to come close to water supply pipelines.

3.04.03 Laying

Each separate pipe shall be individually set for line and for level. Where lengths of sewer or drain pipes are laid in trench, properly painted sight rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed. More sight rails shall be required at manholes, change of gradient and intermediate positions if the distance for sighting is more than 50 ft. apart. The excavation shall be boned in at least once in every 6 ft. The foot of the boning rod shall be set on a block of wood of the exact, thickness of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails.

3.04.04 Support and Protection of Pipelines

All pipes shall be laid with sockets leading uphill. Preferably the pipe shall rest on solid and even foundations for the full length of the barrel. However, the pipe manufacturer's instruction as approved by the Engineer shall be followed in the matter of support and jointing.

To achieve full and continuous support, concrete for bedding and packing is the best. Where pipes are not bedded on concrete, the floor shall be left slightly high and carefully placed so that the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low packing shall be done in concrete. Where laid on rock or very hard ground which cannot be easily excavated to a smooth surface, the pipes shall be laid on a cradle of fine concrete floor of gravel and crushed stone over laid with concrete or on a well consolidated gravel and crushed stone bed as desired by the Engineer. PVC or similar pipes shall be laid directly on stable soil and packed with selected soil.

The minimum support and protection for glazed stoneware pipes shall be as follows:

a) When cover is less than 2 metre below ground level and where pipes are unavoidably exposed above ground surface, the pipes shall be completely encased or surrounded with concrete.

b) Where pipes are laid on soft soil with the maximum water table laying at the invert of the pipe, the sewer shall be bedded on concrete.

c) Where the pipes have to be laid on soft soil with the maximum water table rising above the invert of the pipe, but below the top of the barrel, the pipe sewer shall be haunched.

d) Where maximum water table is likely to rise above the top of the barrel or wherever the pipe is laid on soft soil the pipe sewers shall be completely encased or surrounded with concrete.

Vitrified clay pipes shall be laid on a bed of 150 mm thick cement concrete (1:3:6) nominal mix by volume.

Cast iron pipes and concrete pipes may be supported on suitable concrete or brick support, where specified. The supports shall be unyielding and strong enough. At least one support shall be located close to ends. Spacing of intermediate supports shall be as decided by the Engineer. Pipes shall be secured to the supports by approved means.

Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the expected thrust.

3.04.05 Entry into structures

For entry of the pipe lines into any building of structure suitable conduits under the structure or sleeves shall be used. The conduits and sleeves shall be such as to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipelines, locations and sizes shall be marked and checked by the Engineer. After laying of the pipeline the openings and chases shall be mended.

3.04.06 Ducts

Where solid, waste and ventilating pipes are accommodated in ducts, access to cleaning areas shall be provided. Connection to drain shall be through a gully with sealed cover to guard against ingress of sewer gas, vermin, or backflow.

3.04.07 Traps and Ventilating Pipes

Pipes are carrying off the waste from water closets and waste water and overflow water from baths, wash basins, sinks to drains shall be trapped

immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated whenever such ventilation is necessary to maintain water seal of the trap. Ventilating pipes shall be carried up vertically from the drain to a height of at least 600 mm above the outer covering of the roof of the building or as shown on drawings. All vertical ventilating, anti-syphonage and similar pipe shall be covered on top with a cowl. The cowl shall be made of C. I. unless desired otherwise by the Engineer.

3.04.08 Manhole & Inspection Chambers

At every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The maximum distance between manholes shall be 30 meter unless specially permitted otherwise. However, for truck route (for pipes above 900 mm dia.) this distance can be increased to 45 M. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 metres unless desired otherwise provision of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL shall be followed for construction of a manhole. Manhole shall be constructed so as to be watertight under test. The change in alignment shall be carried out in such a manner as to provide no lodgement for any splashings in case of accidental flashing of the chamber. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement, sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow.

Connecting to existing sewer lines shall be through a manhole.

Unless otherwise specified, 560 mm dia. circular cast iron manhole cover with frame, heavy-duty, conforming to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL shall be provided. The covers shall be close fittings so as to prevent gases from coming out.

3.04.09 Cutting of Pipes

Manufacturer's instructions shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave surface clean and square to the axis of the pipe.

3.04.10 Jointing

Jointing of pipes shall be so planned as to avoid completely any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone.

All joints between pipes, pipes and fittings and manholes shall be gas-tight

when above ground and watertight when underground. Method of jointing shall be as per instructions of the pipe and fittings manufacturer and as approved by the Engineer. However, in the absence of any instruction available from the manufacturer the methods as detailed hereunder shall be used.

a) Cast Iron Pipes

Socket and spigot pipes shall be joined 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. relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL shall be followed for general guidance.

The two adjoining pipes shall be butted against each other and adjoined in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The angular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement : 2 sand) which shall be rammed with caulking tool. After a day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured for 7 days.

c) Glazed Stoneware Pipes

Tarred gasket or hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly so as not to

fill more than 1/4 of the total depth of the socket. The remainder of the socket shall be filled with a stiff mixture of cement mortar 1:1 (1 cement : 1 sand). A fillet shall be formed round the joint with a trowel, forming an angle of 45 deg. with the barrel of the pipe. The newly made joints shall be protected, until set and shall be cured by covering with damp cloth or other suitable materials.

d) Vitrified clay pipes

The vitrified clay pipe shall be made from refractory clay mixed with crushed pottery and stone and burnt at a high temperature. These shall be hard, compact, and glazed to make them acid resistant and impervious, and shall be obtained from approved manufacturer.

Special care shall be taken in handling these pipes. The pipes shall not be jointed until the earth has been partly refilled over the portion of the pipe between the joint holes. Before laying the second pipe, the socket of the first pipe laid shall be thinly painted all round on the inside with cement slurry (1 part of cement and 2 parts of clean, sharp sand). A ring of rope yarn (closely twisted hemp or jute) dipped in neat cement paste or tar or bitumen, shall be inserted in the socket of pipe and driven home with caulking tools. The rope shall fully encircle the spigot with a slight overlap and shall not occupy more than one-fourth of the total depth of the socket. Where the spigot end of the pipe is made for receiving the gasket, it shall be wrapped with two or three turns of tarred spun, as close to the end as possible, before inserting into the socket. The joint shall then be completely filled with cement mortar (1:1), which shall have very little water. A fillet shall be formed round the joint with trowel, forming an angle of 45 degrees with the outside pipe. Special care shall be taken so that any excess mortar etc. left inside the pipe joints is neatly cleaned off immediately after each joint is made. A semi-circular wooden scrapper or a rubber disc to which a long handle is fixed could be used for this purpose.

e) Lead Pipes

The joints in lead pipes shall be made as wiped solder joint. The minimum and the maximum length of the wiped solder joints shall be 8 cm. and 9 cm. respectively. The solders shall generally consist of two parts of lead and one part of tin.

f) Polyethylene Pipes

The joints shall be thermo welded or bolted as per manufacturer's instructions.

g) Jointing Cast Iron Pipes with Stoneware Pipes

Where any cast iron drain pipe, ventilating pipe or trap is connected with a stoneware or semi-vitrified waste pipe, the beaded spigot end of such cast iron drain pipe, waste or ventilating pipe or trap shall be inserted into a socket of such stoneware pipe and the joint made with mortar consisting of one part of cement and one part of clean sand after placing a ratted gasket or hemp yarn soaked in neat cement slurry round the joint and inserted in it by means of a caulking tool.

h) Jointing Stoneware with Cast Iron Pipes

Where any water closet pan or earthware 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 glass-fibre reinforced polyethylene. 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. These tanks shall rest preferable on flat surface so as to distribute the load evenly. The tank shall be leakproof and water tight.

The outlet pipe shall be 50 mm above the bottom of the tank and provided preferably with strainers. The wash out or draining pipe shall be connected at the lowest point and flush with bottom of tank.

Tank shall be provided with all fittings for inlet, outlet, overflow pipes and ball valves.

3.06.00 SEPTIC TANK AND EFFLUENT DISPOSAL

3.06.01 Septic tank

Septic tank shall consist of the tank itself with inlet and outlets there from complete with all necessary earthwork and backfilling. The details of septic tank shall be as shown on drawings. This item shall also include ventilating pipe of at least 100 m dia whose top shall he provided with a suitable mosquito proof wiremesh and cowl. Ventilating pipe shall extend to a height of about 2 meter when the septic tank is at least 15 meter away from the nearest building and to a height of 2 meter above the top of building when it is located closer than 15 meter. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed.

3.06.02 Effluent Disposal

The effluent from the septic tank shall be disposed by allowing it into an open channel or a body of water if the concerned authority approves or into a soak pit for absorption by soil or shall be allowed to be absorbed by soil through open jointed SW pipes laid in a trench filled with broken bricks.

3.06.03 Soak pit

The soak pit shall be complete. It shall consist of a 900 mm dia pit 1000 mm in depth below the invert level of the inlet pipe. The pit shall be lined with stone; brick or concrete blocks set in cement mortar (1:6) and filled with brickbats. Inlet pipe shall be taken down to a depth of 900 mm from the top as an anti-mosquito measure.

3.06.04 Open joined SW Pipe/dispersion trenches

Minimum dia of the SW pipes shall be 150 mm nominal. The trench for laying the pipes shall be a minimum 600 x 600 mm. The joints of the pipes shall be left unsealed. The entire length of the pipe within the trench shall be buried in a 250 mm layer gravel or crushed stone of uniform size. On top of gravel/crushed stone layer is a 150 mm bed of well-graded coarse aggregate. Ordinary soil is used for filling the top of trench.

3.06.05 Commissioning septic tank

After the septic tank has been proved watertight and the sewage system is checked the tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall be seeded with well digested sludge obtained from septic tank or sludge digestion tank. In the absence of digested sludge a small quantity of decaying organic matter such as digested cow-dung may be introduced.

3.07.00 Related Works

All works, like earthwork, masonry, concrete, steelwork, cutting holes, chases, repairs and rectification associated directly with installation of water supply and sanitation systems shall come under scope of the Contractor unless specifically excluded. These works are not detailed out in this Section.

3.08.00 Regulation

The work which is required to be carried out under this section, shall be executed by a licensed Plumber only (engaged by the Contractor) and he shall obtain all necessary sanctions, permissions, certificates etc., from Municipal and/or other Local Authorities and shall abide by all the rules of such

Authorities.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 Inspection Before installation

All pipes, fittings, and appliance shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.

4.02.00 Testing of Water Supply pipe line

4.02.01 Testing of Mains after Laying

After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25 mm inlet with a stop-cock, allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 5 Kg/sq.cm or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of a large diameter, by a power driven test pump, provided that the pump is not left unattached. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable less for at least five minutes. The end of the main shall be closed by fitting a watertight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains.

4.02.02 Testing of Service Pipes and Fittings

The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely watertight. All piping, fittings, and appliances shall be checked for satisfactory support and protection from damage, corrosion, and frost.

4.03.00 Testing of Drain and Sewerage Pipelines

All soil pipes, waste pipes, ventilating pipes and all other pipes, when above ground, shall be gas tight. All sewers and drainpipes laid below ground shall be tested water tight. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for

review and instruction. The Engineer's discretion regarding tolerance shall be final.

General guidance for the tests are given below:

a) Smoke test

All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tarpaper or similar material in the combustion chamber of a smoke machine. Chemical smokes shall not be used.

b) Water test

The pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under tests. The tolerance figure of two litres per centimetre of diameter per kilometre may be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system, with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

Subsidence of test water may be due to one or more of the following cases:

a) Absorption by pipes and joints

b) Sweating of pipes or joints

c) Leakage at joints or from defective pipes

d) Trapped air.

Allowance shall be made for (a) by adding water until absorption has ceased and after which the test proper should commence. Any leakage and the defective part of the work shall be cut out and made good.

c) For straightness

i) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction,

such as yarn or mortar projecting through the joints, the ball with roll down the invert of the pipe end emerge at the lower end; and

ii) By means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipeline is not straight.

4.04.00 Fittings and Fixtures etc.

All fittings and fixtures shall be connected by water tight joints. No dripping of water shall be acceptable.

4.05.00 Testing Septic Tank

The septic tank shall be tested for water tightness. It shall be filled up with water and allowed to soak for 24 hours. Then, it shall be topped up and allowed to stand again for 24 hours and loss of level recorded. The fall shall not be more than 15 mm in 24 hrs.

5.00.00 CODES & STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise.

6.00.00 RATE AND MEASUREMENT

6.01.00 RATE

6.01.01 G.I. Pipes For Water Supply

Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. with cutting, making chases and jointing of pipes, making good the walls.

6.01.02 Rainwater Down-comers

Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. The rate also include cost of jointing and making good the opening in structure.

6.01.03 Sanitary Fixtures

Rate shall include providing and fixing of sanitary appliances & fixtures and at all elevation, including all accessories and fittings, connections pipes, waste

trap and pipes all complete as per description of "Schedule of Items". Rate shall also include the jointing of waste & traps to drain pipes.

6.01.04 Drainage and Sewer Pipes

Rate shall be inclusive of providing, laying and jointing of pipes as specified. Rate also include cost of lead joints or other joint as specified, cost for painting and cutting and making good walls, floors etc.

6.01.05 Floor and Gully Traps

Rate of traps is inclusive of all excavation, filling, repair, making good of opening in floor and walls, grating, painting etc. complete as described in "Schedule of Items".

6.01.06 Manholes, Septic Tank, Soak Pit and Cover

Rate of manholes, septic tank, soak pit shall be paid under respective items of work executed like brick work, plastering, concrete, reinforcement steel etc. provided for completion of the structure as per drawing and specifications. Manhole cover shall be paid separately as per description of item.

6.01.07 Water Storage Tank

The rate for water storage tank is inclusive of supply and installation of tank with all fittings, inlets, outlets, valves etc. complete.

6.02.00 MEASUREMENTS

6.02.01 Pipe for Water Supply and Drainage

For G.I.Pipe of water supply line, rainwater down comers, drainage and sewer pipe, the measurements shall be in running metres and shall be taken along centre line of pipe or specials.

The pipe shall be measured separately according to dia. and class of pipe.

Fixtures like bibcock, stopcocks, valves etc. shall be measured in numbers.

6.02.02 Sanitary Appliances & Fixtures and Allied Works

All sanitary appliances & fixtures like sink, washbasin, WC, shall be measured in numbers for the complete work as described in schedule of items.

Floor and gully traps shall be measured in numbers unless otherwise specified.

Water storage tank shall be measured in numbers for the capacity as specified in "Schedule of Items".

The item of work executed for completion of manholes, septic tank & soak pit shall be measured in respective items of work like brick work, RCC, plastering etc. CI cover shall be measured in numbers as specified in "Schedule of Items".

VOLUME: II B

SECTION - D

SUB-SECTION – D16

SPECIFICATION NO. PE-TS-421-600-C013

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.
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Standard Technical Specification
For Road and Drainage

1.00.00 Scope

The scope include all works required for the construction of road including construction of embankment, sub-base course, base course, pavement slab, provision of joints, shoulder and all incidental items of work specified or not shown but reasonably implied or necessary for the completion of the work etc.

The scope also include all works required for the construction of drainage including construction of road side drains, RCC culverts, pipe culverts, drainage pipes, manholes and all other incidental items necessary for the completion of the work etc.

1.01.00 Works To Be Provided By the Contractor

The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following.

a) Construction of roads including providing all materials, labour, supervision, services, equipment, tools and plants, transportation etc. all required for the completion of the work.

b) Submission of detailed scheme of all operations required for executing the work (e.g. material handling, placement, services, approaches etc.) to the engineer for approval.

c) Carrying out tests whenever required by the engineer to assess the quality of work and submission of the test results to the engineer after completion of the same etc.

1.02.00 Work To Be Provided By Others

No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

1.03.00 Conformity with Designs

The contractor shall carryout the work as per the construction drawings, specification and as directed by the engineer.

1.04.00 Materials to Be Used

All materials required for the work shall be the best commercial variety and as approved by the engineer.

2.00.00 Codes and Standards

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of relevant standard of AASHTO or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise.

2.01.00 Quality Control

The Contractor shall establish and maintain quality control for all materials, procedures, workmanship and equipment used. All works shall conform to the lines, grades, cross sections and dimensions shown on the drawings, specification and as directed by the engineer. Permitted tolerances for road works are described hereinafter.

a) Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of ± 25mm therefrom. The corresponding tolerance for edges of the roadway and lower layers of the pavement shall be ± 40mm.

b) Longitudinal Profile

The finished levels of the sub-grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the engineer and shall not exceed the tolerances as mentioned below.

Sub-grade ± 25 mm
Sub-base ± 20 mm
Base course ± 15 mm
Wearing course ± 10 mm

Tolerance in wearing course shall not be permitted in conjunction with the positive tolerance on base course if the thickness of the wearing course is thereby reduced by more than 6 mm.

c) Surface Regularity of Sub-grade and Pavement Courses

The surface regularity of the completed sub-base, base course and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table - I. The longitudinal profile shall be checked with a 3m long straight edge at the middle of each traffic lane along a line parallel

to the centre of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10m.

TABLE –I

PERMITTED TOLERANCE OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sl. No.	Type of Construction	Longitudinal profile with 3m straight edge					Cross Profile
		Maximum permissible Undulation (mm)	Maximum number of undulations permitted in any 300m length with undulation exceeding (mm)				Maximum permissible variation from specified profile under camber template (mm)
			18	12	10	6	
1	2	3	4	5	6	7	8
1.	Earthen sub-grade	25	30	-	-	-	15
2.	Granular sub-base	15	-	30	-	-	12
3.	Water Bound Macadam with oversize metal (40-90 mm size)	15	-	30	-	-	12
4.	Water Bound Macadam with normal size metal (20-50 mm and 40-63 mm size), Bituminous Penetration Macadam	12	-	-	30	-	8
5.	Surface dressing** (two coat) over WBM (20-50 mm or 40-63 mm size metal), Bituminous penetration macadam	12	-	-	20	-	8
6.	Open graded premix carpet, mix seal Surfacing	10	-	-	-	30	6
7.	Bituminous macadam	10	-	-	-	20***	6
8.	Semi-dense carpet	10	-	-	-	20***	6
9.	Asphaltic Concrete	8	-	-	-	10***	4

Notes:

1. ** For surface dressing in all other cases, the standards of surface evenness will be the same as those for the surface receiving the surface dressing.

2. *** These are for machine laid surfaces. If laid manually due to unavoidable reasons, tolerance up to 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 up to 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 in relevant standard of AASHTO or equivalent international standard approved by BIFPCL/BHEL.
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 to be rolled to required compaction before sub-base is placed thereon. The top layer of minimum 500mm of formation shall be compacted to 85% relative density (ASTM D-4253 and D-4254) for free draining soils containing less than 15% by weight finer than 75 micron sieve non plastic material or 98% of the maximum density as determined by ASTM D-1557 for soils containing more than 15% material passing the 75 micron sieve.

Where the height of the proposed embankment is less than 0.5m, the top layer of minimum 500mm of original ground shall be compacted to 85% relative density (ASTM D-4253 and D-4254) for free draining soils containing less than 15% by weight finer than 75 micron sieve non plastic material or 98% of the maximum density as determined by ASTM D-1557 for soils containing more than 15% material passing the 75 micron sieve.

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 150mm in compacted 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 relevant standard of AASHTO or equivalent international standard approved by BIFPCL/BHEL 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 relevant standard of AASHTO or equivalent international standard approved by BIFPCL/BHEL.

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 equipment, 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 85% relative density (ASTM D-4253 and D-4254) for free draining soils containing less than 15% by weight finer than 75 micron sieve non plastic material or 98% of the maximum density as determined by ASTM D-1557 for soils containing more than 15% material passing the 75 micron sieve. Subsequent layers shall be placed only after the finished layer has been tested and accepted by the Engineer.

When density measurements reveal any soft area in the embankment, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft area shall be removed and replaced with approved material and compacted to the density requirements and satisfaction of the Engineer.

3.03.07 Drainage

The surface of the embankment at all times during construction shall be maintained at such a cross fall as will shed water and prevent ponding.

3.03.08 Finishing Operations

Finishing operations shall include the work of shaping and dressing the shoulders, road bed and side slopes to conform the alignment, levels, cross sections and dimensions as shown on the drawings or as directed by the Engineer. Both the upper and lower ends of the side slopes shall be rounded off to improve the appearance and merge the embankment with the adjacent terrain.

3.04.00 Turfing With Sods

3.04.01 General

This work shall consist of furnishing and laying live sod of perennial turf forming grass on embankment slopes, shoulders or other locations as shown on the drawings or as directed by the Engineer. Unless otherwise specified the work shall be taken up following the construction of embankment provided the season is favourable for establishment of the sod.

3.04.02 Materials

The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically

free from weeds and other undesirable matters. At the time the sod is cut, the grass shall have a length of approximately 50mm and the sod shall be free from any debris.

Thickness of the sod shall be as uniform as possible with about 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that practically all the dense root system of the grass are retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than 250mm x 300mm in size but not so large so that it is convenient to handle and transport without damage. During wet weather the sod shall be allowed to dry sufficiently to prevent rearing during handling and during dry weather it shall be watered before lifting to ensure its vitality and to prevent dropping of soil during handling.

3.04.03 Placing the Sods

The area to be sodded shall be previously constructed to the required slope and cross section. Soil in the area shall be loosened, freed from all stones larger than 50mm size, sticks, stumps and any other undesirable foreign matters etc and brought to a reasonably granular texture to a depth not less than 25mm for receiving the sod.

Where required, top soil shall be spread over the slopes. Prior to placing the top soil, the slopes shall be roughened and wetted in order to have a satisfactory bond. The depth of top soil (to be spread) shall be 75mm.

Following soil preparation and top soiling (if required), fertilizer and ground limestone when specified shall be spread uniformly. After spreading, the materials shall be incorporated in the soil by discing or other means. The prepared sod bed shall be moistened if not already sufficiently moist and the sod shall be placed thereon within 24 hours after the same has been cut. Each sod strip shall be laid in close contact with each other and shall be lightly tamped with suitable wooden or metal tampers so as to eliminate air pockets and to press it into the underlying soil. At points where water may flow over the sod, the upper edges of the sod strips shall be turned into the soil below the adjacent area and a layer of earth shall be placed over it followed by thorough compaction.

3.04.04 Staking the Sods

Where the side slope is 2 to 1 or steeper and the distance along the slope is more than 2m, the sods shall be staked with pegs or nails spaced approximately 500 to 1000mm along the longitudinal axis of the sod strips. Stakes shall be driven approximately plumb through the sods and to be almost flushed with them.

3.04.05 Top Dressing

After the sods have been laid in position, the surface shall be cleaned of any loose sod, excess soil and other foreign materials. Thereafter a thin layer of top soil shall be scattered over the top dressed surface and the area shall be thoroughly moistened by sprinkling water.

3.04.06 Watering and Maintenance

The turfing so laid shall be well watered and protected until final acceptance. Watering shall be done in such a way that no erosion or damage to the sodded areas/embankment occur. The Contractor shall erect necessary warning signs and barriers, repair or replace the sods which are failing to show uniform growth of grass or damaged by his operation and shall maintain the sod at his own cost until final acceptance.

3.05.00 Shoulder Construction

3.05.01 Description

This work shall consist of constructing shoulder on either side of the pavement in accordance with the requirements of this specification and in conformity with the lines, grades and cross sections shown on the approved drawings and as directed by the Engineer.

3.05.02 Materials

The shoulder shall consist of 150 mm thick granular layer. The material used for shoulders shall comply with the specification for wet mix as following:
The wet mix material shall consist of crushed gravel or crushed rock and shall be suitably proportioned to conform to the following grading:

Sieve [mm]	Percentage by Weight Passing
50	100
37.5	90-100
20	60-80
10	40-60
5	25-40
2.36	15-30
0.6	8-22
0.075	0-8

The shoulder shall be compacted to minimum 85% relative density (ASTM D-4253 and D- 4254) for free draining soils containing less than 15% by weight finer than 75 micron sieve non plastic material or minimum 98.1% of the maximum density as determined by ASTM D-1557 for soils containing more than 15% material passing the 75 micron sieve.

3.05.03 Construction Operations

Except in the case of bituminous pavements, the shoulders shall be constructed in advance to the laying of pavement courses. The compacted thickness of each layer of shoulder shall correspond to the compacted layer of pavement course to be laid adjacent to it. After compaction, the inside edges of shoulders shall be trimmed vertical and the area enclosed between the shoulders shall be cleaned of all spilled materials before proceeding with the construction of the pavement layer.

In the case of bituminous pavements, shoulder shall be constructed only after the pavement courses have been laid and compacted.

Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed without any damage to the pavement and the area so affected shall be thoroughly cleaned. During all stages of shoulder construction, the required crossfall shall be maintained to drain off surface water.

3.06.00 Kerb

3.06.01 Material

Kerb if required for the construction of footpath shall consist of precast concrete blocks with concrete grade of C40/50. The blocks shall be of 100mm thick and of suitable length. The depth of blocks unless otherwise mentioned elsewhere shall be 325mm considering 225mm height of footpath above the road level.

3.06.02 Laying

The kerb shall be laid by cutting trenches of 100mm deep. The width of the trench shall be minimum and just sufficient to insert the kerbs. The inside faces of the kerbs shall be in plumb and the gap between the block shall not be more than 10mm.The gap shall be filled with cement mortar as specified.

The kerbs shall be thoroughly packed with a mixture of stone chips (50%) and moorum (50%) at the outside face. The laying and packing shall be done in a proper workmanlike manner acceptable to the Engineer.

3.07.00 Sub-base (Granular Sub-base)

3.07.01 Description

This work shall consist of laying and compacting well graded material on the prepared sub-grade in accordance with the specification. The material shall be laid in one or more layers as shown on the drawings and shall conform to the lines, grades and cross sections shown on the drawings and as directed by the Engineer.

3.07.02 Materials

A layer of 250 mm granular sub-base shall be provided. Sub-base material shall be crushed rock or other approved local material like brick metal (materials passing 425 micron sieve when tested in accordance with AASHTO or British Standard should have Liquid Limit and Plasticity Index of not more than 25 and 6 respectively) and confirming to the following grading.

Table – IV
Grading for Granular Sub-base Material

Sieve [mm]	Percentage by Weight Passing
75	100
37.5	85 - 100
10	45 - 100
5	25 - 85
0.6	8 - 45
0.075	0 - 10

3.07.03 Physical Requirements

The sub-base shall be compacted by approved plant to a dry density, which shall not be less than 98% relative compaction until movement of the surface ceases and the surface is closed. The CBR value shall be at least 30% at the optimum moisture content.

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 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 relevant standard of AASHTO or equivalent international standard approved

by BIFPCL/BHEL 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 98% of the maximum dry density of the material determined as per relevant standard of AASHTO or equivalent international standard approved by BIFPCL/BHEL. 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 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

Sl.No.	Type of Construction	Test	**Test method**	Requirements
1.	Sub-base	Los Angeles Abrasion Value * or Aggregate Impact Value	AASHTO or equivalent international standard AASTHO or equivalent international **	50 percent maximum 40 percent maximum
2.	Base	a) Loss Angeles Abrasion value* or Aggregate Impact Value b) Flakiness Index ***	AASTHO or equivalent international standard ** AASTHO or equivalent international standard approved by BIFPCL/ BHEL	50 percent maximum 40 percent maximum 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 AASTHO or equivalent international standard approved by BIFPCL/ BHEL.

*** 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 AASTHO or equivalent international standard approved by BIFPCL/ BHEL. Application of binding material may not be necessary when the screenings used are of crushable type such as moorum or gravel.

3.08.03 Construction Operations

a) The sub-grade/sub-base to receive the water bound macadam coarse shall be prepared to the specified grade and camber and made free of any dust and other extraneous materials. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm. Where water bound macadam is to be laid over an existing black topped surface, 50mm x 50mm furrows shall be cut at an angle of 45 degrees to the center line of the road at 1m intervals in the latter before laying the coarse aggregates.

b) Inverted Choke

If water bound macadam is to be laid directly over the sub-grade without any other intervening pavement course, a 25mm course of screenings (Grading-B) shall be spread on the prepared sub-grade before application of coarse aggregates is taken up.

c) Spreading Coarse Aggregates

The coarse aggregates shall be spread uniformly over the prepared surface in such quantities that the thickness of each compacted layer is limited to 100mm for Grading-1 and 75 - 100mm for Grading-2 and 3. The spreading shall be done from stockpiles along the side of the roadway or directly from the vehicles. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregates nor shall hauling over permitted. The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may

be required. No segregation of large or fine particles shall be allowed and the coarse aggregates as spread shall be of uniform gradation with no pockets of fine material. The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operation.

d) Rolling

Immediately following the spreading of the coarse aggregates, rolling shall be started with three wheeled power rollers of 8 to 10 tonne capacity or with tandem or vibratory rollers of approved type. The weight of the roller shall depend upon the type of the aggregate and be indicated by the Engineer.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road. Each pass of the roller shall uniformly overlap not less than one half the width of the track made in the preceding pass.

Rolling shall continue until the aggregates are thoroughly keyed and the creeping of aggregates ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wavelike motion in the sub-grade or sub-base course.

The rolled surface shall be checked transversely and longitudinally with templates and any irregularities found shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and rerolled until the entire surface conform to the desired camber and grade. In no case shall the use of screenings be permitted to make up the depressions.

e) Application of Screenings

After the coarse aggregate has been rolled, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregates. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical spreader or directly from trucks. Trucks operating for spreading the screenings shall be so driven as not to disturb the coarse aggregates.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms or hand brooms or with

both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregates.

The spreading, rolling and brooming of screenings shall be carried out in only such lengths of road which could be completed within one day's operation.

f) Sprinkling and Grouting

After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to seep the wet screenings into the voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued with additional screenings applied as necessary until the coarse aggregates are thoroughly keyed, well bonded and firmly set to its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or sub-grade does not get damaged due to the addition of excess quantity of water during construction.

g) Application of Binding Material

After the application of screenings, the binding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water and the resulting slurry shall be swept in with hand brooms or mechanical brooms to fill the voids properly and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling the voids form a wave ahead of the wheels of the moving roller.

h) Setting and Drying

After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam is set. The Engineer shall have the discretion to stop hauling traffic from using the complete water bound macadam course if in his opinion it would cause excessive damage to the surface.

3.09.00 Tack Coat

3.09.01 Description

The work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction.

3.09.02 Materials

The binder used for tack coat shall be bitumen of a suitable grade as approved by the Engineer and conforming to AASTHO or equivalent international standard approved by BIFPCL/ BHEL as applicable or any other approved cutback.

3.09.03 Construction Operations

a) Preparation of Base

The surface on which the tack coat is to be applied shall be thoroughly swept and scraped clean of dust and any other extraneous materials before the application of the binder.

b) Application of Binder

Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer and sprayed on the base at the rate specified below. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be supplied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.

3.10.00 Bituminous Macadam Binder Course

3.10.01 Description

This work shall consist of construction in a single course of 50mm/75mm thickness of compacted crushed aggregates premixed with a bituminous binder laid immediately after mixing on a base prepared previously in accordance with the specification and in conformity with the lines, grades and cross sections shown on the approved drawings.

3.10.02 Materials

a) Binder

The Binder shall be straight run bitumen of a suitable grade as directed by the Engineer complying with relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

b) Aggregates

The aggregates shall consist of crushed stone, crushed gravel (shingle) or other stones. They shall be clean, strong, durable, fairly cubical in shape and free from any disintegrated pieces, organic and other deleterious matter and adherent coats. The aggregates shall preferably be hydrophobic and of low porosity.

The aggregates shall satisfy the physical requirements set forth in Table - VIII.

Table – VIII

Physical Requirements of Aggregates for Bituminous Macadam

Sl. No.	Test	Test method	Requirements
1.	Los Angeles Abrasion Value *	As per relevant standard of AASTHO or equivalent international standard approved by BIFPCL/ BHEL	35 percent maximum
2.	Aggregate Impact Value *		30 percent maximum
3.	Flakiness Index		35 percent maximum
4.	Stripping Value		25 percent maximum
5.	Water Absorption		2 percent maximum

*Aggregates may satisfy requirements of either of the two tests.

The aggregates for bituminous macadam for different thickness shall conform to Grading- A or B as given in Table-IX or X as the case may be.

Table-IX

Aggregates Grading For 75mm Compacted Thickness of Bituminous Macadam

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
63 mm	100	
50 mm	90 - 100	
40 mm	35 - 65	100

25 mm	20 - 40	70 - 100
20 mm	-	50 - 80
12.5 mm	5 - 20	-
4.75 mm	-	10 - 30
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

Table-X
Aggregates Grading For 50mm Compacted Thickness of Bituminous Macadam

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
50 mm	100	
40 mm	90 - 100	
25 mm	50 - 80	100
20 mm	-	70 -100
12.5 mm	10 - 30	-
10 mm	-	35 - 60
4.75 mm	-	15 - 35
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

c) Proportioning of Materials

The binder content for premixing shall be 3.5 and 4.0 percent by weight of the total mix for aggregate Grading-A and B respectively unless directed otherwise by the Engineer. The quantity of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

d) Variation in Proportioning of Materials

The Contractor shall have the responsibility for ensuring proper proportio ning of materials and producing a uniform mix. A variation in binder content up to ± 0.3 percent by weight of total mix shall however be permissible for individual specimens taken for quality control tests.

3.10.03 Construction Operations

a) Weather and Seasonal Limitations

Bituminous macadam shall not be laid during rainy weather or when the base course is damp or wet.

b) Preparation of Base

The base on which the bituminous macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross sections as shown on the drawings and as directed by the Engineer. The surface shall be thoroughly swept and scraped clean and free of any dust and foreign matter.

c) Tack Coat

A tack coat shall be applied over the base.

d) Preparation and Transport of Mix

Hot mix plant of adequate capacity shall be used for preparing the mix. The temperature of binder at the time of mixing shall be in the range 150 Deg. - 165 Deg. C and to that of aggregates shall be in the range 125 Deg. - 150 Deg. C provided the temperature difference between the binder and the aggregate at no time exceeds 25 Deg. C. Mixing shall be thorough to ensure that a homogenous mixture is obtained in which all particles of the aggregates are coated uniformly. The mixture shall be transported from the mixing plant to the point of use in a suitable vehicle. The vehicle employed for transport shall be clean and be covered over in transit if so directed by the Engineer.

e) Spreading

After mixing, the mix shall be spread immediately by means of a self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix to the specified lines, grade and cross sections. However in restricted locations and in narrow widths where the available plants cannot operate in the opinion of the Engineer may permit manual laying of the mix. The temperature of mix at the time of laying shall be in the range 110 Deg. - 135 Deg. C.

In multilayer construction, the longitudinal joint in one layer shall offset into the layer below by about 150mm. However, the joint in the topmost layer shall be at the centre line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

f) Rolling

After spreading of mix, the rolling shall be done with 8 to 10 tonne power roller or with any other approved plant. Rolling should start as soon as the materials are spread. Rolling shall be done with care to avoid any undulation

in the pavement surface.

Rolling on the longitudinal joint shall be done immediately after the paving operation. After this, the rolling shall commence at the edges and progress towards the center longitudinally except on superelevated portions where it shall progress from the lower to the upper edge parallel to the center line of the pavement.

The initial or breakdown rolling shall be done as soon as it is possible to roll the mixture without cracking the surface and no mix pick up on the roller wheels. The second or intermediate rolling shall follow the break down rolling as early as possible and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while the material is still workable enough for removal of roller marks.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding fresh materials. The rolling shall then be continued till the entire surface has been rolled to compaction and there is no crushing of aggregates and till all the roller marks are eliminated. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheels shall be kept damp if necessary to avoid the bituminous material from sticking on the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose.

Rolling operation shall be completed in every respect before the temperature of the mix fall below 80 Deg. C.

Rollers shall not stand on the newly laid material as it may lead to undue deformation. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

The bituminous macadam shall be provided with a final surfacing without any delay. If there is to be any delay the course shall be covered by seal coat before allowing any traffic over it.

3.11.00 Open Graded Premix Carpet

3.11.01 Description

This work shall consist of laying and compacting open graded carpet of specified thickness in a single course of suitable small sized aggregates premixed with bituminous binder on a previously prepared base to form wearing course in accordance with the specification.

3.11.02 Materials

a) Binder

The binder shall be bitumen of suitable grade as approved by the Engineer and satisfying the requirements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL or any other approved cutback as applicable.

b) Aggregates

The aggregates shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be obtained by crushing rock, gravel or river shingle and be free of elongated and flaky pieces, soft and disintegrated materials, vegetable and any other deleterious matter etc. They shall preferably be hydrophobic type. The aggregates shall satisfy the quality requirements set forth in Table-VIII except that the flakiness Index shall be limited to a maximum of 30.

c) Proportioning of Materials

The materials shall be proportioned as per the quantities given in Table-XI for 20mm thick open graded premix carpet.

Table - XI

Quantity of Materials Required For 10 Sq. M of Road Surface for 20mm Thick Open Graded Premix Carpet

Aggregates for Carpet		
i)	Stone Chippings - 12mm size; passing 20 mm sieve and retained on 10 mm sieve	0.18 Cu.m
ii)	Stone Chippings - 10 mm size; passing 12.5 mm sieve and retained on 6.3 mm sieve	0.09 Cu.m
	Total	0. 27 Cu.m
Binder for premixing (quantities in terms of straight run bitumen)		
i)	For 0. 18 Cu.m of 12 mm size stone Chippings at 52 Kg per Cu.m	9.5 Kg
ii)	For 0.09 Cu. M of 10mm size stone	

Chippings at 56 Kg per Cu.m	5.1 Kg
Total	14.6 Kg

3.11.03 Construction Operation

a) Weather and Seasonal Limitations

Open graded premix carpet shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 16 Deg. C or below.

b) Preparation of Base

The underlying base on which the bituminous carpet is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section in accordance with the drawing, specification and as directed by the Engineer. The surface shall be well cleaned by removing caked earth and other foreign matters with wire brushes, sweeping with brooms and finally dusting with sacks as necessary.

c) Tack Coat

A tack coat complying with clause 3.09.00 shall be applied over the base preparatory to laying of the carpet. However application of tack coat shall not be necessary when the laying of carpet follows soon after laying the bituminous course.

d) Preparation of Premix

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated to the temperature appropriate to the grade of bitumen approved by the Engineer in boilers of suitable design avoiding local overheating and ensuring a continuous supply. The aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before these are placed in the mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified. The mixing of binder with chipping shall be continued until the chippings are thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and be covered over in transit if so directed.

e) Spreading and Rolling

The premixed material shall be spread on the road surface with rakes to the required thickness and camber or distributed evenly with the help of a drag spreader without any undue loss of time. The camber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material are laid, rolling shall be commenced with 6 to 8 Ton power rollers preferably with smooth wheel tandem type or with any other approved plant. Rolling shall begin at the edges and progress toward the center longitudinally except on the superelevated portions where it shall progress from the lower to upper edge parallel to the center line of the pavement.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled to compaction and all the roller marks have been eliminated. In each pass of the roller, preceding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose. Rollers shall not stand on newly laid material as it may lead to undue deformations.

The edges along and transverse of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of approved binder before the new mix is placed against it.

f) Seal Coat

A seal coat conforming to clause 3.12.00 shall be applied to the surface immediately after laying the carpet. No traffic shall be allowed on the road till the seal coat has been placed.

3.12.00 Seal Coat

3.12.01 Description

This work shall consist of application of a seal coat as specified for sealing the voids in the bituminous surface laid to the specified levels, grade and camber.

Type-A: Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stone chippings.

Type-B: Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

3.12.02 Materials

a) Binder

The binder shall be bitumen of suitable grade as directed by the Engineer and conforming to the requirements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL as applicable or any other approved cutback.

The quantity of binder to be adopted in terms of straight run bitumen shall be 9.8 Kg and 6.8 Kg per 10 square metre area for Type-A and Type-B seal coat respectively.

b) Stone Chippings for Type A Seal Coat

The stone chippings shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be free of elongated or flaky pieces, soft or disintegrated stone, vegetable or other deleterious matters etc. Stone chippings shall be of 6mm size defined as 100 percent passing through 10mm sieve and retained on 2.36mm sieve. The quantity used for spreading shall be 0.09 cu.m per 10 sq.m area. The chippings shall satisfy the quality requirements spelled out in Table- VIII except that the upper limit for flakiness Index shall be 30.

c) Fine Aggregate for Type B Seal Coat

The fine aggregate shall be sand or fine grit and shall consist of clean, hard, durable, uncoated dry particles and shall be free from dust, soft or flaky material, organic matter or other deleterious substances. The aggregate shall pass 1.7 mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06 cubic metre per 10 square metre area.

3.12.03 Construction Operations

a) Preparation of Base

The seal coat shall be applied immediately after laying the bituminous course which is required to be sealed. Before application of seal coat, the surface shall be cleaned free of any dust or other extraneous matters.

b) Construction of Type-A Seal Coat

The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer and sprayed on the dry surface in a uniform manner preferably with the help of mechanical sprayers. Excessive deposits of binder caused by stopping or starting of the

sprayer or through leakage or due to any other reason shall be suitably corrected before the stone chippings are spread.

Immediately after the application of binder, stone chippings in a dry and clean state shall be spread uniformly on the surface preferably by means of a mechanical grittier or otherwise manually so as to cover the surface completely. If necessary the surface shall be broomed to ensure uniform spread of chippings. Immediately after the application of the cover material, the entire surface shall be rolled with a 8 - 10 tonne smooth wheeled roller. Rolling shall commence from the edges and progress towards the centre except in superelevated portions where it shall proceed from the inner edge to the outer. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up the irregularities. Rolling shall continue until all aggregate particles are firmly bedded in the binder and present an 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 BS 5911 or

equivalent international standard 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 Portland Cement as per EN 197-1: latest or equivalent. Coarse Aggregates shall be as per BS EN 12620: latest or equivalent. Maximum size shall not exceed one third the thickness of the pipe or 20 mm whichever is smaller. Fine aggregates for concrete shall be as per BS EN 12620: latest or equivalent.

3.16.02 Laying of Pipes

Laying of concrete pipes shall correspond to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL and as per the specification given below.

a) The foundation bed for pipe shall be excavated true to lines and grades shown on the drawings and as directed by the Engineer. When trenching is involved, its width on either side of the pipe shall not be less than 150mm and not more than one third the diameter of pipe unless otherwise instructed/permitted by the Engineer. The sides of the trench shall be as nearly vertical as possible. Side slope, shoring, bailing out water etc. as required shall be done by the Contractor.

Side slips if there be any shall be removed by the Contractor. After laying of the pipes are completed, backfilling of the trenches shall be done as per "Specification for Earthwork in Excavation and Backfilling" to the satisfaction of the Engineer. The surplus spoils shall be transported and filled in low areas within the plant area as instructed by the Engineer.

When bedrock or boulder stratum is encountered during excavation, the excavation shall be taken down to at least 200mm below the bottom of the pipe with prior permission of the Engineer and all rock/boulders in the area shall be removed and space filled with approved earth free from stone or fragmented materials, shaped to the requirements and thoroughly compacted to provide adequate support for the pipe.

Filling of trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur and shall be done as per the "Specification for Earthwork in Excavation and Backfilling". When two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to a minimum of 450 mm. Laying of pipes shall start from the outlet and proceed towards inlet. All pipes and fittings shall be gradually lowered into the trench or placed on the supports by approved means taking due care to avoid any damage. Under

no circumstances the pipes shall be dropped into the trench or on supports from heights.

b) Pipe bedding shall be first class projection bedding for positive projecting pipes as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL having a projection ratio not greater than 0.70. The pipe shall be carefully laid on bedding made up of fine granular materials in an earth foundation; the bedding shall be carefully shaped to fit the lower part of the pipe exterior for at least ten percent of its overall height and in which the fill material is thoroughly compacted in layers not exceeding 150mm in depth around the pipe for the remainder of the pipe laid in trench.

When indicated on the drawings or directed by the Engineer, the pipe shall be bedded on a cradle constructed of concrete having a mix not leaner than C12/15. The shape and dimension of the cradle shall be as indicated on the drawing or as directed by the Engineer. The pipe shall be laid on the concrete bedding before the concrete is set.

c) The drop walls shall be made with first class brickwork in 1:4 cement mortar.

d) The pipe culverts shall be made with proper care with respect to the invert of the pipe, gradient if any etc. as specified on the drawings and as instructed by the Engineer.

e) Where R.C.C pipes are encased in concrete at road crossings or at other places the pipes need be suitably supported avoiding reinforcements of concrete blocks, joints properly done before concreting is taken up. Concreting of total height of block may be done in a single operation or may be done up to some height for pipes to be properly laid in position and the balance height of the block shall be concreted subsequently.

f) The R.C.C. pipes shall be joined with cement mortar. Cement mortar shall consist of 1 part of cement and 2 part of clean sand with only enough water for workability. Procedure of jointing shall be as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

3.16.03 Relation With Water Supply Pipeline

Unless specifically cleared by the Engineer, under no circumstances shall the drainage pipes be allowed to come close to water supply pipelines.

3.17.00 Manholes and Inspection Chambers

The maximum distance between the manholes shall be 30m unless specifically permitted otherwise. In addition, at every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The distance

between the manhole or inspection chamber and gully chamber shall not exceed 6 meters unless permitted otherwise. Manhole shall be constructed so as to be water tight under test. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide a smooth flow. Connection to the existing pipelines shall be through a manhole. Manholes shall be provided with standard covers usually of C.I. or as directed by the Engineer. The cover shall be closely fitted so as to prevent gases from coming out.

4.00.00 Testing and Acceptance Criteria

All testing as mentioned in the specification shall be carried out as relevant AASHTO/BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

5.00.00 MEASUREMENT

Method of measurement shall be as per the latest version of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL 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.
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SUB-SECTION – D XVII

FABRICATION OF STRUCTURAL STEEL WORK

1.00.00 SCOPE

This specification covers supply, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and rivets, bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork covered under the scope of the contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following

a) Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on the approved design drawings. As decided by the Engineer, some or all of these detailed drawings will have to be submitted for approval.

b) To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made.

c) To submit design calculations for joints and. connections developed by the contractor along with detailed fabrication drawings.

d) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary rivets, bolts, nuts, washers, tie rods and welding electrodes for field connections,

e) Furnish shop painting of all fabricated steelwork as per requirements of this Specification.

f) Suitably mark, bundle, and pack for transport all fabricated materials.

g) Prepare and furnish detailed Bill of Materials, Drawing Office Dispatch lists, Rivet and Bolt List and any other list of bought out items required in connection with the fabrication and erection of the structural steelwork.

h) Insure, load and transport all fabricated steelwork field connection materials to site.

i) Maintain a fully equipped workshop at site for fabrication, modification and repairs of steelwork at site as may be required to complete the works in accordance with the Contract.

2.02.00 Work by others

No work under this specification will be provided for by any agency other than the contractor, unless specifically mentioned otherwise elsewhere in the contract.

2.03.00 Codes and standards

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise.

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 BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 relevant BS Standards/Specifications or Equivalent

International standards approved by BIFPCL/BHEL 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 BS EN 10025-2 or equivalent.

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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

2.05.05 Bolts and Nuts

All bolts and nuts shall conform to BS EN ISO 898 or equivalent.

Materials for Bolts and nuts under the purview of this contract shall comply with any of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL may be applicable.

a) Mild Steel

All mild steel for bolts of grade 4.6 and nuts when tested in accordance BS EN ISO 898: latest or equivalent shall have a tensile strength of not less than 400MPa, yield strength not less than 240MPa and a minimum elongation of 22 per cent on a gauge length of 5.65 _/A, where "A" is the cross sectional area of the test specimen.

All mild steel for bolts of grade 5.6 and nuts when tested in accordance BS EN ISO 898: latest or equivalent shall have a tensile strength of not less than 500MPa, yield strength not less than 300MPa and a minimum

elongation of 20 per cent on a gauge length of 5.65 _/A, where "A" is the cross sectional area of the test specimen.

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 BS EN ISO 898: latest or equivalent or as approved by the Engineer.

2.05.06 Washers

Washers shall be made of steel conforming to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

2.05.07 Paints

Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

2.06.00 Coal Bin

2.06.01 Shape of bins shall be circular, polygonal, square, or rectangular in plan. Bottom hopper portion may have be conical-cum-hyperbolic or any other profile shape as shown in the drawing. Bin shall be termed as bunkers or silos according to their shape and plane of rupture of coal.

2.06.02 For general requirements, fabrication and construction details relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL shall be followed as general guidance. The bins shall be fabricated and erected in segments.

2.06.03 The Coal bins shall be made of mild steel plates joined together with full strength butt weld and provided with stiffeners at regular interval. Stiffeners shall be provided on the external face and it may be welded with external face.

2.06.04 Bending of plates and rolled sections to the required shape for fabrication shall be done by plate bending machine or cold bending process Without resorting to heating, hammering, angle smithy and black smithy process.

2.06.05 Poking hole (manual or pneumatic) and striking plate shall be provided to facilitate coal flow. Poking holes shall have circular MS pipe and cover cap as detailed in the drawing.

2.07.00 New Erection Marks

2.07.01 Additional structures involving new erection marks may be required to be added at any stage of work.

2.07.02 All such new erection marks shall be detailed and included in marking schemes and fabrication carded out thereafter.

2.07.03 All such new erection marks shall be considered under item of original fabrication work. As a result of additional structures becoming necessary if the work is delayed beyond the time schedule stipulated, the Engineer shall give suitable extension of time provided he is satisfied about the reasonableness of the delay involved. However, no claim for extra payments or revision of rates due to delay shall be entertained.

2.08.00 ELECTRO FORGED STEEL GRATINGS

2.08.01 Factory made fabricated electro forged gratings unit conforming to BS 4592: Part 1 & 2 or equivalent shall be supplied, fabricated, transported, erected and aligned in floorings, platforms, drain and trench covers, walkways, passages, staircases with edge binding strips and anti skid nosing in treads etc.

2.08.02 All grating units shall be rectangular in pattern and electro forged. The size and the spacing of the bearing bars and cross bars shall be as detailed in fabrication drawings. The contractor shall submit the grating design for different spans and load intensities along with fabrication drawings. The depth of the grating unit shall be 40 mm, unless specified otherwise.

2.08.03 The gratings shall be made up in panel units designed to coincide with the span of the structural steel framing or openings as indicated in the design/ scope drawings. Maximum possible standardization of the grating panel sizes shall be tried and designed.

2.08.04 The grating unit shall be accurately fabricated and finished, free from wraps, twists, or any defects that would impair their strength, serviceability, and appearance.

2.08.05 Grating work shall include cut outs and clearance opening for all columns, pipes, ducts, conduits or any other installation penetrating through the grating work. Such cut outs and clearances shall be treated as specified in subsequent clauses.

2.08.06 The gratings shall be notched, trimmed and neatly finished around flanges and webs of the columns, moment connections, cap plates, and such other components of the steel structures encountered during the placement of the gratings. In all such cases, the trimming shall be done to follow the profile of the components encountered. After trimming, the binding strip shall be

provided on the grating to suit the profile so obtained.

2.08.07 Opening in gratings for pipes or ducts that are 150mm in size or diameter or larger shall be provided with steel bar toe plates of not less than 5mm thickness and appropriate width, set flush with the bottom of the bearing bars.

2.08.08 Penetrations in gratings that are more than 50mm but less than 150mm in size or diameter shall be welded with plates of size shown in the detailed drawings set flush with the bottom of the grating panel.

2.08.09 Unless otherwise indicated on the drawings, grating units at all penetrations shall be made up in split section, accurately fitted and neatly finished to provide for proper assembly and erection at the job site.

2.08.10 Grating units shall be provided with all necessary clips, bolts, nuts and lock washers required for proper assembly and rigid installation and fastening to abutting units supporting structural steel framing members.

2.08.11 The gratings shall be of reputed make and manufacturer, as approved by Engineer. The unit rate quoted by him for this item shall be inclusive of transport of gratings to the project site, all taxes, duties etc. He shall also provide all facilities and access to the Engineer or his representative to carry out inspection during all stages of manufacturing of gratings.

2.08.12 Maximum deviation in linear dimension from the approved dimension shall not exceed 12mm.

2.08.13 All fabricated grating section and accessories shall be blast cleaned to near white metal surface (Sa 2½) followed by either of the following two:

(a) Two coats of red lead primer and two coats of black enamel finish paint.

(b) Hot dipped galvanization at 600 gm/sq.m.

in the shop prior to erection at site, as the approved drawing.

2.08.14 Prior to finishing all surfaces shall be cleaned, free from rust, mill scale, grease, oil, or any other foreign matter by blast cleaning. BS: 4232 shall be followed for blast cleaning.

2.08.15 Primer can be applied by spray guns or by brushes, however the finish paint shall necessarily be applied by means of spray guns. The applied coatings shall be uniform, free from voids and streaks; drilled or punched holes shall be touched up prior to erection or assembly.

2.09.00 GALVANIZATION OF GRATINGS

2.09.01 Purity of Zinc to be used-for galvanizing shall be 99.5% as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.`

2.09.02 After the shop work is complete, the structural material shall be punched with erection mark and be hot double dip galvanized. Before galvanizing the steel section shall be thoroughly blast cleaned to near white metal surface (Sa 2½).

2.09.03 The weight of the zinc coating shall be at least 600 gm/m² - unless noted otherwise.

2.09.04 The galvanized surface shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be cleaned and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter that is loosely attached to the steel, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

2.09.05 There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized steel member shall withstand minimum four one minute dips in copper sulphate solution as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

2.09.06 When the steel section is removed from the galvanizing kettle, excess spelter shall be removed by 'bumping'. The processes known as 'wiping' or 'scrapping' shall not be used for this purpose.

2.09.07 Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications or lack of quality control in any manner in the galvanizing plant, shall render the entire, production in the relevant shift liable to rejection.

2.09.08 All structural steel shall be treated with sodium dichromate or an approved equivalent solution after galvanizing; so as to prevent white storage stains.

2.09.09 If the galvanizing of any member is damaged, the Engineer shall be shown of the extent of damage, if so directed the galvanizing may have to the redone in the similar manner as stated above at no extra cost to the Owner.

2.10.00 STAINLESS STEEL HOPPERS (As per BOQ item)

2.10.01 Material

In case SS Hopper is to be fabricated & erected as per BOQ item with SS415M, following specification shall be followed.
Stainless steel hopper of grade SS 415M as manufactured by SAIL or equivalent shall be provided in the lower portion of bunker hopper. SS 4 15M having the following chemical composition shall be used.

Material	**%**	**Remarks**
Carbon	10.03%	Max.
Silicon	1.60%	Max.
Manganese	0.80% to 1.50%	
Phosphorous	0.03%	Max.
Sulpher	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 BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. Fabrication drawings shall be prepared by the contractor on the basis of the design / scope drawings furnished by Engineer. The fabrication and erection works shall be done as per the approved fabrication

drawings.

2.10.03 Fabrication Drawings

a) Fabrication drawing shall give the cutting plan for each hopper plate. Such, cutting plan shall be based on the size of the Stainless Steel plate available at store. In order to reduce the wastage and ensure the maximum utilization of stainless steel plate, the cutting plan shall take in the consideration of the reverse curvature and place the various elements of hopper plate in opposite fashion to reduce the end wastage. Similarly the hopper plate element having different radii shall be placed one inside the other, to optimize the stainless steel plate use. Such optimization may also required adjustment in the size of the each element of hopper plate and also additional weld joints.

b) The bill of material of hopper plate shall indicate the inner surface area of the hopper, weight of the hopper based on the inner surface area, weight of each of the cut plate of hopper fabrication, weight of cut and scrap pieces generated. Contractor shall return to the Owner's store all unutilized (surplus) stainless steel plates and all waste and cut pieces generated. Non return of any part of the surplus/waste steel pieces to the Owner's store will call for the penal recovery at three (03) times the maximum procurement rate for the weight of stainless steel pieces not returned to the store.

c) In case the contractor does the cutting of the stainless steel without approved cutting plan then all the wastage (i.e. the difference between the weight of stainless steel plate cuts and the actual finished weight considered for the measurement for payment) shall be subjected to the penal recovery at the rate mentioned above.

2.10.04 Cuffing

Cutting may be affected by shearing, or by using plasma. The cut edges of all plates shall be perfectly straight and uniform through out. Cutting shall be done as per the cutting plan shown in the fabrication drawing. Should the Engineer find it necessary, the edges shall be ground smooth afterwards by contractor within the unit rates quoted by him. All the edge s shall be ground smooth before they are welded.

2.10.05 Jointing

Welding shall join stainless steel. All weld joints (along the inclined plane) shall be staggered. Any common welding process can weld stainless steel viz. MIG, metal arc or plasma using the covered compatible electrodes as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL or by inert gas arc welding as per relevant BS

Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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 309L electrodes/fillers shall be used for the welding of Stainless Steel to Stainless Steel and Stainless Steel to Mild Steel respectively. However, the welding process and the type of the electrodes to be used for welding shall be as per welding procedure, as approved by the Engineer. On the basis of the welding procedure, the Contractor shall conduct qualification test.

2.10.06 Bending

The stainless steel plates shall be subjected to cold forming and bending in order to get the desired shape and profile.

2.10.07 Welding sequence

The type of electrodes, welding sequence, preheat and interpass temperature and post weld heat treatment shall be as approved by the Engineer.

2.10.08 Acceptance Criteria of Fabricated Structures

The acceptance of the fabricated structure work shall depend upon correct dimensions and alignment, absence of distortion in the structure, satisfactory results from the inspection and testing of the welded structure joints and the test specimens, general workmanship being good meeting the tolerance requirements given in relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

2.11.00 BEARINGS

2.11.01 PTFE (Poly tetra fluorethylene) slide bearing

a) General

The bearings shall consist of upper and lower units. The upper unit shall include a sole plate with mirror finish stainless steel facing bonded to the bottom surface of the sole plate. The lower unit shall consist of a relevant laminated elastomers pad surfaced with PTFE. A rigid confining medium substructure bonds the PTFE to the pad. When the upper and lower units are mated the stainless steel slides on the PTFE surface with an extremely low coefficient of friction. These bearings shall be designed as per the performance requirements. The bearing shall be of reputed make and manufacturer as approved by Engineer, for required vertical loads, as per the construction drawings and for a maximum displacement of ± 50 mm.

b) Material

PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/cm². In order to prevent cold flow in the PTFE surface it shall be rigidly bonded by a special high temperature resistant adhesive to the stainless steel sub-strata. The stainless steel surface, which slides against the PTFE, is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of the stainless steel shall be between 1.0 to 1.5mm.

The resilient bearing pad shall consist of multiple layers of lightweight fabric impregnated with a high quality elastomer compound vulcanized into slabs of uniform standard thickness as per the requirement. This shall withstand vertical (compressive) load not less than 500 kg/cm² and shear loads upto 40 kg/cm².

c) Installation

The seating area for PTFE bearing shall be prepared accurately level and furnished with a thin layer of epoxy resin mortar. The bearing will be placed on this layer while it is still workable and the bearing is levelled. The bearing should not be displaced as the beam is lowered into position. When the mortar and adhesive are fully set and the beam slightly above the top of the bearing. The upper surface of the bearing shall then be coated with sufficient thickness of epoxy resin mortar so that when the beam is lowered on to the temporary supports it comes into full contact with the mortar and some is squeezed out. The surplus shall be troweled off and after the mortar is fully set the temporary supports removed.

2.12.00 Storage of material

2.12.01 General

All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged, shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed and the cost incurred thereof shall be realised from the Contractor. The Contractor shall maintain upto date accounts in respect of receipt, use, and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks.

2.12.02 Steel

The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground section wise and lengthwise so that they can be easily inspected, measured, and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather.

2.12.03 Electrodes

The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating.

2.12.04 Bolts, Nuts and Washers

Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length, and quality.

2.12.05 Paints

Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.

2.13.00 Quality Control

The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer’s representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall co-operate with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor.

Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work.

The quality control procedure shall cover but not be limited to the following items of work

a) Steel: Quality manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.

b) Rivets, Bolts, Nuts & Washers : Manufacturer's certificate, dimension checks, material testing.

c) Electrodes : Manufacturer's certificate, thickness and quality of flux coating.

d) Welders : Qualifying Tests

e) Welding sets : Performance Tests

f) Welds : Inspection, X-ray, Ultrasonic tests

g) Paints : Manufacturer's certificate, physical inspection reports

h) Galvanizing : Tests in accordance with relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

2.14.00 Standard dimensions, forms and weights

The dimensions, forms, weights and tolerances of all rolled shapes rivets, bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

2.15.00 Fabrication Drawings

The contractor shall within thirty (30) days after the award of the Contract submit to the Engineer the Schedule of Fabrication and erection of structural Steelworks, for approval. Within one week after receipt of approval on design of any steel structure (part or full) based on the approved design. As decided by the Engineer, six (6) copies each of some or all of the detailed fabrication drawings will have to be submitted for approval.

The sequence of preparation of fabrication drawings shall match with the approved fabrication and erection schedule. The above-mentioned approval for

fabrication drawings will be accorded only towards the general conformity with the design requirements as well as specifications. The approval of drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents.

The fabrication drawings shall include but not limited to the following:

a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.

b) Dimensional drawings of base plates, foundation bolts location etc.

c) Comparison sheets to show that the proposed alternative section, if any, is as strong as the original sections shown on the Design Drawings.

d) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.

e) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof.

These drawings shall give all the necessary information for the fabrication, erection, and painting of the steelwork in accordance with the provisions of this Specification. Fabrication drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Fabrication drawings shall give complete information necessary for fabrication of the various components of the steelwork, including the location, type, size, and extent of welds. These shall also clearly distinguish between shop and field rivets, bolts, and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the fabrication drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked up stresses and distortion. Welding symbols used shall be in accordance with the requirements of the relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

3.01.02 Straightening Material

Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600°C.

3.01.03 Cutting

Shearing, cropping, or sawing shall affect cutting. Use of a mechanically controlled gas-cutting torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Engineer.

To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges, occasional notches or gouges not more than 4 mm deep will be permitted. Gouges greater than 4 mm that remain from cutting shall be removed by grinding. All re-entrant corners shall be shaped notch free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion.

3.01.04 Planning of edges

Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer.

3.01.05 Clearances

The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams web shall be not more than 3 mm at each end, but where for practical reasons greater clearance is necessary, suitably designed cheatings shall be provided.

3.02.00 Riveted and bolted construction

3.02.01 Holes

Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of rivet or bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the rivet or bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the rivet or black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

Holes for rivets or bolts shall not be formed by gas cutting process.

3.02.02 Assembly

All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the rivets or bolts shall be reamed. Poor matching of holes shall be cause for rejection .The component parts shall be so assembled that they are neither twisted not otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained.

Rivets shall ordinarily be hot driven, in which case their finished heads shall be approximately hemispherical in shape and shall be of uniform size throughout the work for rivets of the same size full, neatly finished and concentric with he holes. Rivets shall be heated uniformly to a temperature not exceeding 1125°C they shall not be driven after their temperature has fallen below 540°C.

Rivets shall be driven by power riveters, of either compression or manually operated type, employing pneumatic, hydraulic or electric power. Hand driven rivets shall not be allowed unless in exceptional cases specifically approved by the Engineer. After driving, rivets shall be tight, shall completely fill the holes and their heads shall be in full contact with the surface. In case of countersunk rivets, the countersinking shall be fully filled by the rivet, any proudness of the countersunk head being dressed off flush, if required.

Riveted members shall have all parts firmly drawn and held together before and during riveting and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole.

All loose, burnt, or otherwise defective rivets shall be cut out and replaced and special care shall be taken to inspect all single riveted connections. Special care shall also be taken in heating and driving long rivets. The Contractor shall prove the quality of riveting by cutting some rivets chosen at random by the Engineer. No extra payment will be made to the Contractor for such cutting and replacing. Riveting work, for any particular section or group, will be considered satisfactory when at least 90% of the corresponding cut rivets is found to be sound. If the ratio is below 75%, all the rivets in the particular section or group shall be cut, removed and replaced and tested again at the Contractor's expense. For cases between 75% and 90% the engineer shall have the option to instruct cutting and replacing any number of further rivets at the Contractor's cost as he deems necessary.

Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if shown on drawing or directed by the Engineer.

Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project trough the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer one spring washer or lock nut shall be provided for each bolt for connections subjected to vibrating forces or

otherwise as may be specified on the Drawings.

3.03.00 Welded Construction

3.03.01 General

Welding shall be in accordance with relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with BS EN 1011-1, BS EN 1011-2 or equivalent standards.

3.03.02 Preparation of material

Surface to be welded shall be free from loose scale, slag, rust, grease, paint, and any other foreign material except that mill scale, which withstands vigorous wire brushing, may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch.

3.03.03 Assembling

Parts to be fillet welded shall be brought in, as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces, which are not completely sealed by, welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2°).

The work shall be positioned for flat welding whenever practicable.

3.03.04 Welding Sequence

In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shod splicing not more than three sub-sections, each made in accordance with this paragraph.

When required by the Engineer, welded assemblies shall be stress relieved by

heat-treating in accordance with the provisions of the relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

3.03.05 Welding technique

All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 m thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross-section. Groove welds made with the use of the backing of the same material, as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness.

Groove welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the contract.
To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

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 BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

3.03. 13 Peening

Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool, peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening.

3.03. 14 Equipment

These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufacturers of electrodes or as may be approved by the engineer.

3.04.00 Finish

Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butted over the whole section with a clearance not exceeding 0.1 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc; after welding/riveting together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles of channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 1.0 mm.

3.05.00 Slab bases and caps

Bases and caps fabricated out of steel slabs, except when cut material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face, which is to be grouted direct to a foundation, need not be machined if such face is true and parallel to the upper face.

To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.

3. 12.00 Lacing bars

The ends of lacing bars shall be neat and free from burns.

3. 13.00 Separators

Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.

3.14.00 Bearing Plates

Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.

3.15.00 Floor Grating

All grating units shall be rectangular in pattern and of pressure locked assembly. The size and spacing of bearing bars and cross bars shall be as approved in detailed drawings. Alternatively diamond pattern grating if approved may be used.

The grating shall be made in panel units designed to span as indicated in structural steel framing drawing or as directed by the Engineer.

The grating units shall be finished free from warps, twists, or any other defects. Grating work shall include cutouts and clearance openings for all columns, pipes, ducts, conduits etc. The gratings shall be notched, trimmed, and neatly finished around components of the steel structures encountered. Binding strip shall be provided on the grating to suit the profile. Openings in gratings shall be provided with steel bar toe plates of not less than 5 mm thickness and 100 mm width.

Unless otherwise indicated on drawings, all penetrations of grating units shall be made up in split section, accurately fitted, and neatly finished. Grating units shall be provided with all necessary clips, bolts, lock washers etc. for proper assembly and installation on supporting steel members. Maximum deviation in linear dimension shall not exceed 12 mm.

3.10.00 Chequered Plates

Minimum thickness of chequered plate floorings, covers etc. shall be 6 mm O/P. Chequered plate shall be accurately cut to the required sizes and shapes and the cut edges properly ground. Stiffeners shall be provided wherever required from design consideration.

3.11.00 Architectural Clearances

Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances.

3.11.00 Shop connections

a) All shop connections shall be otherwise riveted or welded as specified on the Drawings.

b) Heads of rivets on surfaces carrying brick walls shall be flattened to 10 mm thick projection.

c) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the contractor will have to make the desired changes at no extra cost to the exchequer.

3.13.00 Castings

Steel castings shall be annealed.

3.14.00 Shop erection

The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before dispatch. The parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in such a way as will facilitate the check of interchange ability.

3.15.00 Shop painting

3.15.01 General

Unless otherwise specified, steelwork, which will be concealed by interior building finish, need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer.

After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other methods of loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by the solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by trough sweeping with a fibre brush.

3.15.02 Inaccessible parts

Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, Positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

3.15.03 Contact surfaces

Contact surface shall be cleaned in accordance with sub-clause 3.13.1 before assembly.

3.15.04 Finished surfaces

Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

3.15.05 Surfaces adjacent to field welds

Unless otherwise provided for, surfaces within 50 of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

3.16.00 Galvanizing

3.16.01 General

Structural steelwork for switchyard or other structures as may be specified in the contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or equivalent - Recommended practice for Hot-Dip Galvanizing of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.

3.16.02 Surface Preparation

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

3.16.03 Procedure

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements of ISO 1461 or equivalent.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after leaving been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surfaces during transport, handling, and erection. Damages, if occur, shall be made good in accordance or as directed by the Engineer.

4.00.00 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

4.01.00 Inspection

Unless specified otherwise, inspection to all, work shall be made by the or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer’s works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification.

The Contractor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract. The Contractor shall guarantee compliance with the provisions of this Specification.

4.02.00 Testing and Acceptance Criteria

4.02.01 General

The Contractor shall carry out sampling and testing in accordance with the relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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 BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. Cost of all tests shall be born by the contractor.

All material shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance.

4.02.02 Welding

a) The weld surface shall be cleaned with steel wire brush to remove spatter metal, slag etc. and 100% of welds shall be inspected visually for size, length of weldment and external defects. Weld gauges shall be used for checking weld sizes. The surface shall be clean with regular beads and free from slags, cracks, blow-holes etc.

b) Non-destructive examination shall be carried out to determine soundness of weldments as follows:

   i) 10% at random on fillet-joints.

   ii) 100% on all butt-joints.

c) Should the ND tests indicate defects like improper root penetration, extensive blowholes, slag intrusion etc., such welds shall be back gauged, joints prepared again and rewelded. All defects shall be rectified by the Contractor at no extra costs.

d) All electrodes shall be procured from approved reputed manufacturers with test certificates. The correct grade and size of electrode, which has not deteriorated in storage, shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. For every 50 tones of welded fabrication, the Engineer may ask for 1(one) test-destructive or non-destructive including X -ray, ultrasonic test or similar, the cost of which

shall be borne by the Contractor.

4.02.04 Rivets, bolts, nuts and washers

All rivets, bolts, nuts, and washers shall be procured from M/s. Guest Keen William Ltd. or equivalent and shall confirm to the relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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 BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. Cost of all such testing shall have to be borne by the Contractor. In addition to testing the rivets by hammer, 2% (two per cent) of the rivets done shall have to be cut off by chisels to ascertain the fit, quality of material and workmanship. The removal of the cut rivets and re-installing new rivets shall be done by the Contractor at his own cost.

4.02.05 Shop painting

All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

4.02. 12 Galvanizing

All galvanizing shall be uniform and of standard quality and shall conform in all to ISO 1461 or equivalent.

4.03.00 Tolerance

The tolerances on the dimensions of individual rolled steel components, straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures shall be as specified in relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

4.04.00 Acceptance

Should any structure or part of a structure be found not to comply with any of the provisions of this specification, the same shall be liable to rejection. No Structure or part of the structure once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check some of the tests at an appropriate laboratory at the contractors cost.

When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue acceptance certificate, upon receipt of which, the items will be shop painted, packed and dispatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract.

4.05.00 Delivery of materials

4.05.01 General

The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. The Owner may prescribe or control the sequence of delivery of materials, at his own discretion.

4.05.02 Marking

Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection.

4.05.03 Shipping

Shipping shall be strictly in accordance with the sequence stipulated in the agreed Programme. Contractor shall dispatch the materials to the e worksite securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All parts shall be adequately braced to prevent damage in transit.

Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following:

a) Name and address of the consignee

b) Name and address of the consignor

c) Gross weight of the package in tonnes and its dimensions

d) Identification marks and/or number of the package

e) Custom registration number, if required

All markings shall be carried out with such materials as would ensure quick drying and indelibility.

Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers.

Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially -

a) Name of the Contractor

b) Number and date of the Contract

c) Name of the office placing the contract

d) Nomenclature of stores

e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawings and the quantity of each.

The shipping dimensions of each packing shall not exceed the maximum dimensions permissible for transport over the Bangladesh Railways/Roads/applicable mode of transport.

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 advise regarding the shipment with relevant details shall reach the Engineer at least a week in advance.

5.00.00 INFORMATION TO BE SUBMITTED

5.01.00 With Tender

The following information is required to be submitted with the Tender:

a) Progress Schedule

The Contractor shall quote in his Tender a detailed schedule of progress of work and total time of completion, itemizing the time required for each of the following aspects of work.

i) Preparation and approval of fabrication drawing

ii) Procurement of Materials

iii) Fabrication and shipping of all anchor bolts

iv) Fabrication and shipping of main steelwork.

v) Fabrication and shipping of steelwork for bunkers, tanks and/or silos as applicable.

vi) Fabrication and shipping of all other remaining steelwork including miscellaneous steelwork.

vii) Final date of completion of all shipments.

b) Shop

Location of the Tenderer's fabrication workshop giving details of equipment, manpower, the total capacity, and the capacity that will be available exclusively for this contract shall be submitted.

5.02.00 After Award

After award of the Contract the successful Tenderer is to submit the following:

a) Complete fabrication drawings, material lists, cutting lists, rive and bolt lists, field welding schedules based on the approved design drawings prepared by him in accordance with the approved schedule.

b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Engineer on or before the 7th day o. each month, giving the up-to-date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other

relevant information.

c) Detailed monthly material reconciliation statements relevant to the Work done and reported in the Progress Report, giving the stock at hand of raw steel, work in progress, finished materials.

d) Results of any test as and when conducted and as require by the engineer.

e) Manufacturer's mill test report in respect of steel materials, rivets, bolts, nuts, and electrodes as may be applicable.

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

6.01.01 The items of work in the Schedule of items describe the work in brief. The various items of the Schedule of items shall be read in conjunction with these specifications including amendments and additions, general conditions of contract, special conditions of contracts, and other tender documents, if any. For each item of Schedule of Items, the bidder's rates shall include the activities covered in the description of the item as well as all necessary operations described in the Specifications.

6.01.02 The bidder's rates shall include cost of all minor details which are obviously and fairly intended and which may not have been included in the description in these documents but are essential for the satisfactory completion of the work. Rates shall also include for taking all safety measures.

6.01.03 The bidder's -rates for all items of schedule of items shall include complete cost towards plant, equipment, erection and dismantling of scaffolding, men, materials and consumables, skilled and unskilled labour, levies, taxes, royalties, duties, transport, storage, repair/rectification/maintenance until handing over, contingencies, overhead and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work.

6.01.04 No claims shall be entertained, if the details shown on the `Released for Construction' drawings differ from those shown on the bid/tender drawings.

6.01.05 Rates shall be inclusive of all leads and lifts/elevation.

6.01.06 The bidder's rates for Structural Steel shall include for fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, erection scheme, alignment, welding, including preheating and post heating, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection

and testing, erection scheme, protection against damage in transit, stability of structures, etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus/waste steel materials including cut pieces/waste steel, provision of additional butt/weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work.

The rates for fabrication are inclusive of all tests on welds and material and no extra shall be payable for quality tests specified for fabrication of structure in shop or at site.

Separate BOQ items for test on welds like radiography or Ultrasonic, DPT, magnetic particle tests are kept for tests on material/fabrication not covered under regular fabrication item of BOQ.

6.01.07 The bidder's rates for foundation bolts assembly shall include fabrication, threading, heat treatment, erection, installation, and alignment of complete bolt assembly with nuts, locknuts, anchor plates, stiffener plates, protective tape, etc. This shall also include the cost of all materials not issued by the Owner. Material issued by Owner will be specified in GCC.

6.01.08 The 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.

6.01.09 The bidder's rates for application of finish painting system shall include surface preparation, application of intermediate (under) coat, finish coat and final finish coat, and getting approval of the specialized agency supplying the finish paint.

6.01.10 The bidder's rates for electro-forged gratings (if specified) shall include supply, fabrication, transportation to the site, erection and alignment of factory made electro-forged gratings, all taxes, duties thereon etc. The rates shall also include preparation of grating design for different spans and load intensifies, preparation of design and fabrication drawings, edge preparation, blast cleaning followed by finish paint.

6.01.11 The bidder's rates for galvanization of factory made electro-forged gratings (if specified) shall include the application of hot dipped galvanization as finish over the fabricated gratings and the treatment to be given for prevention of white storage stains, as per the technical Aspiration.

6.01.12 The bidder's rates for permanent mild steel bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types of Structural Steel works, as per the technical specification.

6.01.13 The bidder's rates for high strength structural bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types, of Structural Steel works, as per the technical specification.

6.01.14 The bidder's rates for dismantling, additions to, alterations in and/or modifications shall be inclusive of all operations such as lowering of material, carriage etc., as mentioned in the technical specification. Unutilised steel pieces cut/removed shall be returned to the project stores free of charge. Non-return of unublized steel pieces to the Owner's store would be considered as wastage and recovery would be affected as per the provision of contract for structural steel consumption. This shall not include the weight of temporarily dismantled/supported members, connected member.

The bidder should prepare an optimised cutting plan as per fabrication drawing to utilise the steel material up to maximum extent and minimise the wastage/scrap. Quantity of wastage/scrap of material should be limited to the percentage mentioned elsewhere in the conditions of tender/ contract specifications.

6.01.15 The bidder's rates for re-erection of erection marks after additions to, alterations in and/or modifications shall be inclusive of all operations mentioned in technical specification for the calculated weight of the rectified/modified erection mark rejected at site. This shall not include the weight of temporarily dismantled/supported members, connected member. All the operations mentioned above for restoring such members shall be carried out at no extra cost. The work of erection of any erection mark which has not been dismantled but have been modified/rectified before erection shall not be paid under this item but shall be paid under relevant item of fabrication and erection of steel work of Schedule of items for the modified weight.

6.01.16 The bidder's rates for PTFE shall include design, supply, transportation of the complete assembly with guides and dust protection cover and installation of bearings in position drilling, bolting, erecting aligning etc. along with any taxes, duties thereon etc.

6.01.17 The bidder's rates for Stainless Steel hopper (if specified) shall include fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, all other operations mentioned in the technical specification. The rates shall also include for erection scheme, alignment, making cutting plan, cutting, jointing, bending, rolling, grinding, drilling, bolting, assembly, edge preparation, welding including pre-heating, post-heating, testing of welders, inspection of

welds, inspection and testing, protection against damage in transit, stability of structures, installation of temporary structures etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus / waste steel materials including cut pieces/waste steel, provision of additional butt / weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work.

6.01.18 The bidders 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 rolled sections, 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

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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SUB-SECTION – D 18

ERECTION OF STRUCTURAL STEELWORK

1.00.00 SCOPE

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at site, installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Contractor, unless otherwise specified in the Contract, shall include but not be limited to the following:

a) The Contractor shall provide all construction and transport equipment, tools, tackle, consumables, materials, labour, and supervision required for erection of the structural steelwork.

b) Receiving, unloading, checking, and moving to storage yard at Site including prompt attendance to all insurance matters as necessary for all fabricated steel materials arriving at Site. The Contractor shall pay all demurrage and/or wharfage charges etc. on account of default on his part.

c) Transportation of all fabricated structural steel materials from Site storage yard, handling, rigging, assembling, riveting, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer. If necessary suitable temporary approach roads to be built for transportation of fabricated steel structures.

d) Checking centre lines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets. Any defect observed in the foundation shall be rectified with Engineer's approval. The Contractor shall fully satisfy himself regarding the correctness of the foundations before installing the fabricated steel structures on the foundation blocks.

e) Aligning, plumbing, levelling, riveting, bolting, welding and securely fixing the fabricated steel structures including floor gratings, chequered plates etc. in accordance with the Drawings or as directed by the Engineer.

f) Painting of the erected steel structures.

g) All minor modifications of the fabricated steel structures as directed by the Engineer including but not limited to the following:

i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.

ii) Cutting, chipping, filling, grinding, etc. if required for preparation and finishing of site connections.

iii) Reaming of holes for use of higher size rivet or bolt if required.

iv) Refabrication of parts damaged beyond repair during transport and handling or refabrication of parts, which are incorrectly fabricated.

v) Fabrication of parts omitted during fabrication by error, or subsequently found necessary.

vi) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.

vii) Carry out tests in accordance with this specification.

2.02.00 Work by Others

No work under this Specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Codes and Standards

All work under this Specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

2.04.00 Conformity with Designs

The Contractor will erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification and the sequence and the design criteria laid down by the Engineer. All work shall conform to the provisions of this specification and /or instructions of the engineer. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specifications and/or the instructions of 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 codes/standards

All materials required to be supplied by the Contractor under this contract shall conform to the relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

2.06.00 Storage of Materials

2.06.01 General

All material shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site, failing which, the engineer shall be at liberty to get the materials removed by agency and the cost incurred thereof shall be realised from the Contractor's dues.

2.06.02 Yard

The Contractor will have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other raw steel materials such as structural sections and plates as required. The yard shall have facilities like drainage, lighting, and suitable access for large cranes, trailers, and other heavy equipments. The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved Programme of work.

The Tenderer must visit the site prior to submission of his tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc. all of which shall be carried out by the Contractor at his own cost as directed by the Engineer.

2.06.03 Covered Store

All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building to be built at the cost of the Contractor.

2.07.00 Quality Control

The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the Following items of work:

i) Erection: Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.

ii) Grouting: Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency, and strength of grout.

iii) Painting: Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

2.08.00 Taking Delivery

The Contractor shall take delivery of fabricated structural steel and necessary connection materials from railhead/trucks as may be necessary and as directed by the Engineer. He shall check, unload; transport the materials to his stores for proper storing at his own cost. The Contractor shall submit claims to insurance or other authorities and pursue the same in case of loss or damage during transit and handling and all loss thereof shall be borne by him.

The Contractor shall also take all precautions against damage of the materials in his custody after taking delivery and till the same are erected in place and accepted. The Contractor shall salvage, collect, and deliver all the packing materials to the Owner free of charge.

3.00.00 WORKMANSHIP

3.01.00 Erection

3.01.01 Plant and Equipment

The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be thoroughly verified. They shall be efficient, dependable, in good working condition and shall have the approval of the Engineer.

3.01.02 Method and sequence of erection

The method and sequence of erection shall have the prior approval of the Engineer. The Contractor shall arrange for most economical method and sequence available to him consistent with the drawings and specifications and other relevant stipulations of the contract.

3.01.03 Temporary Bracing

Unless adequate bracing is included as a part of the permanent framing, the erector during erecrtion shall install, free of cost to the Owne, temporary guys and bracings where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations.

If additional temporary guys are required to resist wind or seismic forces acting upon components of the finished structure installed by others during the course of the erection of the steel framing, arrangement for their installation by the erector shall be made free of cost to the Owner.

The requirement of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned, and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer.

The temporary guys, braces, false work, and cribbing shall not be the property of the Owner and they may be removed immediately upon completion of the steel erection.

3.01.04 Temporary Floors for Buildings

It shall be the responsibility of the Contractor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or bylaws of state, Municipal or other local authorities.

3.01.05 Setting Out

Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Engineer. For heavy columns, etc. the Contractor shall set proper screed bars to maintain proper level. No extra payment shall be made for this.

Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance under this Specification.
No permanent field connections by riveting, bolting or shall be carried out until proper alignment and plumbing has been attained.

3.01.06 Field Riveting

All rivets shall be heated and driven with pneumatic tools. Hand passing or "throwing" of rivets are desirable. Any other method of conveying hot rivets from the furnace to the driving point must be approved by the engineer. No-cold rivets shall be driven. All other requirements of riveting including quality and acceptance criteria shall be in accordance with the relevant portions of the Specification for Fabrication of Structural Steelwork of the Project.

3.01.07 Field Bolting

All relevant Portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following:

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other, defects that would prevent solid seating of the parts. Contact surfaces within friction type joints shall be free of oil, paint, lacquer, or galvanizing.

All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods.

a) Turn-of-nut Method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the Joint are brought into good contact with each other. 'Snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table-I with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

TABLE-I

Bolts length not exceeding 8 times dia or 200 mm	Bolt length exceeding 8 times dia or 200 mm	Remarks
1/2 turn	2/3 turn	Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation-30° over or under.

Bolts may be installed without hardened washers when tightening is done by the turn -of-nut -method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have the outer face of the match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque Wrench Tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques specified in TABLE-II (See Note below the Table). Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

TABLE-II

Nominal Bolt Diameter (mm)	Torque to be applied (Kg.M) for bolt class 8.8 of BS EN ISO 898-1: latest or equivalent
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 BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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 Bangladesh National Building Code or equivalent.

3.05.00 Final cleaning up

Upon completion of erection and before final acceptance of the work by the Engineer, the contractor shall remove free of cost all false work, rubbish and all Temporary Works resulting in connection with the performance of his work.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 General

Loading tests shall be carried out on erected structures, if required by the Engineer, to check adequacy of fabrication and/or erection. Any structure or a part thereof found to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member as per the Contract and no payment towards the cost of the dismantled portion and any connected work shall be made to the contractor. In course of dismantling, if any damage is done to any other parts of the structure or to any fixtures, the same shall be made good free of cost by the Contractor, to the satisfaction of the Engineer.

The Cost of the tests specified hereinafter shall be borne by the Owner; but if the structure fails to pass the tests, the cost of the tests shall be recovered from the Contractor. Any extra claim due to loss of time, idle labour, etc. arising out of these testing operations shall not be entertained, however, only reasonable and appropriate time extensions will be allowed.

The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing and the tests shall be conducted as indicated in the following sub-clauses 4.01.01, 4.01.02 and 4.01.03. The method of testing and application of loading shall be as approved by the Engineer.

4.01.01 Stiffness Test

In this test, the structure or member shall be subjected, addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after this second test is not less than 90 per cent of the maximum increase in strain or deflection recorded during the second test.

4.01.02 Strength Test

The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours.

In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on the removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load.

4.01.03 Structure of same design

Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first

application of the test load, particular note shall be taken of the strain or deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours. This information is required as a basis of comparison in any check test carried out on samples of the structure.

When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 time the specified live load, in a manner and to an extent prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the maximum strain or deflection recorded at similar load in the test on the prototype.

4.01.04 Repair for subsequent test and use after strength tests

An actual structure which has passed the “Strength Test” as specified in Sub-clause 4.1.2 hereinbefore and is subsequently to be erected for use, shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in Sub-clause 4.01.01 hereinbefore.

4.02.00 Tolerances

Some variation is to be expected in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications for fabrication of structural steel work applicable to this Project and as specified below: The specified tolerance is mainly for welded erection. In case of bolted erection, no tolerance is desired so that all prefabricated bolt holes are matched on erection.

I. For Buildings Containing Cranes

Component	Description	Variation Allowed
1.	2.	3.
Main columns	a) shifting of column axis at foundation level with Respect to building line	
	i) In longitudinal direction	i) ± 3.0 mm

	ii) In lateral direction	ii) ± 3.0 mm
	b) Deviation of both major column axis from vertical between foundation and other member connection levels:	
	i) For a column upto and including 10M height	i) ± 3.5 mm from true vertical
	ii) For a column greater than 10M but less than 40M height	ii) ± 3.5 mm from true vertical for any 10 M length measured between connection levels, but not more than ±7 mm per 30m length.
	c) For adjacent pairs of columns across the width of the building prior to placing of truss	± 9.0 mm on true span.
	d) For any individual column deviation of any bearing or resting level from levels shown on drawings.	± 3.0 mm
	e) For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating	3.0 mm
Trusses	a) Deviation at centre of span of upper chord member from vertical plane running through centre of bottom chord.	1/1500 of the span or greater than 10mm whichever is the least.
Trusses	b) Lateral displacement of top chord at center of span from vertical plane running through center of supports.	1/250 of depth of truss or 20 mm which ever is the - least.
Crane Cirders	a) Difference in levels of crane rail measured between	

	adjacent columns.	2.0 mm.
	b) Deviation to crane rail-gauge	± 3.0 mm
	c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermite welding.	1.0 mm.
	d) Deviation of crane rail axis from centre line of web.	± 3.5 mm
Setting of Expansion gaps	At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30°C. The coefficient of expansion or contraction shall be taken as 0.000012 per °C per unit length.	

iv) For Building without Cranes

The maximum tolerances for line and level of the steel work shall be ±3.0 mm on any part of the structure. The structure shall not be Out of Plumb more than 3.5 mm on each lox section of height and not more than 7.0 mm per 30 m section.

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

4.03.00 Acceptance

Structures and members have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.01.00, 4.01.01, 4.01.02, 4.01.03 and 4.01.04 and other applicable provisions of this specification and are within the limits of tolerances specified in Sub-clause 4.02.00 and/or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfillment of the provisions of this contract.

5.00.00 INFORMATION TO BE SUBMITTED

5.01.00 Before Tender

5.01.01 Tentative Programme

The Tenderer shall submit a tentative programme based on the information available in the Tender Document and visit to site indicating the structure-wise erection schedule proposed to be maintained by the Contractor to complete the job in time in accordance with the Contract.

5.01.02 Constructional Plant and Equipment, Tools, Temporary works & manpower A detailed list Of all constructional plant and equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tenderer which he will be able to employ on the job to maintain the progress of work in accordance with the Contract shall be submitted along with the Tender. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.

5.01.03 Erection Yard

A site plan showing the layout and location of the erection yard proposed to be established by the tenderer shall also be attached with the tender indicating the storage space for fabricated steel materials, site-fabrication and repair shop, covered stores, offices, locations of erection equipments and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the Contractor shall comply with the same without any claim whatsoever.

5.02.00 After award of the Contract

After award of the contract, the Contractor shall submit the following:

5.02.01 Detailed Programme

The Contractor shall submit a detailed erection programme within a month of the award of the Contract for completion of the work in time in accordance with the Contract. This will show the target programme, with details of erection proposed to be carried out in each fortnight, details of major equipment required, and an assessment of required strength of various categories of workers in a proforma approved by the Engineer.

5.02.02 Fortnightly Progress Report

The Contractor shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and all details of actual achievements against the target programme specified in Sub-clause 5.02.01 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the Contractor shall also furnish details of fabricated materials in hand at site and

the strength of his workers.

VOLUME: II B

SECTION - D

SUB-SECTION – D19

ROOF DECKING

SPECIFICATION NO. PE-TS-421-600-C019

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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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 Deareator bay and bunker building consists of permanently color coated (on exposed face) galvanized MS trough metal sheet decking plate of approved color over roof purlins for cast-in-situ roof slab as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL and conform to class 3. Thickness of deck plate shall be minimum 0.7mm 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 color coating shall be 20 microns. It shall serve as permanent shuttering for cast-in-situ roof slab. It should have adequate strength to support weight of green concrete and imposed load during construction. The thickness of the deck plate shall however be designed suitably according to the spacing of roof purlins.

3.00.00 INSTALLATION

The Contractor shall furnish all labour, equipment and materials as required for the design, fabrication, coating, erection and fixing of the decking over purlins, painting and for the complete performance of the work in accordance with the construction drawings and as described herein.

The description, which follows, gives a general indication of the nature and extent of the work but is not necessarily exhaustive and does not purport to cover all the details/operations which will be necessary in order to carry out the work.

3.01.00 Detailed Design of Roof Decking

The Contractor, in conjunction with the manufacturer, shall be responsible for the detailing of the profiled decking, fittings and fixtures and shall submit with his tender particulars of the proposed manufacturer and of the particular product proposed for use. The detailing is to be based on typical details furnished by the Engineer. The Contractor shall submit to the Engineer, two copies of the general arrangement and detailed working drawings for the proposed design, together with all calculations necessary to verify the adequacy and completeness of the design & detailing of decking sheets,

fixtures, flashings and trims. After approval he shall supply further eight copies.

The Engineer will verify the correct interpretation of his requirements but may not necessarily check the design and details, and the Contractor shall be entirely responsible for the accuracy of the drawings and the correctness of the design and the suitability of the details. Manufacture of roof decking sheets shall not commence until the necessary approval of the Engineer has been obtained.

3.02.00 Erection & Fixing

3.02.01 Sequence of Manufacture/Erection

Cutting Schedules, delivery to site and stacking arrangements in store shall ensure that sheets are erected in a sequence which follows that for the manufacture. The decking sheets shall be erected using an arrangement of sheets and joints to conform with the requirements of this specification. Decking erection for each elevation or feature shall commence at one end only and proceed towards the other end, in order to ensure tight fitting laps.

3.02.02 Position and Location of Laps

Side and end laps of roof decking sheets shall be located and positioned in such a manner as to provide the maximum weather protection taking into account the direction of the prevailing wind.

The lines formed by horizontal laps and fixing shall where possible, be continuous and coincide with the edges of large openings in the roof.

3.02.03 Alignment of Sheets and Fixings

All roof decking sheets shall be fixed plumb and level with all fixings evenly spaced and accurately lined. All dirt and grease shall be removed from the surfaces of the sheets as the work proceeds.

3.02.04 Site Cutting

Approval must be obtained before the roof decking sheets are cut at site. Generally cutting of sheets to length will not be permitted, only special cutting and trimming for small openings shall allowed. Where possible, site cut edges shall be concealed at laps.

3.02.05 Damaged Sheets

Distorted, blemished or water stained sheets and any other fittings shall not be used.

3.02.06 Laps

End laps and side laps to roof decking sheets shall be sufficiently large to ensure that the decking complies with the weather tightness and other requirements of this specification. The length of each decking sheet shall be adjusted so that the end laps shall bear on the purlins. In no case end laps shall not be less than 150 mm and side laps shall not be less than 53 mm.

3.02.07 End Lap Fixings

End lap fixings shall be located at least 25 mm from the end of each sheet.

3.02.08 Side Lap Fixings

The spacing of side lap fixings shall ensure compliance with this specification regarding tightness. The spacing of these fixing screws shall not exceed 500mm. The fixing shall be located in the bottom flat of the corrugation.

3.02.09 Holes

Holes in MS decking sheets shall be punched. In case holes are drilled holes, it is to be ensured that the holes do not go oversize due to the small thickness of the sheeting. All drilling swarf shall be removed from the surfaces of decking, supporting steel work, purlins etc.

3.02.10 Location and Spacing of Fixings

Fixings shall be accurately located in position in the centre of the corrugations to ensure that the heads of bolts, nuts and washers bear squarely down on the surface of the sheeting and are not located at the edge or on the joints in supporting purlins.

3.02.11 Fixings

The tenderer shall submit with his tender details of the proposed method for securing the roofing sheets to the metal purlins. The roof decking sheets are to be fixed to the roof purlins with hex washer head white zinc plated heat treated carbon steel self-drilling / self-tapping screws of minimum thread diameter of 5.6mm. These self-drilling screws shall be drilled through the roofing sheets and purlins supporting the roofing sheets. These purlins shall be suitably spaced as per the requirement of roofing sheets and the roofing sheets shall not sag more than span/250 for the loads likely to be imposed during concreting and in future. The self-drilling screws are to be spaced at a maximum distance of 390mm centre to centre along the length of the purlins and top chord of truss. The screws are to be located preferably in the valley only and shall be installed in accordance with the manufacturer's recommendations using tools

approved by the manufacturer which do not damage the coating of the decking sheets.

3.03.00 Protection during Construction

Precautions shall be taken during the erection of the roof decking to ensure that partially erected decking are protected during inclement weather and damage at all times.

3.04.00 Damage

Any damage to coating & primer during transportation is to redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner.

4.00.00 Acceptance Criteria

The installation shall present a neat appearance and shall be checked for water tightness. The following shall be checked:

a) Side and end laps

b) Absence of damage in the sheeting.

c) Conformity of fixings with the approved design.

5.00.00 IS Codes

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise.

6.00.0 RATES AND MEASUREMENTS

6.01.00 Rates

Rates shall be unit rate for complete item described in the Schedule of Items and shall include all wastage.

6.02.00 Method of Measurement

Roofing shall be measured for net area of the work done. Profiled sheeting (coated & painted) shall be measured in plan area of sheets and not girthed. No deduction shall be made for openings measuring up to 0.1 sq.m. in

area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.

No payments shall be made for laps.

VOLUME: II B

SECTION - D

SUB-SECTION – D20

FALSE FLOORING

SPECIFICATION NO. PE-TS-421-600-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

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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 supply 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 $\pm$ 0.2mm. Floor panel shall have 2mm thick non-static PVC on top, 2mm thick hard PVC strip lipping on four edges and 26 G aluminium sheet fixed with araldite at bottom. Minimum thickness of the panel shall be 35mm, unless otherwise noted. All panels shall be completely interchangeable and easily removable with a suction lift tool. Panels shall be square within a tolerance of $\pm$ 0.25 mm on the diagonal. The floor panels shall be cut, wherever required for providing suitable outlets for

cables and edges shall be lipped with hard PVC sheets.

2.02.01 Strength

Each 610mm x 610 mm floor panel must be capable of withstanding the designed service load. The ultimate strength shall provide a safety factor of 3. The false flooring shall be capable of carrying a axial load of 800 kg and uniform load of 2000 kg/sq.m with maximum deflection of 1/350. If required by the Engineer, the samples shall be accepted only after carrying out load tests. The Engineer may relax the test requirements with concentrated load in case cabinets are not handled with castor fitting arrangement.

One additional pedestal shall be provided under floor stringer along front panel area of each control board for taking possible additional load that may occur from time to time.

2.02.02 Surface finish

All removable panels shall have the top surface finished with 2 mm thick flexible PVC flooring conforming to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL and shall be fixed to the surface with compatible high-creep resistant adhesive. The PVC floor tile shall be in single piece for each floor panel. Under side of panels shall also be painted with suitable epoxy or oil based paint.

2.02.03 Damaged Floor Panels

Distorted, blemished or stained floor panels shall not be used.

2.03.00 Skirting

Skirting shall be 150 mm high and 2 mm thick, completely matching with false flooring surface finish materials and shall be fixed to the wall surface as per manufacturer's installation instructions.

3.00.00 INSTALLATION

3.01.00 Base

The system shall be placed over a base of RCC floor slab and beams. Any grouting etc. that is necessary to fix the supporting structure shall be done.

The concrete sub floor shall be sealed with two coats of polyurethane paint to prevent moisture from coming in contact with cables and to minimize dust problem.

The floor panels and channels shall be completely interchangeable and remain in position without screwing or bolting under working/imposed loadings.

Any damage to the sub floor during installation of the false flooring system shall be made good by the contractor without any extra cost to the Owner. All steel surfaces are to be protected by two coats of polyurethane paint over a compatible primer and any damage to the paint during installation shall be made good. In case the loads exerted by the weight of machines are above the stated characteristics of floor finish material, the floor shall be protected by overlaying hard board during installation of machine or equipment.

All installation work of the false flooring system shall be supervised by the manufacturer's authorized representative.

3.03.00 Painting

After fixing the false flooring supporting system the sub floor shall be given a coat of polyurethane paint.

3.04.00 Protection during Construction

All precautions shall be taken during the erection of the false flooring to ensure that partially erected flooring are protected and shall not be damaged before handing over to owner.

3.05.00 Damage

Any damage of coating to supporting system caused during transportation is to be redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner.

4.00.00 ACCEPTANCE CRITERIA

The false flooring system shall only be accepted after completion of following checks:

a. Level

b. Alignment of joints

c. Thickness of joints

d. Surface finish

e. Colour and texture

f. Details of edges, junctions etc.

g. Performance

h. Criteria specified for strength.

5.00.00 CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise.

6.00.0 RATES AND MEASUREMENTS

6.01.00 Rates

Rates shall be unit rate for complete item described in the Schedule of Items and shall include, but not limited to, supply & installation of floor panels, supporting systems, paintings atc.

6.02.00 Method of Measurement

False flooring shall be measured in Sq.M for net area of the work done. No deduction shall be made for openings measuring up to 0.4 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.

VOLUME: II B

SECTION - D

SUB-SECTION – D21

BORED CAST-IN-SITU RCC PILES

SPECIFICATION NO. PE-TS-421-600-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 covers the technical requirements for piling work.

2.02.00 The work shall include supplying and providing necessary materials, mobilization of all necessary equipments, providing necessary engineering supervision through qualified and technical personnel, skilled and unskilled labour, etc. as required to carryout 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 shall be as given in drawings.

2.05.00 The Contractor shall confirm and guarantee the "Safe Load" capacities by conducting both initial and working load test on piles as mentioned in the specific requirements.

2.06.00 The Contractor shall submit along with tender documents his tender design of piles based on soil data furnished by the Owner along with this specification. The ultimate load capacity of a pile may be estimated using suitable static formula and the minimum factor of safety shall be 2.5. However, safe load carrying capacity shall be conformed and guaranteed by conducting initial and routine load tests.

2.07.00 In case of initial or routine load test piles, if the Contractor fails to establish the safe load capacity as per his design, the Owner has the right to either derate the pile capacity on prorata basis or insist the Contractor to modify the pile design, to achieve the desired safe load capacity at no extra cost to the Owner.

2.08.00 Derating is acceptable up to 90 percent. In such case, additional piles shall be installed as per the design requirements.

2.09.00 The Owner shall decide whether to derate or modify the design based on the design considerations such as providing additional piles in the designed pile cap, provision for extending the pile cap size, etc.

2.10.00 In case the Owner decides to modify the design instead of derating the pile, the contractor shall carry out the same and install separate test piles and test the same to guarantee the safe load at no extra cost to the Owner. However no extra shall be charged for the additional test piles as well as testing of these piles as per agreed contract conditions.

2.11.00 In case of working piles, if the pile does not meet the guaranteed capacity or rejected due to any other reason, the Contractor shall install extra piles at no extra cost to the Owner. Further, the extra cost, due to the increase in the pile cap size if any, on account of extra piles, shall be borne by the Contractor.

2.12.00 It is essential that all equipment and instruments are properly calibrated both at commencement and immediately after the completion of tests so that they represent true values. Certificates to this effect from an approved institution shall be furnished to the Engineer. If the Engineer so desires the Contractor shall arrange for having the instruments tested at an approved laboratory at no extra cost to the Owner and the test report shall be submitted to the Engineer. If the Engineer desires to witness such tests Contractor shall arrange to conduct the test in his presence.

2.13.00 The Contractor shall make his own arrangements for locating the coordinates and position of piles as per drawings supplied to him and for determining the Reduced Levels (RL) of these locations with respect to the benchmark indicated by the Engineer. Two established reference lines in mutually perpendicular direction shall be indicated to the Contractor. The Contractor shall provide at site all the required survey instruments to the satisfaction of the Engineer so that the work can be carried out accurately according to specifications and drawings.

2.14.00 The contractor shall assure the quality of piling work including cleaning of pile bore, quality of concrete, integrity of piles, etc.

2.15.00 **AVAILABLE SUB-SOIL DATA**

An abstract of the sub soil data is furnished in the tender document. However, the detailed soil investigation report shall be made available for reference of the bidder, if so required, at the office of the Owner. The soil data furnished is in good faith and only for the guidance of the Bidder, to arrive at design parameters and construction methods.

3.00.00 MATERIALS

3.01.00 General

All materials viz cement, steel, aggregates, water, etc. which are to be used for pile construction shall conform to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 BS EN 206: latest or equivalent.

3.02.01 Technical Specification for Cement Concrete (Plain and Reinforced) works along with DIN EN 1536: latest or equivalent 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 0.6.

3.02.02 Grade and minimum cement content
Minimum grade of concrete shall conform to BS EN 206: latest or equivalent. Minimum cement content of 325 Kg/M³ of concrete shall be used for placement in dry conditions and 375 325 Kg/M³ for placement in submerged conditions.

3.02.03 Slump of concrete
The slump of concrete shall vary between 150 to 200 mm.

3.03.00 REINFORCEMENT

3.03.01 Longitudinal reinforcement in pile shall be of grade B500B conforming to BS 4449 latest or equivalent unless specified otherwise. Lateral reinforcement in pile shall be of mild steel or HYSD bars as per BS 4449 latest or equivalent.

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 as per Table 5 of DIN EN 1536: latest or equivalent. 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 as per Table 6 of DIN EN 1536: latest or equivalent 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/pile bore by providing necessary laps as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

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 as per DIN EN 1536: latest or equivalent, unless otherwise mentioned.

3.03.11 Bundling of bars is not permitted.

4.00.00 PILE INSTALLATION

Installation of piles shall be carried out as per pile layout drawings, installation criteria, and the direction of the Engineer.

4.01.00 Equipment and Accessories

4.01.01 The equipment and accessories for installation of bored cast-in-situ piles shall be selected giving due consideration to the sub soil conditions, ground water conditions and the method of casting, etc. These shall be of standard type and shall have the approval of the Engineer.

4.01.02 List and details of equipment and accessories proposed to be used for the job shall be submitted along with the bid.

4.01.03 The capacity of the rig shall be adequate so as to reach the specified founding level.

4.01.04 Provision shall be kept for chiselling within the pile bore, as specified elsewhere in this specification. Chiselling shall be carried out only with the approval of Engineer.

4.02.00 Installation Criteria

4.02.01 For determining the founding level of piles in soil as specified elsewhere, the Contractor shall have to perform Standard penetration test (SPT) as per as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL in a separate bore hole. The SPT shall be conducted at 1.0 m interval between the depths covering 5 metres each above and below the specified founding level. The bore shall be 100 mm diameter and method of boring shall conform to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

4.02.02 For determining founding level of piles in rock, as specified elsewhere socketing horizon shall be established by the Contractor by collecting rock cores of NX size in a separate borehole, and testing the same for uniaxial compressive strength (UCS). Cores shall be collected by double tube core barrel attached with diamond bit. Coring shall be done up to a depth as indicated in the "specific requirements." Coring in rock shall conform to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

4.02.03 In case it is not possible to test the cores so obtained for uniaxial compressive strength, cores shall be tested for point load strength index and correlated to obtain uniaxial compressive strength.

4.02.04 Number of boreholes for carrying out SPT in soil or uniaxial compressive strength in rock, shall vary from one in 100 to 150 piles or pile group of 150 Sqm depending on the site condition and as decided by the Engineer. However, at the location of initial load test piles, one such borehole shall be done.

4.02.05 A protocol between contractor and BHEL site shall be maintained regarding the strata at founding level. SPT value and UCS from the nearest borehole shall be indicated therein.

4.02.06 The founding level of the pile shall be decided based on the criteria elaborated in the relevant drawing/document. Concreting shall not be done until the above conditions for founding level are satisfied.

4.02.07 Approval of founding level by the Engineer shall in no way absolve the Contractor of his responsibility to guarantee the Safe load capacity of the piles as indicated in this document.

4.03.00 Control of position and alignment

4.03.01 Piles shall be installed as accurately vertical as possible. The permissible limits for deviation with respect to position and (inclination) alignment shall conform to DIN EN 1536: latest or equivalent.

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-A.

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 up to the required depth, the bottom of the hole shall be cleaned very carefully before concreting work is taken up. Cleaning shall ensure that the pile bore is completely free from sludge/bored materials, debris of rock/boulder etc. Necessary checks shall be made as given in clause 5.0 to confirm the thorough cleaning of the pile bore.

4.06.02 Pile bore shall be cleaned by fresh drilling mud through tremie pipe after placing reinforcement and just before start of concreting.

4.06.03 Pile bore spoil along with used drilling mud shall be disposed off from site as directed by the Engineer.

4.06.04 Pile bore bottom shall be thoroughly cleaned to make it free from sludge or any foreign matter before and after placing the reinforcement cage.

4.07.00 Adjacent Structures

4.07.01 When working near existing structures care shall be taken to avoid any damage to such structures.

4.08.00 Concreting

4.08.01 The Contractor shall carry out concrete mix design in accordance with relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 BS EN 206: latest or equivalent 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 DIN EN 1536: latest or equivalent. 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 6%. The drilling mud sample shall be collected from the bottom of pile bore 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 up to 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 at least 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 up to 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 per DIN EN 1536: latest or equivalent. 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 relevant BS Standards or equivalent International standards approved by BIFPCL/BHEL. Where no specific testing procedure is mentioned the tests shall be carried out as per the prevalent accepted engineering practice and as per the directions of the Engineer. Tests shall be done in the presence of the Engineer or his authorized representative. In case the Engineer requires additional tests, the Contractor shall arrange to get these tests done and submit to the Engineer the test results in triplicate within three days after completion of any test.

5.02.00 The Contractor shall maintain records of all inspection and testing, which shall be made available to the Engineer. The Engineer at his discretion may waive some of the stipulations for small and unimportant concreting operations and other works.

5.03.00 Materials found unsuitable for acceptance shall be removed and replaced by the Contractor. The work done by this unsuitable material shell be redone as per specification requirements & and to the satisfaction of the Engineer at no extra cost to the Owner.

5.04.00 Quality Assurance Programme

a) The Contractor shall submit and finalize a detailed Field Quality Assurance Programme within 30 days from the date of award of the contract, according to the requirements of this specification. This shall include setting up of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of field quality plan, etc. On finalized field quality plan, the Owner shall identify, customer hold points, beyond which work shall not proceed without written approval from the Engineer. The testing apparatus/equipment installed in the field laboratory shall be calibrated/ corrected by the qualified persons as frequently as possible to give accurate testing results.

b) Frequency of sampling and testing, etc. and Acceptance Criteria are given in Table - 1. The testing shall be done at field laboratory or any other laboratory approved by the Engineer. However, the testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications. The materials shall be tested to meet all the specified requirements before acceptance at manufacturers premises or at independent government approved laboratory. Tests indicated in the table are for cross checking at site the conformity of the materials to some of the specifications.

5.05.00 Testing of Concrete

5.05.01 Concrete and other materials shall be tested for quality, strength and other properties. Details of testing shall be as specified under technical specification for Cement concrete (Plain and Reinforced).

5.05.02 One sample consisting of six test cubes shall be made from the concrete used in each test pile, three to be tested after 7 days and three after 28 days.

5.05.03 For working piles, minimum one sample consisting of six test cubes shall be made from the concrete for the first ten piles, three to be tested after 7 days and three after 28 days. Thereafter, minimum one sample consisting of three test cubes for every 10 piles shall be tested for the 7-days & 28-days cube strength.

5.05.04 In preparation of test cubes or specimens vibrators shall not be used.

5.05.05 Concrete shall be tested for slump at every 1-hour interval during concreting of piles.

5.05.06 The frequency of sampling and testing of concrete and materials shall be done as per technical specification for cement concrete (Plain & Reinforced).

5.05.07 The acceptance criteria shall be as mentioned in Table-1.

5.06.00 Testing for position and alignment

5.06.01 Each pile shall be checked for its position with respect to specified location. Each pile bore shall be checked for its alignment.

5.06.02 Permissible limits for deviation shall be as specified under clause no. 4.03.

5.07.00 Properties of Drilling mud

5.07.01 Properties of drilling mud shall be checked as per requirement under Annexure A. 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 DIN EN 1536: latest or equivalent 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise.

8.00.00 RATES AND MEASUREMENTS

The clauses below shall apply for item rate contracts only. They shall not be applicable to turnkey/lump sum Contracts.

8.01.00 Rates

8.01.01 The items of work in the schedule of items, describe the work in brief. The various items in schedule of items shall be read in conjunction with the corresponding sections in the Technical Specifications, including amendments, and additions, if any. For each item in schedule of items, the unit rate shall include for the activities covered in the description of the item as well as for all necessary operations described in the specification and specific requirements.

8.01.02 The unit rates shall include for minor details which are obviously and fairly intended, and which may not have been included in the description in these documents, but are essential for the satisfactory completion of the work. Unit rates shall also include for all safety measures as required by codal provisions, local regulations, acts, bye-laws, etc. and for execution of work to the satisfaction of the Engineer.

8.01.03 The quoted rate for each item shall be inclusive of mobilization of all plant, equipment, scaffolding, labour, materials, skilled and unskilled labour, and demobilization after completion of work, supervision, establishing the level and coordinates at each work.

8.01.04 The quoted rate for piling for a particular diameter and capacity of pile shall remain valid for the actual lengths provided /to be provided irrespective of the minimum length specified elsewhere in this specification.

8.01.05 The quoted rate for piling as per description of item works shall be inclusive of providing all plant equipment, labour, materials, skilled and unskilled labour, making observations, establishing the ground level and coordinates at each

location of pile by carrying levels from one established bench mark and distances from one set of grid lines furnished by the owner.

8.01.06 The quoted rate for piling shall be inclusive of bailing out all the pile bore spoil from the pilebore, keeping the borehole free from bored material/debris etc. and disposing the bored/chiselled material along with the drilling mud upto 2 Km. beyond plant boundary or as directed by Engineer, flushing the pile bore by fresh bentonite before concreting, collection of samples from bottom of pilebore, transporting to laboratory, testing and reporting of results.

8.01.07 The quoted rate for piling shall include shifting of plant and equipment from one pile location to another pile locations, providing temporary casing pipe and removal of the same after completing, concreting, supply of necessary materials, equipment and manpower, cost of boring by approved method as specified, circulation of bentonite slurry and cleaning of borehole free from sludge, as specified, etc.

8.01.08 The quoted rate for piling shall also include chiselling, if any, required for socketing the pile in rock.

8.01.09 The quoted rate for the piling shall include concreting by termite method, length of pile above COL, withdrawal of guide casing, cost for preparation of pile head and disposal of debris etc., resulting from breaking off of pile up to COL, up to 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, up to 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 up to 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 as per relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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 up to 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 up to the depth as specified, up to 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

Bentonite suspension used for piling work shall satisfy the following requirements

a) Liquid limit of bentonite when tested in accordance with relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL shall be more than 300 percent and less than 450 percent.

b) Sand content of the bentonite powder shall not be greater than 4 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 pile bore may be up to 1.15 gm. /ml.

d) The Marsh viscosity when tested by a Marsh cone shall be between 32 to 50 seconds.

e) The differential free swell shall be more than 540 percent.

f) The pH value of the bentonite suspension shall be between 7 and 11.

VOLUME: II B

SECTION - D

SUB-SECTION – D22

SITE LEVELLING & GRADING WORKS

SPECIFICATION NO. PE-TS-421-600-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 cover the works to be carried out for **"Site Levelling and Grading Works including Slope Protection"** etc. for the entire plant and associated areas. The specified formation level(s) shall be achieved either by excavation or by raising with controlled fill with excavated/borrowed earth as the case may be.

2.00 SCOPE

2.01 The scope include all works involved in levelling the site to the lines, grades, cross sections and dimensions as shown on the approved drawings and/or as directed by the engineer including site clearance, setting out, earth work in excavation, stacking, loading, transportation, unloading, dewatering, drainage, filling, watering, compaction, turfing on slopes (if required), lighting, disposal of residual/surplus earth etc. It also include supplying and providing all labour, materials, supervision, services, equipments, tools and plants, testing and all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work etc.

2.02 All tools and plants, equipments and machineries to be used in this work shall be of standard quality and manufactured by reputed concerns conforming to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL.

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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise.

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 include all type of soil including laterite, moorum etc. with/without any percentage of kankars 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 include 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 up to 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 chiseling 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 14 or as allowed by Bangladesh statutory norms 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 license from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per relevant Explosives Rules of Bangladesh corrected up to 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 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 shall any person 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 tonne roller. The approved earth/fill material shall then be spread in horizontal layers not exceeding 250mm in compacted thickness. Each layer shall be watered and thoroughly compacted with proper moisture content and such equipments as may be required to obtain 80% relative density (ASTM D-4253 and D-4254) for free draining soils containing less than 15% by weight finer than 75 micron sieve non plastic material or 95% of the maximum density as determined by ASTM D-1557 for soils containing more than 15% material passing the 75 micron sieve. 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 are 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 **roughened** 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 are 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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL 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 numericals shall be as per relevant relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL. 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-421-600-C023

Maharatna Company

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

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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 relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL and as per approved specification of the agency having special know-how for the job.
All necessary work to ensure uniform distribution and proper penetration of treatment of treating solution shall be done according to the instruction of the Engineer.
Soil treatment shall not be done when it is raining or when the soil is wet with rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.

2.02.00 Chemicals and Rate of Application

Any of the following chemicals (conforming to relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL) in water emulsion shall be applied by pressure pumps, uniformly over the area treated.

Chemicals		Concentration by Weight, Percentage
Chlorpyrifos Emulsifiable	:	1.0
Heptachlor Emulsifiable Concentrate	:	0.5
Chlordane Emulsifiable Concentrate	:	1.0

2.02.01 Treatment of Column Pits, Wall Trenches and Basement Excavations

Foundations, basements etc. may either be fully enveloped by the chemical barrier or the treatment may start 500 mm below ground level. The bottom

surface and sides of excavation (up to a height of about 300 mm) for column pits, walls trenches and basements shall be treated with chemicals at the rate of 5 litres / M^2 of surface area. Backfills around columns, walls etc. shall be treated at the rate of 7.5 litres / M^2 of the vertical surface. Chemical treatment shall be done in stages following the compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by rodding the earth at 150 mm centres close to the wall surface and spraying the chemicals in the specified dose.

2.02.02 Treatment of Top Surface of Plinth Filling

Holes 50 mm to 75 mm deep at 150 mm centres both ways shall be made with crowbars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5 litres / M^2 of surface shall be applied prior to laying soling or sub-grade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces.

2.02.03 Treatment of Soil Surrounding Pipes, Wastes and Conduits

Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 mm and a depth of 75 mm at the point where they enter the building.

2.02.04 Treatment of Expansion Joints

These shall receive special attention and shall be treated in a manner approved by the Engineer.

2.02.05 Treatment at Junction of the Wall and the Floor

Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surfaces from ground level up to the level of the filled earth surface.
A small channel 30 x 30 mm shall be made at all the junctions of wall and columns with the floor. Rod holes made in the channel up to the ground level 150 mm apart and the chemical emulsion poured along the channel at the rate of 7.5 litres per square meter of the vertical wall or column surface. The soil should be tamped back into place after this operation.

3.00.00 ACCEPTANCE CRITERIA

The Contractor shall give a 10-year service guarantee in writing supplemented by a separate and unilateral guarantee from the specialised agency for the job to keep the building free of termites for the specified period.

4.00.00 RATES

Rates shall be of complete work per unit area as stated in the Schedule.

5.00.00 METHOD OF MEASUREMENT

Complete work of anti-termite treatment shall be measured for plinth area treated.

This includes treatment, to foundations, walls, trenches, basements, plinth, burried pipes, conduits etc. The extended portions of foundation and like beyond plinth limit shall be the part of complete work.

6.00.00 CODES & STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of relevant BS Standards/Specifications or Equivalent International standards approved by BIFPCL/BHEL, unless specified otherwise.

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SECTION – D

SUB SECTION – D30

QUALITY ASSURANCE TESTS AND INSPECTION

SPECIFICATION NO. PE-TS-421-600-C030

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)		
Grain Size Analysis *	1	
Liquid Limit & Plastic Limit *	2	
Shrinkage Limit #	3	
Free Swell Index #	4	
Chemical Analysis #	5	
STD Proctor Test *	6	
Moisture Content *	7	
Dry Density by core cutter/sand display cut @	8	
Relative Density Index @	9	
Dry Density by Proctor Needle Penetration @	10	
All tests as per relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL	11	
b) Earth Fill Material (After Compaction)		
Grain Size Analysis *	1	-
Liquid Limit & Plastic Limit *	2	-
Shrinkage Limit #	3	-
Free Swell Index #	4	-
Chemical Analysis #	5	-
STD Proctor Test *	6	-
Moisture Content *	7	-
Dry Density by core cutter/sand display cut @	8	Y
Relative Density Index @	9	Y
Dry Density by Proctor Needle Penetration @	10	Y
All tests as per relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL	11	Y

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 *	-	-			Particle Size and Shape Sieve analysis
	2	Y *	Y #	-	-			Moisture Content
	3	Y	Y	-	-			Specific Gravity, Density, Void, Absorption
	4	Y	-	-	-			Mech. Properties
	5	Y	Y	-	-			Soundness
	6	Y	Y	-	-			Reaction with Alkali
	7	Y	-	-	-			Flakiness Index
	8	Y	Y	-	-			Deleterious Matl. And MICA content
b) Fine Aggregate/ Sand	9	-	Y	-	-			Mortar Making Properties
	10	-	Y #	-	-			Bulkage
	11	-	Y	-	-			Silt, Clay and organic impurities
	12	Y	Y	-	-			Petrographic Exam.
	13	-	-	Y	-			Setting Time
	14	-	-	Y	-	Y		Crushing Strength
c) Cement	15	-	-	-	Y	-		pH Value
	16	-	-	-	Y	-		Harmful substance
d) Water	17	-	-	-	-	Y		Slump and Compaction Factor
	18	-	-	-	-	Y		W.C. Ratio
	19	-	-	-	-	Y		Cement Content
e) Concrete	20	-	-	-	-	Y		Rebound Hammer Test
	21	Y	Y	Y	Y	Y		All tests as per relevant BS Standards/ Specifications or Equivalent International standards approved by BIFPCL/BHEL

CIVIL & STRUCTURAL WORKS

Test Checks / Requirement / 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	Remarks/Frequency of Test
Load test on structures as per relevant BS Standards/ Specifications or Equivalent International standards	-	-	-	-	-	-	-	-	-	-	Y*	-	-	-	* These tests shall be carried out, incase of doubt regarding grade of concrete due to poor workmans-hip based on results of cube strength.
Water tightness test as per relevant BS Standards/ Specifications or Equivalent International standards	-	-	-	-	Y	-	-	Y	-	-	-	-	-	-	
All Tests as per relevant BS Standards/ Specifications or Equivalent International standards.	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	-	Y	
Core Test	-	-	-	-	-	-	-	-		-	Y	-	Y	-	
Ultrasonic Test	-	-	-	-	-	-	-	-		-	-	-	-	-	
Verticality all	-	-	-	-	-	Y	-	-		-	-	-	Y	-	
Work man ship	-	-	-	-	-	Y	-	-		-	-	-	-	-	
Water Retentivity as per relevant BS Standards/ Specifications or Equivalent International standards	-	-	-	-	Y	-	-	-		-	-	-	Y	-	
Consistency as per relevant BS Standards/ Specifications or Equivalent International standards	-	-	-	-	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	
Hydraulic test		Y
All tests as per relevant BS Standards/ Specifications or Equivalent International 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

Test Requirements / Item/Components		17. Roof Decking sheets (Supply and fixing)	18. Wall Cladding work a) Outer sheet	b) Inner sheet	c) Insulation	d) Fixing of wall cladding	19. Acid Resistant Lining a) Acid resistant Bricks/Tiles	b) Acid resistant Mortar
T.Cs for Physical & Chemical properties	1	Y	Y	-	-	-	-	-
Dimensional, thickness, depth of valley etc.	2	Y	-	-	-	-	-	-
Fixing of decking sheets	3	Y	-	-	-	-	-	-
Sides end laps	4	Y	-	-	-	Y	-	-
Appearance	5	Y	-	-	-	Y	-	-
T.Cs for fasteners &'Z' spacers	6	Y	-	-	-	-	-	-
Dimensional conformity	7	-	Y	Y	Y	-	Y	-
Check for coating of silicon modified polyester paint thickness	8	-	Y	Y	-	-	-	-
Galvanizing test as per IS code	9	Y	-	Y	-	-	-	-
Check type of permanent colour coating	10	Y	Y	Y	-	-	-	-
Tests as per relevant BS Standards/ Specifications or Equivalent International standards	11	-	-	-	Y	-	-	-
Storage	12	-	-	-	-	Y	-	-
Positioning and location of laps and plumb level	13	-	-	-	-	Y	-	-
Compressive strength, Water absorption resistant to Acid, resistant to flexural strength, INEAD	14	-	-	-	-	-	Y	-
Comp. Strength, bond strength working, time, chemical resistant	15	-	-	-	-	-	Y	Y
Warpage	16	-	-	-	-	-	Y	Y

BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED

2x660MW MAITREE STPP, RAMPAL BANGLADESH

VOLUME – II B
CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-421-600-C006

SECTION - B
PROJECT INFORMATION

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

PROJECT INFORMATION

1.	Owner	BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED,
2.	Project	2 x 660 MW MAITREE KHULNA-STPP
3.	No of Units	2
4.	Consultant	FICHTNER
5.	Location	The site is located approximately 14 km northeast of the Mongla Port and 14 km northwest of the Sundarbans, is infringed by the Passur and Moidara Rivers to the west and south east respectively. The project requires an area of approximately 500 acres.
6.	District	The site is located in Rampal Upazila of the Bagherat District in the Rajnagar Union
7.	Nearest Railway station	Khulna
8.	Nearest Airport	Jessore
9.	Nearest Seaport	Mongla
10.	Accessibility	Currently, the Site is accessible by boat and road.

BANGLADESH-INDIA FRIENDSHIP POWER CORPORATION (PVT.) LTD. (BIFPCL)

MAITREE SUPER THERMAL POWER PLANT UNITS- 1 & 2 [2 x 660 MW]

VOLUME – II B
CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-421-600-C005

SECTION – DI
GENERAL SPECIFICATION

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

July 2015

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2 x 660 MW Maitree-STPP
Technical Specification Power Plant

FICHTNER

8140A01/FICHT-15702705-v5
BIFPCL/EPC-Main Plant/2015/1/

FICHTNER

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Rev No.	Rev-date	Contents /amendments	Prepared/revised	Checked/released
0	10.10.2014	FTS PP	Gebeshuber	Alisch
1	19.12.2014	Final FTS PP	Gebeshuber	Alisch
2	19.01.2015	Revised Final	Gebeshuber	Alisch
3	28.01.2015	Revised Final	Seeber	Alisch
4	12.02.2015	Revised Final (adaptations due to PPA requirements)	Seeber	Alisch
5	24.07.2015	Amendment of FTS acc. to Pre-Bid Clarifications	Gebeshuber	Alisch

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B0. General Specification

Preamble

The Technical Specification is amended in accordance with following Technical Clarifications to Bidding Documents ("Clarification Batches"), which are already published on the BIFPCL"s Website:

- Clarification No. 1 (Clarification #01);
- Clarification No. 3 (Clarification #03);
- Clarification No. 5 (Clarification #05);
- Clarification No. 7 (Clarification #07); and
- Clarification No. 8 (Clarification #08).

Only technical clarifications with regard to content and consequently causing alterations of Scope of Services and Supplies, Technical Requirements, Data Sheets and/or Annexes are incorporated.

General clarifications such as "Subject to BIFPCL"s approval during Basic/Detailed Engineering" or "Details to be discussed during Engineering" are not incorporated as it is self-evident that Contractor"s design and engineering shall subject to Employer"s approval.

Already published Amendments (reference is made to Amendments No. 1 and No. 2) are not again incorporated/included in the amended Technical Specification. This applies for instance for:

- B3, B4 including Data Sheets (replacement of the original documents, refer to Amendment No. 1);
- B12.8 PV Plant and B12.9 Waste Management including Data Sheets (additional documents, refer to Amendment No. 2);
- Annex C, G-05 Health and Safety Manual (additional document, refer to Amendment No. 2); and
- Annex C, M-03 Design Limestone List (replacement of the original document, refer to Amendment No. 1).

In addition some parts of the Technical Specification are modified without reference to a published Clarification or Amendment. This applies for instance for:

- Annexes M-06, M-07, M-08 and M-10, which are revised according to Amendment of B3 and B4 and which shall replace the respective original Annexes.
- Annexes M-04 and M-12, which are revised according to the latest available river water sampling and analysis.

B0.1 Subject of Specification

The Joint Venture of Bangladesh-India Friendship Power Corporation (pvt) Ltd (BIFPCL) intends to construct a 2x 660 $MW_{e, ,gross}$ coal fired power plant (the Plant, the Maitree-STPP Project or the Project) in the district of Khulna for which BIFPCL firms as Employer, utilizing high availability, high efficiency steam cycle technology.

The Contractor shall cover all works for the engineering, procurement, construction and commissioning of the whole plant on a turnkey basis.

Two power units with steam generator, steam turbine generator and ancillary systems shall be proposed in a technology that enables the Contractor to guarantee a high net efficiency while achieving a high reliability (certain restrictions regarding the technology and the design parameters apply, as detailed herein). A second phase of the same capacity is foreseen as a future possibility, however, this Specification deals only with 2 x 660 $MW_{e, gross}$ unless otherwise and expressly stated.

The Plant shall be built on a "green field" basis. It shall be conceptualized in accordance with the above criteria, the thermodynamic cycle adopted must be capable of working successfully over prolonged periods and the system shall be able to withstand severe shocks when connected to the Grid as specified in this **Section B0.** The steam cycle shall operate with once-through technology at supercritical.

Deleted: i.e. with steam temperature of 568°C 600°C, with established and proven parameters a materials.

The Plant shall be based on supercritical technology. The main steam (MS) pressure at turbine inlet shall be in the range of 250 to 270 bar(g). The MS temperature at turbine inlet shall be in the range of 568 to 600 °C. The reheat steam (RH) temperature at turbine inlet shall be chosen by the Bidder/Contractor accordingly. That means, a proposed plant with a MS pressure at turbine inlet between 250 and 270 bar(g) and MS/RH temperature at turbine inlet upto 600°C/600° will be acceptable.

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The Plant shall be suitable to be operated with the specified fuel. Only proven equipment and materials shall be used.

With the Tender the Bidder shall provide evidence:

- that the proposed Plant is based on proven supercritical technology with similar MS pressure, MS/RH temperature, design and materials; However, Reference plant of MS pressure and temperature at turbine inlet in the range of 242 to 270 bar(g) and 565 to 600 °C respectively, shall also be considered to quqlify.
- that the proposed design of the steam generator and auxiliary equipment has been fully proven by extensive successful commercial operation (the experience base for main component and the design data shall be demonstrated by the Bidder);

- that the proposed Plant is based on a reference plant(s) which shall be based on supercritical technology, which shall be of similar design and which shall use similar fuel as specified (The Bidder shall submit with the Tender detailed information on this reference plant(s) and shall allow the Employer and/or his representatives to contact and visit and examine the reference plant(s) in detail).

Regarding the Qualifying Requirements reference is made also to Section I IFB.

Transmission lines (OHL connections) from power plant to HV substation as well as transmission lines (GIL) within HV substation area are included in Bidder"s/Contractror"s scope of services and supplies. However, transmisson lines for PGCB grid connection are out of Bidder"s/Contractror"s scope of services and supplies. For detailed scope at interface points refer to section B10.3.3 and B10.3.5.

The engineering design of the Plant shall be conceptualized in accordance with the above criteria, and therefore it is vital that the thermodynamic cycle adopted must be capable of working successfully over prolonged periods and the system shall be able to withstand severe load adjustments when connected to the Grid. The proposed Plant shall be based on a reference plant of equal size firing similar fuel, which shall have a proven track record. The Tenderer shall submit with the tender detailed information on this reference plant(s) and shall allow the Employer and / or his representatives to contact and visit and examine the reference plant(s) in detail.

The steam boilers shall be designed to burn coal from Australia, Indonesia, South Africa, Mozambique and potentially other countries and to burn high speed diesel for start-up and shut-down purposes. The Plant is designed for the coal range as per design coal list attached in the **Annexes in Part C.** The steam turbo-generators and thermal cycles shall be selected such, that the Plant heat rate would be optimized under consideration of the investment costs. The condenser cooling systems shall be realized with induced draft wet cooling towers.The turbine generators and all grid relevant parameters shall be designed in accordance with applicable Grid Code and the requirements of NLDC.

The Plant shall be equipped with suitable emission abatement technologies, consisting of primary measures for the CO- and NO_x-reduction, an electrostatic precipitator and a wet flue gas desulphurization plant operating with limestone.

The Project shall include the facilities for the export of the produced power consisting of switchyards, substations and transmission lines.

In addition the Plant shall include all auxiliary and ancillary systems required within the terminal points to render the Plant fit for purpose, this

shall also include workshops, admin and staff amenities buildings and the likes unless expressly excluded in this specification.

B0.2 General Plant Description

B0.2.1 General purpose of the plant

The Plant is intended to serve the increasing power demands of the electricity market in Bangladesh. It will be operated in base load operation but frequency support operation must also be possible.

The scope under the EPC turnkey contract shall cover all services and supplies required to meet the purpose of the Power Plant even if not expressively mentioned in the Bidding Documents. This shall include but shall not be limited to: design, engineering, manufacturing, shop testing, procurement, supply, transportation to site (location of use), handling, storage, insurance, taking any permit/approval required, erection, testing at site, commissioning, performance testing, training Employer‟s personnel and final completion of entire Power Plant inter alia including steam generators and auxiliaries, turbine generators and auxiliaries, all associated BOP packages, all civil, electrical and I&C works for the entire Power Plant as well as for the jetty and associated facilities and the 400kV/230kV substation as described in the Bidding Documents and complete in all respects for successful operation of both units of 660 MW to dispatch power from the Plant to the grid.

The Plant covers the following main systems and components (including all systems not specifically mentioned):

B0.2.2 General scope of supply

The following data are applicable per unit, unless they refer to common systems. For further information see the respective **Sections B1 to B12**.

- **Boiler systems** (refer to **Section B1**)
  - steam generator (supercritical once-through)
  - regenerative air preheater
  - coal pulverizers
  - coal bunker system
  - bottom ash extraction system (dry)
  - boiler fans (PA, SA/FD fans)
  - HP steam / feed water piping
  - HP bypass system
  - air system
  - auxiliary boiler

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- **Turbine systems** (refer to **Section B2**)

- steam turbine generator
- LP bypass
- condenser system incl. evacuation
- Condenser cleaning system
- LP/HP heaters
- deaerator/feed water tank
- condensate pumps
- feed water pumps
- water/steam piping system
- drip collecting and pump system
- EOT crane and hoists.

- **Flue gas treatment systems** (refer to **Section B3)**
  - dust filter system (ESP)
  - FGD system (based on wet limestone process)
  - ID fans
  - flue gas ducts.

- **Fuel and Ash handling system** (refer to **Section B4**)
  - coal handling system, including:
    - coal unloaders (grab type)
    - stackers
    - portal scraper reclaimers
    - coal yard (90 days capacity at BMCR with worst coal)
    - coal yard roof cover (take-out option)
    - coal dust suppression systems
    - coal crushers
    - Coal screens
    - emergency coal supply by front end loader
    - belt conveyors, junctions towers and other systems as required
    - coal blending silos
  - limestone handling system, including:
    - Stacker
    - limestone yard for 90 days
    - limestone transportation system from jetty to stockyard, as required
    - transportation from stockyard to limestone intermediate silo by front end loader
  - HSD handling, including:
    - HSD truck unloading station
    - HSD tanks
    - HSD transfer pumps and pipe distribution system
  - fly ash handling , including:
    - pneumatic fly ash transportation to intermediate fly ash silos
    - intermediate fly ash silos
    - pneumatic fly ash transportation fly ash storage silos at jetty
    - fly ash storage silos at jetty with truck and ship loading
  - bottom ash handling, including:
    - bottom ash transportation to intermediate bottom ash silos
    - intermediate bottom ash silos

    - bottom ash storage silos at jetty with truck loading
  - gypsum handling, including:
    - Gypsum storage silo at jetty with truck and ship loading
  - common residue handling systems
    - transportation of limestone, bottom ash and gypsum from intermediate silos to storage silos at the jetty by pipe conveyor
    - discharge of fly ash and bottom ash via high concentrated slurry/solids disposal (HCSD) to the ash point.

- **Plant Water and Cooling Systems** (refer to **Section B5**)
  - Plant water intake channel
  - Plant water intake structures
  - Plant water screening plant
  - Plant water supply pumps
  - Plant water pre-treatment and storage
  - Main cooling water system
  - Cooling Water pump station
  - Induced Draft Cell Cooling Towers
  - Main cooling water collection basin
  - Desalination feed water supply system
  - Auxiliary cooling water system
  - Plant water discharge system
  - Cathodic corrosion protection systems.

- **Water Treatment Systems** (refer to **Section B6**)
  - Plant water pre-treatment storage and supply
  - Electrochlorination plants
  - Desalination plant
  - Potable water treatment plant
  - Demineralization plant
  - Condensate polishing plant
  - FGD Waste Water Treatment Plant (FGDWWTP)
  - Process waste water treatment facilities including oil separators
  - Sewage treatment plant for sanitary wastes
  - Chemical handling and storage facilities
  - Chemical dosing of cooling water and feed water conditioning
  - Monitoring system for the water/steam cycle.

Note:
The Desalination and Demineralization Plant shall be common for all the units.

- **Electrical systems** (refer to **Section B7**)
  - All electrical components related to turbine / boiler / flue gas treatment system and BOP systems
  - Power transformers incl. GT, SUT, UAT, all MV- and LV-T
  - Switchboards and power distributions (busducts, cabling etc.)
  - Emergency diesel, DC and safe AC Systems

- 400/230kV GIS including auxiliary and ICT.

Electrical works like illumination, communication, etc. outside plant boundary are not included in the scope of works.

- **I&C systems** (refer to **Section B8**)
  - All I&C components related to turbine / boiler / flue gas treatment system and BOP systems
  - Central DCS and decentralized PLC Logics
  - Power Plant training simulator.

- **Civil works** (refer to **Section B9**)
  - site surveys and investigations to ensure safe civil design and undisturbed construction
  - site preparation (incl. site filling works) and temporary site installation.

    No grading activities outside the plant boundary shall be considered.

  - all civil related works for the Power Plant including turbine/boiler/flue gas treatment system/cooling water system/electrical system/balance of plant etc.
  - Marine Works including coal jetty, plant water intake and discharge.
  - Power Plant related buildings and structures
  - ancillary buildings such as admin building, canteen, storage and workshop building
  - ash pond
  - HVAC
  - Biomass generation plant (use organic waste of Township and Power Plant)

    It is to be noted that the biomass plant shall not produce power. The biomass plant is understood as waste segregation and treatment plant. (Refer to B12.9 in Amendment No. 2).

  - Cranes.

- **Infrastructure** (refer to **Section B9**)
  The following works are included in the infrastructure lot
  - all internal roads incl. tie-in with existing roads at bridge and access roads to nearest township

    Bridge and highway from bridge to Khulna-Mongla-Highway will be provided by GOB.
    The Interface Point is at the roundabout.
    Remark:
    Access Road
    GOB will construct a 6 Km road connecting the Site with Khulna-Mongla Highway. It is to be highlighted that:

- Bidder/Contractor cannot expect that the access road will be available when the site works start.
- Bidder/Contractor cannot expect that the access road will be suitable for the transportation of heavy equipment to Site.
- Site access and transportation of personnel, material and equipment etc. to Site shall be in the sole responsibility of the Contractor.
- Bidder/Contractor shall execute a transportation study to familiarize himself with the local and Site condition and to elaborate how equipment can be transported to Site.

All roads, except town ship roads are in Bidder's/Contactors' scope.Interface is the roundabout, whereas the roundabout itself shall be constructed by the Bidder/Contractor.

- fencing, gate house inside the boundary
- landscaping in all areas where Contractor work will be performed
- Infrastructure related works outside the boundary wall

Electrical works like illumination, communication, etc. outside plant boundary are not envisaged.

- underground services (non-pressurized - rain water discharge, domestic waste water
- rain water retention basin
- oil water separators.

- **Electrical Works 400/230 kV Substation** (refer to **Section B10**)
  - 400 kV gas insulated switchgear
  - 400 kV AIS equipments and accessories
  - 230 kV gas insulated switchgear
  - 230 kV AIS equipments and accessories
  - 230 kV XLPE Cables
  - 400/230 kV 520 MVA interconnection transformers
  - Substation Control and Monitoring System (SCMS)
  - 11/0.415 kV auxiliary power transformers
  - Telecommunication Equipment
  - AC/DC installations
  - Power and control cables, bus ducts
  - Tariff metering
  - Substation outdoor lighting
  - Earthing system & lightning protection system
  - Power & auxiliary systems for 400 kV and 230 kV area, incl. coordination with overall system
  - Fire detection, alarm and fire fighting system
  - Substation other supply and services.

- **Jetty structure** (refer to **Section B11**)
  - Retaining wall
  - Revetment and Shore protection.

- **Auxiliary plant systems** (refer to **Section B12**)
  - Compressed air system
  - Hydrogen system
  - Workshop and store
  - Chemical laboratory
  - Fire fighting system
  - De-dusting system
  - HVAC system

B0.2.3 Interface points

For interface points see below.

B0.2.4 Site conditions

The following information on local conditions is investigated or compiled by the Employer. The Contractor is hereby in no way relieved from his duties of carrying out all investigations required for satisfactory performance of his works. The Contractor shall perform his own Site visits and investigations, prior to Contract award in order to familiarize him with the existing conditions of the Site and the surrounding area.

Location, accessibility and present condition of the Site
The site for the Maitree-STPP Project is geographically located between 22° 370‟0‟‟ N to 22°34‟30‟‟N and 89°32‟0‟‟E to 89°34‟5‟‟E, approximately 14 km northeast of the Mongla Port and 14 km northwest of the Sundarbans, is infringed by the Passur and Moidara Rivers to the west and south east respectively. The project requires an area of approximately 500 acres.

The topographical survey indicates a natural ground level of +1.15 to + 1.35 meters above sea level. A severe cyclone in 2009 raised the level to 4.47 meters and it was decided to raise the Plant level to +5.00 meters.

Politically, the site is located in Rampal Upazila of the Bagherat District in the Rajnagar Union

Currently, the Site is accessible by boat only.

The nearest inland port is Mongla port at around 14km direct distance.

The proposed Khan Jahan Ali Airport is located at a distance of approximately 12 km from the project site.

Soil conditions
First soil investigations of the Plant site and adjacent areas have been carried out. For information only the findings of these initial soil investigations are attached in Part C Annexes.

In general the subsoil conditions can be described as follows:

- top layer filled sand (with unknown silt content) in Plant area
- underlying layers of clay
- underlaying fine sand.

The Contractor shall conduct soil improvement measures at site. Beside other aspects, consolidation of filling shall be incorporated in soil improvement concept.

Seismic zone

Attention shall be paid to seismic parameters. Related to soil type as identified to Soil Investigation Report, the effect of local soils on earthquake ground motion shall be determined.

For site class “S1” and “S”, as expected for the Project, site specific studies shall be carried out to determine the design acceleration response spectrum. During field study minimum the following tests shall be executed:

- Seismic cross hole test; and
- Seismic refraction test.

Based on these results a site specific Response Spectra shall be established. Peak spectral acceleration shall be determined, but shall be not less than 0.12g, as mentioned in BNBC 2012, Table 2.5.2.

Site climatic conditions

The Plant site is from the climatic point of view under maritime tropical conditions. The assumed meteorological conditions for the Site are as follows:

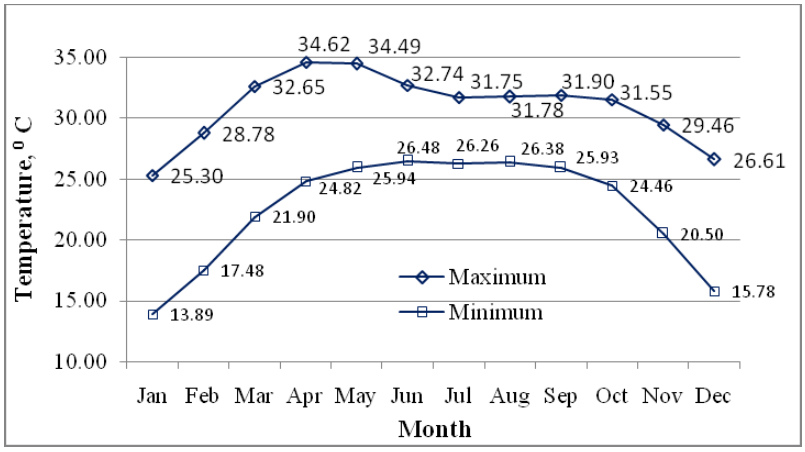
The project site is located in the country‟s South Central Zone consisting of three dominant seasons:

- summer season-March to May
- monsoon season-June to October
- winter season-November to February.

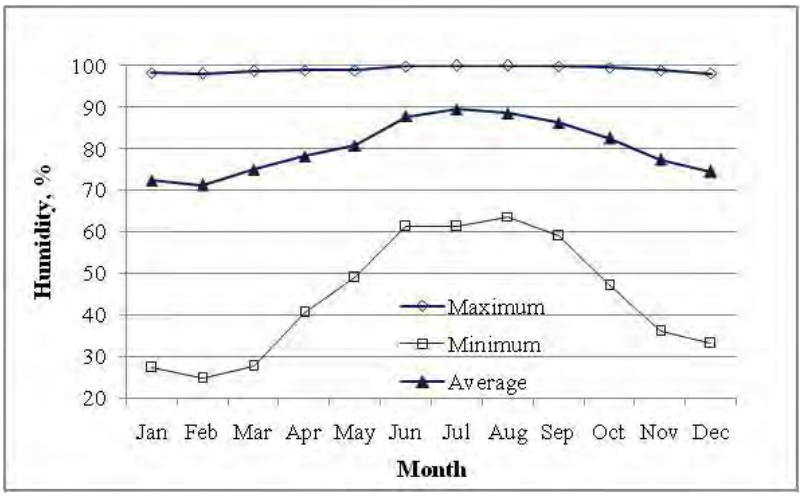
During the Monsoon Season occasional cyclonic storms can occur.

The climatic conditions in the area are continuously monitored by the Bangladesh Meteorological Department (BMD) at the Mongla Meteorological Station.

The temperature varies only slightly throughout the year with the highest temperature of 36.9°C and the lowest temperature of 12.2°C recorded in the period from 1989 to 2008. This distribution is depicted in figure below.

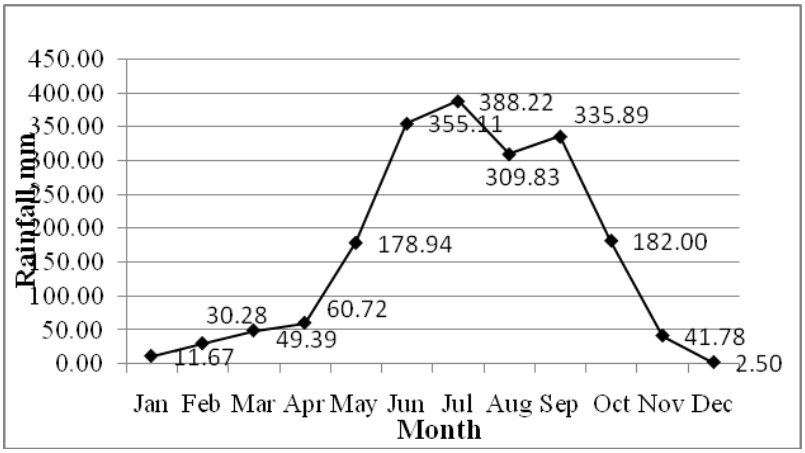


The relative humidity varies drastically during the Monsoon Season with 80% to 90% and the lowest levels of 20% to 30% during the Summer Season. The humidity profile recorded in the same period as the temperature is visualized in below figure.



The maximum rainfall occurs during the Monsoon Season by varying between 300 mm and 350 mm with almost no rainfall during the Winter Season.

The average evaporation in the project area varies between 3 - 5 mm/day with its peak of 16 mm/day during July. The average rainfall for the period between 1991 and 2008 is depicted in below figure.



Below definitions are to be used as typical data for the different climatically seasons at the site.

Average Site Condition ASC

Ambient Temperature:	27.3 °C
Ambient Humidity	87 %
Ambient Pressure	1007.6 mbar
River Water Temperature:	29.8 °C

Summer Site Condition SSC

Ambient Temperature	36.9 °C
Ambient Humidity	60 %
Ambient Pressure	1007.9 mbar
River Water Temperature:	33 °C

Winter Site Conditions WSC

Ambient Temperature	12.2 °C
Ambient Humidity	100 %
Ambient Pressure	1017.2 mbar
River Water Temperature:	20°C

Reference Site Conditions RSC

Ambient Temperature	31 °C
Ambient Humidity	88 %
Ambient Pressure	1007 mbar
River Water Temperature:	32°C

Deleted: Wind speed . . 1 m/s¶

Reference Site Condition shall apply for the Guarantee Values as well as for the Guarantee Tests/Performance Test. However, Plant must cope with the Site Conditions as specified.

Wet bulb temperature shall be calculated by Bidder/Contractor based on ambient temperature (dry bulb), ambient humidity and ambient pressure for the different cases.

Bidder/Contractor shall determine the wet bulb temperature for all site conditions and not only for reference site condition.

Design ambient conditions for Electrical Systems

- Maximum design temperature (outdoor) 45°C
- Maximum daily average ambient shade temperature 38°C
- Maximum monthly average temperature (in the shade) 34.6°C

- Maximum annual average temperature (in the shade) 27.3°C
- Maximum design temperature of the electrical equipment installed indoors in air conditioned rooms 40°C
- Maximum design temperature of the electrical equipment installed indoors non in air conditioned rooms 45°C
- Minimum design temperature 0°C

Marine conditions

Two tides (e.g. flood and ebb) are regularly observed in the Passur River, which enters into the project site through numerous connected creeks.

The tidal range varies between 1.2 and 3.1 meters. The mean water level (CD) is about 0.87 meters (PWD=CD –1.17 meters). The mean high water level varies due to spring-neap tide conditions between +1.60 m and +2.6m PWD. The Highest High Water Level (HHW) is about +3.1m PWD and the Lowest Low Water Level (LLW) is about –1.4m PWD.

The marine conditions are detailed in **Section B11**, with details about:

- water levels
- waves
- currents
- river bathymetry, topography.

The salinity of the Passur River system varies with the amount of fresh water entering the system which is highly seasonal dependent. The surface water temperature ranges between 22.9°C and 33.0°C and the different water quality parameters are tabulated in **Part C Annexes.**

The marine conditions as recorded at Mongla Port Gauge Station (approx. 14 km south-east to the site) are as follows:

- Highest High Water Level (HHW) + 2.642 MSL
- Lowest Low Water Level (LWL) - 1.858 MSL

The Power Plant shall be designed for 100 years flood condition based on data provided by relevant Organization in Bangladesh and taking into account the Highest Astronomical Tide (HAT), the maximum wave conditions (including storm surges) and the potential event of Cyclone. The Contractor is responsible to verify the worst conditions.

These reference data are with respect to LAT, which corresponds to the Chart Datum (CD). The site land data is however with respect to the Bangladesh Land Survey Datum (BLSD), which corresponds to approx. +1.55 m CD (hence the MLSD corresponds to MSL).

Design Wave Height	2.0 m
Design Wave Period	6.0 sec
Sedimentation and Siltation:	Soft to stiff clay and alternations of very sandy and stiff clay.

The results of bathymetric investigations of the Possur River can be found in **Part C Annexes.**

A water analysis from the area adjacent to the site giving salinity and water quality is shown below:

Location	Date	Temp.	pH	EC	Cl	T. Alkalinity	Turbidity	T S	TDS	SS	DO	BOD	COD	Salinity
		°C		µS/cm	mg/l	mg/l	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	7-Jan	27.4	7.74	3010	879	36	68.7	1565	1510	55	5.1	0.8	55	1.6
2	7-Jan	27.1	7.72	3020	878.8	36	68.5	1570	1510	60	5.1	0.8	55	1.6
3	7-Jan	27.8	7.71	3030	879	36	68.8	1565	1510	55	5.1	0.8	55	1.6
1	11-Feb	29.8	7.66	4380	1262	36	182	2390	2180	210	4.7	1	76	2.3
2	11-Feb	29.2	7.63	4380	1268	36	178	2390	2190	200	4.7	1	76	2.3
3	11-Feb	29.1	7.65	4380	1263	36	179	2380	2180	200	4.7	1	76	2.3
1	9-Mar	32.6	7.56	11780	2944.4	38	176	6080	5890	190	4.7	1.2	76	6.7
2	9-Mar	32.6	7.57	11780	2945.2	38	178	6080	5890	190	4.7	1.2	76	6.7
3	9-Mar	32.1	7.55	11780	2946.4	38	177	6090	5890	200	4.7	1.2	76	6.7
1	17-Apr	32.6	7.59	25300	8273	36	185.6	12950	12700	250	4.6	0.7	136	15.5
2	17-Apr	32.6	7.59	25300	8273	36	186.2	12950	12700	250	4.6	0.7	138	15.5
3	17-Apr	32.6	7.59	25300	8273	36	184.8	12950	12700	250	4.6	0.7	136	15.5
1	5-May	32.6	7.59	29200	9480	36	198.6	14900	14600	300	4.5	1.2	177	17.6
2	5-May	32.9	7.54	29200	9470	36	198.6	14900	14600	300	4.4	1.2	177	17.6

Figure 1 Water quality of the Passur River at Mongla point (Source: EIA-Report)

loc ati on	Date	Tem p.	pH	EC	Cl	T. Alkal inity	Turbid ity	T S	TDS	SS	DO	BOD	COD	Sali nity
		°C		µS/c m	mg/l	mg/l	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
3	5-May	33.2	7.57	29200	9470	36	199.6	14900	14600	300	4.5	1.2	177	17.6
1	13-Jun	31.6	7.69	18000	5820	36	112.6	9200	9000	200	4.7	1.1	97	10.8
2	13-Jun	31.6	7.69	18000	5800	36	113.2	9200	9000	200	4.7	1.1	97	10.8
3	13-Jun	31.6	7.69	18000	5810	36	112.4	9200	9000	200	4.7	1.1	97	10.8
1	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
2	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
3	1-Jul	31.6	7.69	440	32.6	36	76.6	285	220	65	5.2	0.8	26	-
1	5-Aug	31.6	7.69	275	16.6	36	68.6	192	137	55	5.3	0.7	22	-
2	5-Aug	31.6	7.69	275	16.6	36	68.6	192	137	55	5.3	0.7	22	-
3	5-Aug	31.6	7.69	275	16.6	36	68.6	192	137	55	5.3	0.7	22	-
1	8-Sep	31.6	7.74	270	15.6	36	65.6	180	135	45	5.5	0.7	22	-
2	8-Sep	31.6	7.76	270	15.6	36	65.6	180	135	45	5.5	0.7	22	-
3	8-Sep	31.6	7.74	270	15.6	36	65.6	180	135	45	5.5	0.7	22	-
1	12-Oct	30.6	7.79	290	26.6	36	62.6	192	145	47	5.6	0.7	22	-
2	12-Oct	30.6	7.78	290	26.6	36	62.6	192	145	47	5.6	0.7	22	-
3	12-Oct	30.6	7.78	290	25.6	36	62.6	192	145	47	5.6	0.7	22	-
1	5-Nov	24.6	7.79	340	38.6	36	56.6	210	170	40	5.6	0.7	22	-
2	5-Nov	26.6	7.79	340	38.6	36	56.6	210	170	40	5.6	0.7	22	-
3	5-Nov	25.6	7.79	340	38.6	36	56.6	210	170	40	5.6	0.7	22	-
1	12-Dec	21.5	772	520	62.6	36	72.6	320	260	60	5.1	0.9	25	0.4
2	12-Dec	20.9	7.71	520	62.6	36	73.6	320	260	60	5.1	0.9	25	0.4
3	12-Dec	21.1	7.72	520	62.6	36	71.6	320	260	60	5.1	0.9	25	0.4

Figure 2 Water quality of the Passur River at Mongla point (Source: EIA-Report)

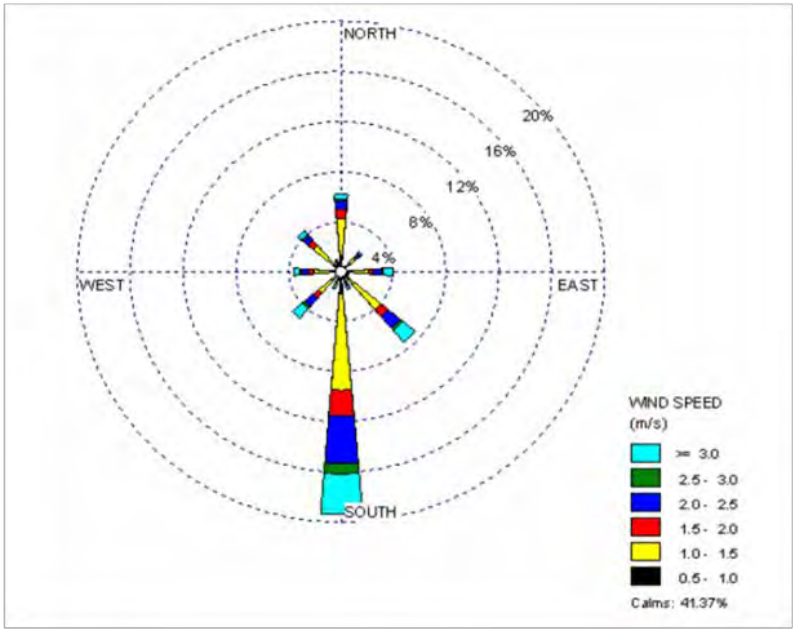
Additional information on water quality parameters is shown in **Part C Annexes**.

Wind data

The project region is characterized by southerly winds from the Bay of Bengal during the Monsoon Season and north-westerly winds from the Himalayas during the Winter Season. During the Summer Season, the wind blows from south-southwest to north-northeast. The annual average wind speed amounts to 1.7 meter/second and the wind rose for the entire year is shown in Figure 5.5.

The wind load calculation for the buildings and structures shall be as per Bangladesh National Building Code -2012, Part 6, Chapter 2.4.

Basic wind Speed, V, shall be taken as 73 m/s, Three-second gust at 10 m above ground in exposure C, having a return period of 50 years.
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B0.2.5 Configuration

Two (2) Plant units mainly consisting of steam generator, steam turbine generator, flue gas treatment plants and associated equipment represent the core components of the Plant. The configuration of the power units and all of its main components shall be chosen according to proven and reliable vendor configuration. In doing so, adequate safety clearances, fire compartments, favourable layout of the Plant components for monitoring and maintenance and all other requirements such as those during Power Plant construction shall be taken into account.

The cooling requirement of the Plant shall be accomplished by induced draught cooling towers. The coal unloading facilities and the ash and gypsum loading facilities to ships shall be incorporated in a new jetty structure. Other main items are the power island, the coal yard, ash pond and other balance of plant facilities.

B0.2.6 Layout

The existing conditions at the location of the Plant are shown in the site overview as per the indicative layout in **Part C Annexes**. The Tenderer shall perform own Site visits and investigations prior to bidding in order to familiarize himself with the existing conditions. The Contractor shall propose the Plant layout deemed most practical and cost optimized for the Power Plant.

An indicative general layout is shown in **Part C Annexes** where only the major Plant components have been indicated. The indicative layout takes into consideration the location of the river water intake and jetty, however the final layout is subject to hydraulic studies and optimizations by the Contractor. The design shall allow access vessels with a draught of 9.60m at the jetty. The vessels shall be suitable for transport of coal, ash, gypsum and limestone. The dredging works for the construction of the intake and outfall are part of the Contractor‟s scope.

The intake and outfall locations may change according to the permitting process, results of calculations or model tests or clarifications with the Contractor.

The substations for the export of the produced power are located in the northern portion of the Site. The EHV transmission lines to Dhaka and Khulna are not part of these Tender Documents.

Any costs for relocations or reconfigurations shall exclusively be borne by the Contractor.

The general layout enclosed in Section V TS, Part C is only indicative. Bidder/ Contactor shall elaborate the final layout, which shall be subject to approval by BIFPCL during basic/detailed engineering.

B0.2.7 Design requirements

This specification entails a functional technical specification (FTS). Hence, the Contractor is given as much freedom as possible in designing the main Plant components, characteristics and design data according to the Contractor‟s experiences and good engineering practice. One main acceptance requirement is that the Contractor‟s proposed design work shall be based on a very good reference basis. Prototype equipment and/or design features will not be accepted. All parts and equipment shall be arranged in such a manner as to facilitate surveillance by the operator and for ease maintenance, operation and control.

In the event of contradictions or discrepancies within B0 or between requirements in B0 and stipulations other parts of the Technical Specifications these shall be clarified by mutual consent before Contract signature. In case contradictions have been not clarified the more stringent requirements shall apply.

The main design features (basic design reports, drawings, PFD, P&IDs, design data etc.) and the main vendors and subcontractors shall be subject to the approval by the Employer.

The main equipment/system subcontractors for: steam generator, steam turbine, main transformers, flue gas desulphurization plant shall be firm with the tender. Bidder‟s/Contractor‟s sub-suppliers and vendors shall

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comply with Provennes Criteria as stipulated elsewhere in the biding document.

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The Employer has the right to refuse design features and vendors or subcontractors, if the Contractor cannot verify the reliability of the suggested design, vendor or subcontractor.

Following transformers shall be considered as "Main transformers":

- generator transformer
- unit auxiliary transformer
- start-up/stand-by transformer
- 400/230 kV interconnection transformers.

The Plant is expected to operate in base-load mode with high plant load factor. The design lifetime of the Plant shall be of not less than 30 years of operation or 200,000 full load operating hours, whichever is longer. The Plant and all its auxiliaries shall be designed to operate for the complete lifetime under the site conditions as described in **Section B0** and dedicated other part of this FTS.

All Plant equipment and material must be suitable for the range of ambient site conditions. In particular the saline atmosphere has to be considered.

The thermodynamic process of the Plant is to be optimized by the Contractor according to the proposed equipment. An economic optimal balance between investment, maintenance and operation expenses and Plant availability (planned and unplanned outages) shall be proposed.

The Contractor shall ensure a design of the Plant to achieve an average target availability of 90 % (regarding the definition and calculation of the availability please refer to Chapter B0.2.9.5). The Contractor shall accordingly provide for all systems:

- sufficient redundancies
- sufficient storage capacity
- appropriate adjustment of control parameters, and
- shall provide an appropriate spare part concept/proposal as further described under Chapter B0.3.7.

Astockyard capacity of 90 days at BMCR operation with design coal is envisaged.

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The stockpile height shall be approx. 10 m and the angle of repose shall be approx. 37°.

But is is to be underlined that it is Bidder's/Contractor's sole responsibility to determine the actual coal yard dimensions (length, width, height angle etc.)

to achieve the envisaged stockyard capacity under consideration of the soil bearing capabilities and the selection of coal yard equipment.

The 90 days storage area is shown in Annex C-01. The extension for further 90 days storage shall be done on the areas which are marked as "construction laydown area" and "site installation".

Redundancy concept
All equipment shall be implemented with (n+1) redundancy - unless otherwise stated -, where n is the number of equipment required to maintain the maximum capacity of a unit. N+1 means that even in case of outage of the biggest component sufficient capacity is available to maintain the maximum capacity of the Power Plant unit.

For all components which are not redundant, the Contractor shall provide a maintenance and spare part concept to ensure that outage times are minimized and to ensure that the required availability is met (refer to Amendment No. 3 and Annexure I to Amendment No. 3, both already published on BIFPCL"s Website). Each equipment whose unavailability due to a failure could result in damages to another equipment shall be backed up by a stand-by equipment, one of them being fed by an emergency source in case of external black out.

Failure of any single item of auxiliary equipment including the Power Plant"s DCS and electrical systems shall not result in a reduction in power evacuated from the Power Plant.

Replacement and repair of redundant components shall be possible without interrupting Plant operation.

Future Extension
The Contractor shall ensure sufficient space to enlarge the coal storage capacity from 90 day storage to 180 day storage capacity.

All provisions to enable generally the later extension of the coal storage shall be implemented but no additional costs shall be incurred which are not immediately required for the first phase only, unless expressly mentioned here or in the respective parts of this specification.

B0.2.8 Fuel

The Plant shall be operated with imported sub-bituminous and bituminous coal as the principle fuel. Coal will be supplied via bulk carrier vessels (barges and vessels up to 25,000t, to be unloaded at the Coal Jetty.

The Plant will have to be able to be fully operational and in accordance with all guarantee parameters with all coals on a 100 % basis that comply with the coal characteristics as indicated in **Part C**.

For reference purposes**,** the list that contains the performance coal and the design range for the coals is included in **Part C Annexes**.

For start-up, low-load operation and shut-down, high speed diesel (HSD) shall be used. HSD will be supplied by truck. A typical analysis is given in **Part C Annexes**.

Special technical requirements for the HSD system are given in **Section B4**.

B0.2.9 Output, heat rate and availability requirements

B0.2.9.1 Guarantee definitions

The following guarantees are defined:

Acceptance Guarantees:
The acceptance guarantees must be met in all operating gases unrestrictedly. They are not subject to any correction. Acceptance Guarantees are specified in the Technical Schedules of **Section B0**. The acceptance guarantees are required to be achieved or executed as a condition precedent to Taking Over.

Special Guarantees:
These guarantees are subject to correction, e.g. for fuel characteristics or ambient conditions and if they are not met, they are subject to payment of performance damages. Special Guarantees are specified in the Technical Schedules of **Section B0**.

Minimum Acceptance level (MAL):
Minimum acceptance level (MAL) means the relevant minimum performance levels for the Plant as specified in the relevant part of the Technical Schedules of **Section B0**. The MAL are required to be achieved or executed as a condition precedent to Taking Over.

Liquidated Damages (LD)
Liquidated Damage means the monetary amount to be paid by the Contractor to the Employer if the Special Guarantees are below the Guaranteed Value but above Minimum Acceptance Levels.

B0.2.9.2 Plant output

Gross Electrical Power Output
The gross electrical power output per unit is determined at the turbine generator terminals to the isolated phase busbars, downstream of the connection for the excitation transformer.

The gross electrical power output per unit shall be: **660.0 $MW_{e,gross}$** (plus excitation power requirement in case of static excitation) and shall be kept for the whole coal range.

Net Electrical Power Output
The net electrical power output per unit is determined at the off-take point in the switchyard that means at the high voltage (HV) terminals of the dedicated generator transformer (GT).

The net output is determined by subtracting the consumption of the auxiliary transformer including transformer losses from the gross output.

Export Power Output
The export power output of the Plant is determined at the tariff meterings of the Plant.

The export power output of the Plant equals the net power output of both units minus the losses of the interconnection transformers (ICTs) and start-up transformers.

Dependable Capacity
Dependable Capacity means - according to the Power Purchase Agreement (PPA) - at any given time the net amount of capacity at the tariff metering; either for the first generating unit or for the Plant, as the case may be.

MCR - Maximum Continuous Rating
MCR is defined as the maximum continuous rating (gross electrical power output) of one (1) power plant, coal within the coal range, under Reference Site Conditions (RSC), governor valves being throttled to provide frequency variation as required, boiler in normal operating mode including blow down (if applicable), auxiliary steam consumption (if applicable) etc.). All load percentages apply to MCR, unless otherwise noted.

The dedicated net electric power output at MCR with PF and RSC is:

- $P_{MCR\text{-}PF\text{-}RSC}$ in [MWe]

The dedicated steam generator load at MCR with PF and RSC is.

- $F_{MCR\text{-}PF\text{-}RSC}$ in [kg/s]

TMCR - Turbine Maximum Continuous Rating / VWO - Valves Wide Open (Peak Load)
TMCR/VWO is defined as the maximum continuous rating, at which the steam turbine is capable of operating under normal operating conditions (see MCR). However, when the governor valves are fully opened TMCR/VWO shall be at least 103% of MCR, i.e.:

- $P_{TMCR} = 1.03 \times P_{MCR}$

That means, Gross Electrical Power Output at

- MCR shall be 660 MW ((plus excitation power requirement in case of static excitation)
- TMCR shall be 679.8 MW.

BMCR - Boiler Maximum Continuous Rating
BMCR is defined as the maximum continuous steam generating capacity, at which the boiler is capable of operating under normal operating conditions (see MCR). BMCR shall be at least 105% of MCR, i.e.:

- $F_{BMCR} = 1.05 \times F_{MCR}$

The steam flow at superheater outlet at BMCR shall be 105% MCR flow. Reheater steam flow at BMCR shall be as per Heat Balance Diagram.

MNCR - Minimum Continuous Rating
MNCR is defined as the minimum rating of a power plant unit under normal, continuous operating conditions (see MCR) with coal fire only (without back-up firing with start-up/ignition fuel) with any coal within the coal range. MNCR shall be 30% of MCR.

$P_{MNCR} = 0.3 \times P_{MCR}$.

B0.2.9.3 Net heat rate

The guaranteed Net Heat Rates of the Units and the Plant are to be given in the Technical Schedules of **Section B0.**

The competitiveness of the bid will be evaluated by considering the lowest life-cycle-costs of the bids, which will strongly be influenced by the Bid price on the one hand and the guaranteed Net Heat Rate on the other hand. The optimization criterion which may be utilized by the Contractor in the determination of the proposed power station design is the penalty imposed by not achieving the guaranteed Net Heat Rate as per the Contract.

The guaranteed Net Heat Rates refer to the following load points:

- 100% MCR
- 80% MCR
- 60% MCR
- 50% MCR

The „Net Heat Rate" is the heat rate for the dedicated unit. It is defined according to ASME PTC 46.

PerformanceTests/Guarantee Tests at MCR shall correspond to rated pressure (with throttled valves); whereas for part load (i.e 80%, 60%. 50% MCR) the PerformanceTests/Guarantee Tests shall be under modified sliding pressure (with 5% throttled turbine inlet valve(s)).

B0.2.9.4 Auxiliary power consumption, losses, own consumption,

Auxiliary Power Consumption
The auxiliary power consumption is the power that is required by the auxiliary power transformer of each unit.

ICT Losses and Start-up Transformer Losses
The losses of the ICTs and start-up transformers apply for the complete switchyard of the Plant.

Own Consumption
The own consumption is the sum of the auxiliary power of both units and the ICT losses and star-up transformer losses.

B0.2.9.5 Plant availability

The Contractor shall:

a. design and configure all components of the Plant;
b. propose spare parts stock, comprising as minimum requirement the Initial Spare Parts as requested in Amendment No 3 and Annexure I to Amendment No.3 (both already published on BIFPCL"s Website; and
c. propose maintenance works

in such a way that the average availability of each unit for a period of two year is not lower than 90 %.

The availability for the year means the yearly availability of the Dependable Capacity of each unit for dispatch by the Control Centre, calculated in accordance with the following formula:

$$AF_n = \frac{DC \times \text{hours in the year} - ((MO_{cap} \times MOH) + (FO_{ca}p \times FOH) + (SO_{cap} \times SOH))}{DC \times \text{hours in the year}}$$

Where:

AF_n	Availability Factor for the year "n"
DC	Dependable Capacity of the Unit as per the Contract
MO_{cap}	capacity reduction during each maintenance outage in the year n"
MOH	maintenance outage hours for each maintenance

	outage (MO_{cap}) in the year "n"
FO_{cap}	capacity reduction during each forced outage in the year "n"
FOH	forced outage hours for each forced outage (FO_{cap}) in the year "n"
SO_{cap}	capacity reduction during each scheduled outages in the year "n"
SOH	scheduled outages hours for each scheduled outage (SO_{cap}) in the year "n"
$\Sigma(MO_{cap} \times MOH)$	maintenance outage energy for the year "n"
$\Sigma(FO_{cap} \times FOH)$	forced outage energy for the year "n"
$\Sigma(SO_{cap} \times SOH)$	scheduled outage energy for the year "n"

B0.2.9.6 Maintenance intervals

The Plant shall be designed to follow at least the following requirements for maintenance intervals:

	Recommended outage duration (days)	**Recommended intervals between maintenance outages (years)**
Scheduled Maintenance (Minor Overhauls)	to be determined by Contractor, see B0 TS	> two years
Major Overhaul	to be determined by Contractor, see B0 TS	> eight years

It is meant that the Bidder/Contractor shall determine the final maintenance intervals which shall > 2 years for minor overhauls and > 8 years for major overhauls, supposed that the plant is operated with the specified fuels and according to the operation and maintenance manuals.

In case a minor or major overhaul has to be carried out in the first two years after PAC that means during the warranty period it will have an impact on the availability and as the case may be on the availability guarantee.

B0.2.10 Mode of operation

The Plant shall be designed for base load operation and is expected to participate in the system frequency regulation by free governor operation.

All the equipment and the facilities shall be suitable for:

- Continuous and short-time operation under average ambient air and river water conditions present on site; and
- Continuous and short-time operation under extreme ambient air and river water conditions present on site.

Deleted: All the equipment and the facilities sh be suitable for continuous and also for short-time operation under the average and the extreme amb air and river water conditions present on site.

The design of the Plant shall be based on the following operation and dispatching requirements:

a. It shall be capable of following the daily and seasonal demand profile of the electrical network.
b. Full compliance with the conditions of the admissible air pollution is required within the power range.
c. The power generation shall be fully dispatch able within the technical limits of the Plant to be specified by the Contractor but at least between MNCR and 100 % of the Net Output of the Plant at BMCR.

The units shall be operated as base load plant. It must be capable for following operation modes:

- Fixed/Constant pressure operation upton 40% MCR load;
- Sliding pressure operation from rated pressure down to 40% of rated with as well as without any throttle reserve. At any operating load, the throttle reserve shall be sufficient so as to achieve an instantaneous increase in turbine output by 5% (except MCR, 3% for MCR) of the corresponding load by opening turbine control valve wide open VWO/TMCR). The throttle reserve shall be adjustable to 0% for pure sliding pressure mode operation;
- Fixed/Constant pressure: from 100% MCR to 103% MCR (TMCR/VWO) load. Consequently the plant shall be designed also for fixed pressure operation as much higher load than 40% upto to 100% load;
- start-up modes from notice to start to synchronization:
  - hot start: start-up following a continuous shutdown for a period of 8 hours or less in max. 3 hours;
  - warm start: start-up following a continuous shutdown for a period between 8 and 48 hours in max. 4 hours;
  - cold start: start-up following a continuous shutdown for a period more than 48 hours in max. 12 hours;
- shut-down mode;
- Each Unit shall be capable of automatic operation and control and full cyclic operation between MNCR and BMCR without restriction;
- operation without HP heater;

  With all HP heaters out of service 100% el. load shall be generated with maximum cooling water temperature, 3% make up and normal auxiliary steam requirement being tapped from cold re-heat line. For bypass of HP heaters a full bypass shall be considered.

- house load operation;
- In case of sudden load throw-off, the steam generator shall be capable of automatically bringing down the steam generating capacity from BMCR to match with HP-LP bypass capacity;

Deleted: of HP pressure from subcritical pressu at part load to supercritical pressure range at full load;

- The Power Plant shall be designed for minimum rate of loading/unloading mentioned below without compromising on design life of pressure parts;
- step load change: Minimum ± 10% /min;
- ramp rate: Minimum ± 3%/min (MNCR to 50% BMCR);
  Minimum ± 5% /min (50% MCR to 100% BMCR).

In addition to the the following requirements shall be considered:

- Steam Generator (refer also to Bidding Documents, Section V TS, B1.3.1.1 Operational requirements): "The steam generator shall be operable in the variable (i.e. sliding or modified sliding) and fixed pressure mode";
- Steam Turbine (refer to Bidding Documents, Section V TS, B2.3.15 Control and monitoring equipment): "The steam turbine shall be capable of operating in both the sliding and fixed pressure modes. The Bidder/Contractor shall propose the operating regime which will maintain a highest efficiency of the Plant at various loads."

The Performance Tests/Guarantee Tests shall be executed for the load points as specified. Performance Tests/Guarantee Tests at MCR shall correspond to rated pressure (with throttled valves); whereas for part load (i.e 80%, 60%, 50% MCR) the guarantee test shall be under modified sliding pressure (with 5% throttled turbine inlet valve(s)).

For more detailed requirements refer also to Chapter B0.2.12.

B0.2.11 Electrical network connection conditions

The Plant shall comply with:

a. the Essential Electrical Requirement of the PPA
b. the latest edition of the Electricity Grid Code of the Bangladesh Energy Regulatory Commission; and
c. the Great Britain Grid Code.

In case of contradictions or discrepancies the order of precedence shall be as follows:

a. Essential Electrical Requirements of the PPA
b. Electricity Grid Code of the Bangladesh Energy Regulatory Commission
c. Great Britain Grid Code.

Any other requirements of the Bangladesh Power Development Board (BPDB) or Power Grid Company of Bangladesh (PGCB) shall also be considered.

The Tenderershall list all those grid connection requirements which cannot be met by the proposed Plant.

B0.2.11.1 Essential Electrical Requirements of the PPA

In this chapter essential electrical requirements for the grid connection and Plant operation are extracted from the PPA. For ease of reference, the relevant chapters/articles of the PPA are indicated.

PPA Section 11: Power Evacuation and Switchyard

11.1 Power Evacuation

The Company shall deliver power at the Delivery Point and BPDB shall evacuate power from the Delivery Point. In this regard, BPDB itself or through PGCB shall construct Power Evacuation Facilities at its own costs and expenses. The Company shall construct switchyard for evacuation of power, with the provision for termination of two 400 kV circuits and two 230 kV circuits of PGCB. This switchyard along with line breaker, CT, PT and other necessary equipment and associated relays, controls, protection, communication and instrument system situated within this switchyard, will be operated and maintained by the Company. The company will also construct connecting lines (U/G or O/H) from power plant to this switchyard. The Company shall provide suitable interface unit at the Company premises for communication links to the power grid SCADA system to accommodate the PGCB and the National Load Dispatch Center (NLDC) requirements. The communication interface unit provided in the Company premises shall be adequate to fulfil the PGCB/NLDC information requirement and may be in the form of RTU or a suitable Gateway on company switchyard automation network at a mutually agreed communication protocol (i.e. IEC-60870-5-101/104). The Company shall be responsible for construction of the interconnections between the switchyard and the Facility. The company Switchyard including the interconnecting link with the generation facility should have design standards as per Minimum Functional Specification. Line relays and controls at the switchyard shall be provided by the Company.

In addition refer to B10.

Only the "start up transformer" and the "future GT's" shall be connected by means of 230 kV cables. Connection between GT"s and GIS switchyard shall be done by overhead line.

BPDB shall provide by no later than two hundred and seventy (270) Days prior to Scheduled Initial Operation Date, the following facilities to the Company for the purpose of Commissioning, synchronization and operation of the Facility:

i. One number 230 KV D/C transmission line from the BPDB / PGCB 230 KV system, to be terminated at the specified point at the switchyard of the Facility;

ii. (ii) Start-up power of not less than 50 MVA capacity, to be supplied to the Facility through this 230 KV transmission line, by no later

than two hundred and seventy (270) Days prior to Scheduled Initial Operation Date;

iii. One number 400 KV D/C transmission line from the BPDB / PGCB 400KV system, to be terminated at the specified point at the switchyard of the Facility, with adequate capacity to evacuate entire power generated by the Contracted Capacity of the Facility, by no later than one hundred and eighty (180) Days prior to Scheduled Initial Operation Date;

11.2 Electrical

a. Communication link

The Company shall provide suitable interface unit at the Company premises for communication links to the power grid SCADA system to accommodate the PGCB and the National Load Dispatch Center (NLDC) requirements. The communication interface unit provided in the Company premises shall be adequate to fulfil the PGCB/NLDC information requirement and may be in the form of RTU or a suitable gateway on Company switchyard automation network at a mutually agreed communication protocol (i.e. IEC-60870-5-101/104).

The Company shall be responsible for construction of the interconnections between the switchyard and the Facility. The Company switchyard including the interconnecting link with the generation facility should have design standards as per Minimum Functional Specification. Line relays and controls at the switchyard shall be provided by the Company.

b. Control of Switchyard

Provision and installation of all control and signal cables between the company switchyard and the Facility shall be responsibility of the Company. Necessary interface shall be provided within the switchyard control facility for receiving the signals from PGCB grid control. It shall be responsibility of the Company to lay and terminate cables for this purpose.

All circuit breakers and disconnect switches shall be capable of being electrically controlled from the three control positions as follows:

i. Local Control: Located adjacent to switching devices, to facilitate maintenance, inspection, and emergency operation.

ii. Remote Control: Located at the switchyard control room, where switching devices are controlled by direct wire.

iii. Supervisory Control: Located at the Load Dispatch Centre (NLDC) at Dhaka, for remote control and supervision via the tele-control systems to be supplied by the Company.

Also refer to B10.

The Company shall provide all the necessary control-selector switches, position indicating contacts, and interposing relays.

11.3 Electrical Protection, Communication and Instrument Systems
The Company shall provide a complete and comprehensive protection system for the generators/generator transformers/service transformers, transmission lines and the station electrical distribution systems. The Company shall undertake the installation of the protection relay panels within the control room, wiring between panels and switchyard equipment, and commissioning tests of the protection schemes.

The Company (in consultation with BPDB) shall provide suitable interface unit at the Company premises for communication links to the PGCB"s SCADA system for Communication, control, monitoring and voice channels required for PGCB"s National/Regional Control Center.

Communication, telemetry, fiber optical terminal, and tele-protection equipment (PLCC) shall be supplied and installed by PGCB at company switchyard end, matching with PGCB"s remote substation end requirements. However, line trap and capacitive voltage transformer of required rating along with 48V DC/AC auxiliary supply at company switchyard end shall be provided by company. The wiring of all signalling and control circuits required for the system shall be cabled out to interface marshalling cubicles by the Company. The Company shall supply and install necessary cabling and cubicles. Cabling between the Company"s cubicles and PGCB" LDC equipment shall be provided and installed by the Company.

PPA Schedule 1: Minimum Functional Specifications
3. ELECTRICAL REQUIREMENTS
3.1 Generators

a. Each generator shall comply with IEC 34: Latest Edition and shall be rated to match [each][the] Steam turbine[s] and the steam turbine output over the full range of ambient temperatures. Generator and exciter windings shall possess insulation that is non-hydroscopic and of Class F type in accordance with IEC 85 standard.

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b. Not Used

c. The quality management of the generator[s] and accessories shall be in accordance with the requirements of ISO 9001, EN 29001 or BS 5750 Part 1 or such other equivalent international quality standards and Prudent Utility Practices.

d. Temperature detectors shall be provided (to be placed in the hottest zone as decided by manufacturer) to monitor the maximum operating temperature of the machine.

Deleted: ¶

e. The generator[s] shall be capable of operating within 48.5 Hz and 51.5 Hz and +/- 5% of nominal rated voltage within the power factor

range 0.85 lagging and 0.95 leading at the generator terminal. However, the combined variation in voltage and frequency shall not exceed 5%.

f. Generator[s] shall have a minimum short circuit ratio complying with IEC 34.

3.2 Excitation System

a. A continuous fast acting automatic excitation control system of proven design shall be provided to control each generator‟s voltage without hunting or instability over the entire operating range of the generators.

b. The excitation system shall be provided with a fast acting MVAR limiter so as to prevent the generator output falling below safe limits. A power system stabiliser shall be incorporated in the excitation system of each generator. BPDB shall provide the settings for the power system stabiliser. The AVR shall be provided with but not limited to Quadrature Droop Compensation and Cross Current Compounding. Protection features, as part of the system shall include overvoltage, overcurrent, voltage transformer (VT) fuse failure, diode failure, overfluxing, and AVR power supply failure. A field shorting or discharge switch feature shall be included in the system as protection against over stressing the generator insulation in the event of a fault.

c. Manual excitation control facilities shall be provided as back up to the automatic channel, and shall have an adequate range to allow for control of excitation for testing purposes. A true null balance shall be provided to allow for smooth excitation transfer between manual and automatic control.

Bidder's/Contractor‟s/OEM‟s standard and proven static excitation system with advanced duall channel digital voltage regulator system which do not require true null meter or follow up device for smooth AVR control transfer between auto and manual will be accepted.

The requirement related to on load tap changer is not applicable to excitation transformer.

3.3 Power and Auxiliary Transformers

The Facility shall include a main transformer for each generator, together with all protection, busbars and disconnectors where required. These main transformers shall be equipped with on load [to be discussed with BPDB] tap changers and shall be of OFAF (forced oil, forced air) or ODAF (oil direct, forced air cooled) or suitable type rated for the full continuous output of the generator.

All service station auxiliary transformers (utilization voltage <650V) shall be OFAF, ODAF or ONAN cooled if located outside, or resin type design if situated inside the buildings.

3.4 Control and Supervision

a. Supervisory control, monitoring, and data acquisition information shall comply with BPDB‟s system control concept and proposed/current system. BPDB shall provide all supervisory control, monitoring, and data acquisition circuits from BPDB‟s National/Regional Control Center, all of which shall conform to the Company‟s requirements.

b. Manual synchronising facilities, with such check facilities shall be provided as a minimum for all circuits except for station/service transformer circuits.

c. The Facility shall be provided with a central on-site control room (CCR) so that operators can control the generators and perform switching and load dispatch duties. A Distributed Control System (DCS) shall be provided to coordinate the control and supervision of the Facility including half hourly Dependable Capacity correction for Reference Site Condition

d. The Facility shall be equipped with terminals to receive command from the BPDB load dispatch center to allow control from Load Dispatch Center.

3.5 Electrical Protection, Communication Instrument Systems

The Facility shall incorporate a protection system for generators, generator transformers, service transformers, and station electrical distribution systems as per Prudent Utility Practice.

Communication, control, monitoring, and voice channels will be provided between the Facility and BPDB‟s National/Regional Control Center by BPDB. The Company shall provide interconnection within the Facility for all such communication circuits/channels.

3.6 Power Tariff Metering

a. The Metering System to be installed at the Facility shall include tariff metering and indicative metering.

b. For each unit, the measurements, which are used for calculation of the main tariff metered energy, are taken at the outgoing side of the interconnecting lines (main and check) and Back-Up Metering System on the high voltage side of each generator transformer and station transformers, as applicable. The tariff meters installed will measure the net energy sent out from the facility. As provided in Section 12.1, the Back-Up Metering System shall also be of the same type and identical to the Metering System.

Main and check meters shall be provided on HV side of generator and start-up transformer as well as at the outgoing side of the interconnection lines (Reference is made to chapter B10.3.13).

c. The tariff meters shall have separate facilities for recording the net inflow to the Facility and net outflow of energy from the Facility, and the aggregate of these parameters. This information shall be available for transmission to remote locations via the communication circuit to be provided by BPDB.

d. Sufficient indicative metering facilities will be installed to allow efficient normal operating and maintenance procedures and automatic control functions to be conducted at the Facility. The metering shall be logged by the Facility‟s DCS.

PPA Schedule 1: Technical Limits and Contracted Characteristics

1.3 Frequency, Power Factor and Voltage Limits

a. At rated voltage and frequency, the Facility will operate at 100% load with a power factor in the range 0.85 lagging to 0.95 leading at the generator terminals, which range shall not be exceeded. The curves from the manufacture(s) showing the Reactive Power capability of the generators form part of Schedule 2.

b. The Facility will operate within the line voltage range used in practice by BPDB and in no case shall the Facility be required to operate more than +5% or less than -10% on the 400 kV high voltage system.

c. The Facility shall operate within the frequency range 48.5 Hertz to 51.5 Hertz which range shall not be exceeded. The Facility shall be capable of continuous operation for the periods defined in Table 3,

Table 3: As per PPA

Frequency Range (Hz)	Minimum Sustainable Operation
48.5 to 51.5	Continuous
47.5 to 48.5	10 minutes
Less than 47.5	Trip Condition
Greater than 51.5	Trip Condition

B0.2.11.2 Essential Requirements of Electricity Grid Code of the Bangladesh Energy Regulatory Commission

In this chapter essential requirements for the grid connection and Plant operation are extracted from the BGC. For ease of reference, the relevant chapters/articles of the BGC are mentioned in brackets.

The full compliance with the BGC shall be proven by electrical system studies and investigations.

The ratio of X/R can be considered as 40 based on the table 10 given in IEEE C37.010.

It is to be emphasized that there are some discrepancies between the requirements of the BGC and the requirements of the International Electrotechnical Commission Standard IEC 60034. In case of contradictions the requirements and stipulations of IEC 60034 shall prevail.

The Tenderer shall discuss all deviations from the grid connection conditions, which will result in an economic advantage for the investment and the operation of the Plant.

B0.2.11.2.1 System performance (Section 5.4)

Each generating unit shall be capable of generating at full rated power output within following ranges:

	From	To
Frequency	47.5 Hz	52 Hz
Rated Voltage	-10%	+ 10%
Power factor	0.85 lagging *)	0.95 leading

*) This value deviates from the BGC and is chosen as common for generator of this size.

The Transmission System frequency shall normally be 50.0 Hz and shall normally be controlled in the range 49.0 – 51.0 Hz (50 Hz ± 2%). The User shall however be subject to the grid discipline directed by the Commission.

Voltage variation on the Transmission System shall normally be +/- 10% during emergencies and +/- 5% during normal operation, in accordance with the provisions of Planning and Security Standards for Transmission System. Insulation coordination of the **Users'** equipment and rupturing capacity of switchgear shall conform to applicable Bangladesh Standards/Codes.

Protection schemes and Metering schemes shall be as detailed in the Protection & Metering Sections of the Code.

For new Power Stations the equipment within their site for data transmission and communications shall be owned and maintained by the respective Generator**.**

B0.2.11.2.2 Connection point (Section 5.6.1)

Unless specifically agreed with the Licensee the Connection point shall be the outgoing gantry of Power Station switchyard. The metering point shall be at the outgoing connection point. All the substation equipment including Protection, Control and Metering equipment owned by the Generator within

the perimeter of the Generator‟s site shall be maintained by the Generator. Other Users‟ equipment shall be maintained by the respective Users. From the outgoing feeder gantry onwards, the Licensee shall maintain all electrical equipment.

B0.2.11.2.3 Data requirements (Section 5.7)

Users shall provide the Licensee with data for this Section as specified in the Data Registration Section.

B0.2.11.2.4 Frequency management & responsibilities (Section 8.3 and 8.4)

Generators shall follow the dispatch instructions issued by the **NLDC**.

All Generating Units shall have the governor available and in service and must be capable of automatic increase or decrease in output within the normal declared frequency range and within their respective capability limit.

Under certain conditions the system frequency could rise to 52 Hz or fall to 47.5 Hz. All Generating Units should be capable of operating within the range and the **NLDC** informed promptly of any restrictions. **Generators** shall be responsible for protecting their Generating Units against damage should frequency excursions outside 52 Hz and 47.5 Hz ever occur. Should such excursions occur, the **Generator** should decide whether or not to disconnect his apparatus for reasons of safety of apparatus, Plant and/or personnel. The **Generator** shall inform the **NLDC** immediately after taking such action.

Sustained rising frequency
Under rising frequency conditions, the **NLDC** shall take appropriate action to issue instructions to **Generators** to arrest the rising frequency and restore frequency within normal range. Such instructions may include reducing generated output or de-synchronizing Generating Units from the Transmission System. When the frequency rises above 51.0 Hz actions must be taken immediately by the **Generator**. Under such condition, the Generating Units which were responsible for seeing frequency of the system shall decrease their Generating Output at a rate of – (minus) 2% per 0.1 Hz for departure of frequency above 51.0 Hz until the frequency is restored within the normal range. The **Generator** shall inform the **NLDC** immediately after taking such action.

Sustained falling frequency
Under falling frequency conditions, the **NLDC** shall take appropriate action to issue instructions to arrest the falling frequency and restore it to be within normal range. Such instructions may include dispatch instructions to **Generators** to increase output, to synchronize standby Generating Units to

the Transmission System and/or instructions to Distribution Utilities to reduce load demand by appropriate manual and /or automatic load shedding.

When the frequency falls below 49.0 Hz the Generating Units which were responsible for seeing frequency of the system shall increase their Generating Output at a rate of + (plus) 2% per 0.1 Hz (if available) for departure of frequency below 49.0 Hz until the frequency is restored within the normal range. The **Generators** shall be responsible for protecting own units should frequency excursions occurs outside 47.5 to 52 Hz range. The **Generator** shall inform the **NLDC** immediately after taking such action.

All Generating Units that have been declared available shall be required to be synchronized and loaded in the event of the sustained low frequency below 49.0 Hz provided local and safety conditions permit. This action shall be performed without delay after failed attempts to contact the **NLDC**. The Generator shall inform the **NLDC** immediately after taking such action.

B0.2.11.2.5 Voltage management (Section 8.5)

The **Licensee** and **NLDC** shall carry out load flow studies from time to time to predict where voltage problems may be encountered and to identify appropriate measures to ensure that voltages remain within the defined limits. On the basis of these studies the **NLDC** shall instruct **Generators** to maintain specified voltage levels at interconnecting points.

The **Licensee** shall continuously monitor 400 kV/ 230 kV/ 132 kV transmission grid voltage levels at strategic substations. The **NLDC** and the Licensee shall regulate voltage levels within the prescribed levels.

The **NLDC** and the **Licensee** shall jointly take appropriate measures to control Transmission System voltages that may include but not be limited to transformer tap changing and use of MVAR reserves with Generating units within technical limits agreed to between the **NLDC**, **Licensee** and Generating units.

All Generating Units shall have Automatic Voltage Regulator (AVR) in service.

Generators shall inform the **NLDC** of their reactive reserve capability promptly on request. **Generators** shall make available to the **NLDC** the up-to-date capability curves for all Generating Units, as detailed in **Section 5**, indicating any restrictions, to allow accurate system studies and effective operation of the Transmission System.

B0.2.11.2.6 Monitoring of generation (Section 8.7)

For effective operation of the Transmission System, it is important that a **Generator's** declared availability is realistic and that any departures are continually fed back to the **Generator** to help effect improvement.
The monitoring by the **NLDC** of Generating Unit output, and active and reactive reserve capacity, shall be carried out to evaluate the reliability and performance of plant.

The **NLDC** shall continuously monitor Generating Unit outputs and bus voltages (by SCADA). More stringent monitoring may be performed at any time, as detailed in the Testing Section, when there is reason to believe that a **Generator's** declared availability may not match the actual availability or declared output does not match the actual output.

Generators shall provide to the **NLDC** hourly generation summation outputs where no automatically transmitted metering or SCADA equipment exists.

The Generator shall provide other logged readings that the **NLDC** may reasonably require, for monitoring purposes where SCADA data is not available.
Generators shall submit data to **NLDC** as listed in Data Registration Section, termed as Frequency and Voltage Management.

B0.2.11.2.7 Contingency planning (Section 9)

Total System Blackout (Section 9.3.1)
NLDC shall instruct all relevant Generators having Power Stations with Black Start capability to commence their pre-planned Black Start procedure.

Remark: The Maitree-STPP shall **not** have Black Start capability.

Partial Transmission System Blackout (Section 9.3.2)
NLDC shall ensure with the **Licensee** and **Users** that security of the healthy part of the Transmission System is maintained.

NLDC and the **Licensee** shall gradually extend the healthy system to provide start-up power to appropriate Generating Units.

NLDC and the **Licensee** with close coordination with Distribution Utilities and **Generators** shall gradually restore demand to match generation as it becomes available.

All **Users** shall take care to ensure load generation balance is maintained at all times under **NLDC's** direction.

Special Consideration (Section 9.5)
During the restoration process following Transmission System blackout conditions, normal standards of voltage and frequency shall not apply.

B0.2.11.2.8 Protection (Section 12)

General Principals (Section 12.3)
No item of electrical equipment shall be allowed to remain connected to the Transmission System unless it is covered by appropriate protection aimed at reliability, selectivity, speed and sensitivity. Guidelines mentioned in protection manuals may be kept in view.

All **Users** shall co-operate with the **Licensee** to ensure correct and appropriate settings of protection to achieve effective, discriminatory removal of faulty equipment within the time for target clearance specified in this Section.

Protection settings shall not be altered, or protection bypassed and/or disconnected without consultation and agreement of all affected Users. In the case where protection is bypassed and/or disconnected, by agreement, then the cause must be rectified and the protection restored to normal condition as quickly as possible. If agreement has not been reached the electrical equipment will be removed from service forthwith.

Fault Clearance Times (Section 12.5)
From a stability consideration the maximum fault clearance times for faults on any **User's** system directly connected to the Transmission System, or any faults on the Transmission System itself, are as follows:

Target Clearance Times:

i. 400 kV : 100 ms
ii. 230 kV : 160 ms
iii. 132 kV : 160 ms.

Slower fault clearance times for faults on a Users system may be agreed to but only if, in the **Licensee's** opinion, system conditions allow this.

Generator Requirements (Section 12.6)
All Generating Units and all associated electrical equipment of the **Generator** connected to the Transmission System shall be protected by adequate and coordinated protection so that the Transmission System does not suffer due to any disturbance originating from the Generating Unit.

In the event of failure of the protection systems provided to meet the fault requirements detailed above, backup protection shall be provided by the **Generator** with a fault clearance time not slower than 400ms for faults on the Generating Unit"s HV connections. The protection shall also cover EHV lines and transformers to the standards as for the Transmission System and

circuit breaker fail, pole slipping, loss of excitation, power system stabilizer and negative phase sequence tripping.

Transmission Line Requirements (Section 12.7/12.7.1/12.7.3)
Every 400 kV Line and 230 kV Line taking off from a Power Station or a substation shall have main protection and backup protection as mentioned below. The **Licensee** shall notify **Users** of any changes in its policy on protection from time to time.

- Two distance protections plus directional earth-fault protection (in directional comparison scheme) shall be provided as the Main-1 and Main-2 protection respectively.
- One stand alone directional 3-phase or 2-phase over-current relay and one directional earth-fault relay shall provide the backup protection.
- Three pole and/or single pole single shot auto-reclosing equipment shall be fitted, as appropriate, as considered by the licensee. All auto-reclosing equipment will be made inoperative for three phase trip-out and/or back-up protection operation.
- Both distance and directional earth-fault functions shall have compatible communication aided transfer trip scheme.

For short transmission lines Line Differential Protection along with backup Directional normal, Directional time-lag and/or Non-Directional Over-current and Earth-fault protection shall be provided as an appropriate protection scheme.

Relay Panels for the protection of lines of the **Licensee** taking off from a Power Station shall be owned and maintained by the **Licensee**. **Generators** shall provide space, connection facility and access to the **Licensee** for such purpose.

The **Generator** shall ensure that all common facilities needed for installing required protective relaying are made available to the Licensee.

Transformer Requirements - Generating Station/Transmission System (Section 12.9.1)
All windings of auto-transformers and power transformers of EHV class shall be protected by differential relays and REF relays as main protection. In addition there shall be one backup time lag 3-phase Over-current and Earth-fault protection relay. For parallel operation such backup protection shall have directional feature. For protection against heavy short circuits, the Over-current and Earth-fault relays should incorporate a high set instantaneous element. In addition to electrical protection, gas operated relays, winding temperature protection and oil temperature protection shall be provided. Over-voltage, thermal overload and over-fluxing protection should also be provided.

Substation Busbar and Fire Protection (Section 12.10.1/12.10.2)
All **Users** shall provide adequate main and backup bus zone protection incorporated with Local Breaker Backup (LBB) or Breaker Fail Protection (BFP) for busbars in all 400 kV, 230 kV and 132 kV class substations.

Adequate precautions shall be taken and protection shall be provided against fire hazards to all Apparatus of the Users conforming to relevant Bangladesh Standard Specification and/or provisions in the Electricity Rules, 1937 and amendments thereof and other standard engineering practices.

Data Requirements (Section 12.11)
Users shall provide the **Licensee** with data for this Section as specified in the Data Registration Section.

B0.2.11.2.9 Testing (Section 14)

Introduction (Section 14.1)
This Section specifies the responsibilities and procedures for arranging and carrying out Tests which have (or may have) an effect on the Transmission System or the **Generator's** or **Distributor's** systems.

Objective (Section 14.2)
The objective of the Section are to establish whether Generating Units can operate within their Generation Schedule and Dispatch parameters as registered under the Data Registration Section and that the Generator and Distributor comply with the Connection Section. It shall also establish whether each Generating Unit"s declared availability capacity is as declared and that the requirements of the provisions of frequency, voltage management and reserve capability are met in accordance with the provisions of the Grid Code.

B0.2.11.2.10 Performance standards for transmission (Section 17)

Purpose and Scope (Section 17.1.1/17.1.2)
Purpose:

a) To ensure the quality of electric power in the Grid.
b) To ensure that the Grid will be operated in a safe and efficient manner and with a high degree of reliability; and
c) To specify safety standards for the protection of personnel in the work environment.

Scope of Application:
This Chapter applies to all Grid Users including:

a) the Licensee
b) the System Operator/ NLDC
c) generators

d) distribution utilities, and
e) any other entity (e.g. owners of HVDC converter, large furnaces, etc.) with a User System connected to the Grid.

Power Quality Standards (Section 17.2)

Power Quality Problems (Section 17.2.1)

For the purpose of this Article, Power Quality shall be defined as the quality of the voltage, including its frequency and the resulting current that are measured in the Grid during normal conditions.

A Power Quality problem exists when at least one of the following conditions is present and significantly affects the normal operation of the System:

a) The System Frequency has deviated from the nominal value of 50 Hz.
b) Voltage magnitudes are outside their allowable range of variation.
c) Harmonic Frequencies are present in the System
d) There is imbalance in the magnitude of the phase voltages.
e) The phase displacement between the voltages is not equal to 120 degrees.
f) Voltage Fluctuations cause Flicker that is outside the allowable Flicker Severity limits, or
g) High-frequency Over-voltages are present in the Grid.

Frequency Variations (Section 17.2.2)

The nominal fundamental frequency shall be 50 Hz. The control of System frequency shall be the responsibility of the System Operator. The System Operator shall maintain the fundamental frequency within the limits of 49.0 Hz and 51.0 Hz during normal conditions.

Voltage Variations Section 17.2.3)

For the purpose of this Section, Voltage Variation shall be defined as the deviation of the root-mean-square (RMS) value of the voltage from its nominal value, expressed in percent. Voltage Variation will either be of short duration or long duration.

A Short Duration Voltage Variation shall be defined as a variation of the RMS value of the voltage from nominal voltage for a time greater than one-half cycle of the power frequency but not exceeding one minute. A Short Duration Voltage Variation is a Voltage Swell if the RMS value of the voltage increases to between 110 percent and 180 percent of the nominal value. A Short Duration Voltage Variation is a Voltage Sag (or Voltage Dip) if the RMS value of the voltage decreases to between 10 percent and 90 percent of the nominal value.

A Long Duration Voltage Variation shall be defined as a variation of the RMS value of the voltage from nominal voltage for a time greater than one minute. A Long Duration Voltage Variation is an Under-voltage if the RMS value of the voltage is less than or equal to 90 percent of the nominal voltage. A Long Duration Voltage Variation is an Overvoltage if the RMS

value of the voltage is greater than or equal to 110 percent of the nominal value.

The Grid Owner and the System Operator shall ensure that the Long Duration Voltage Variations result in RMS values of the voltages that are greater than 95 percent but less than 105 percent of the nominal voltage at any Connection Point during normal conditions.

Harmonics (Section 17.2.4)
For the purpose of this Section, Harmonics shall be defined as sinusoidal voltages and currents having frequencies that are integral multiples of the fundamental frequency. The Total Harmonic Distortion (THD) shall be defined as the ratio of the RMS value of the harmonic content to the RMS value of the fundamental quantity, expressed in percent.

The Total Demand Distortion (TDD) shall be defined as the ratio of the RMS value of the harmonic content to the RMS value of the rated or maximum fundamental quantity, expressed in percent. The Total Harmonic Distortion of the voltage and the Total Demand Distortion of the current at any Connection Point shall not exceed the limits given in Tables 17-1 and 17-2, respectively.

Harmonic Voltage Distortion

Voltage Level	THD*	Individual	
		Odd	Even
400 kV	1.5%	1.0%	0.5%
132-230 kV	2.5%	1.5%	1.0%
66 kV	3.0%	2.0%	2.0%

* Total Harmonic Distortion

Table 17-1: Maximum Harmonic Distortion Factor

Harmonic Current Distortion

Voltage Level	TDD*	Individual	
		Odd	Even
400 kV	1.5%	1.0%	0.5%
132-230 kV	2.5%	2.0%	0.5%
66 kV	5.0%	4.0%	1.0%

* Total Demand Distortion

Table 17-2: Maximum Harmonic Distortion

T.H.D of the line-to-line terminal voltage for the Generator shall be as per latest IEC 60034-3 (clause 9.11.2 - Limits (Total Harmonic Distortion (THD) for synchronous machines) will be accepted. As per this clause of IEC, it shall be limited to 5%. However, at the 400 kV and 230 kV grid connection points the requirements of the specification Section B0.2.11.2.10 shall apply.

Voltage Unbalance (Section 17.2.5)
For the purpose of this Section, the Negative Sequence Unbalance Factor shall be defined as the ratio of the magnitude of the negative sequence component of the voltages to the magnitude of the positive sequence component of the voltages, expressed in percent. For the purpose of this section, the Zero Sequence Unbalance Factor shall be defined as the ratio of the magnitude of the zero sequence components of the voltages to the magnitude of the positive sequence component of the voltages, expressed in percent. The maximum Negative Sequence Unbalance Factor at the Connection Point of any User shall not exceed one (1) percent during normal operating conditions.

The maximum Zero Sequence Unbalance Factor at the Connection Point of any User shall not exceed one (1) percent during normal operating conditions.

Voltage Fluctuation and Flicker Severity (Section 17.2.6)
For the purpose of this Section, Voltage Fluctuations shall be defined as systematic variations of the voltage envelope or random amplitude changes where the RMS value of the voltage is between 90 percent and 110 percent of the nominal voltage. For the purpose of this Section, Flicker shall be defined as the impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time.

In the assessment of the disturbance caused by a Flicker source with a short duty cycle, the Short Term Flicker Severity shall be computed over a 10-minute period. In the assessment of the disturbance caused by a Flicker source with a long and variable duty cycle, the Long Term Flicker Severity shall be derived from the Short Term Flicker Severity levels.

The Voltage Fluctuation at any Connection Point with a fluctuating demand shall not exceed one percent (1%) of the nominal voltage for every step change, which may occur repetitively. Any large Voltage Fluctuation other than a step change may be allowed up to a level of three percent (3%) provided that this does not constitute a risk to the Grid or to the System of any User. The Flicker Severity at any Connection Point in the Grid shall not exceed the values given in Table 17-3.

	Short Term	**Long Term**
132 kV and above	0.8 unit	0.6 unit
below 132 kV	1.0 unit	0.8 unit

Table 17-3: Maximum Flicker Severity

Transient Voltage Variations (Section 17.2.7)
For the purpose of this Section, Transient Voltages shall be defined as the high-frequency Over-voltages that are generally shorter in duration compared to the Short Duration Voltage Variations. Infrequent short-duration peaks may be permitted to exceed the levels specified in Section **17.2.4** for harmonic distortions provided that such increases do not

compromise service to other End-users or cause damage to any Grid equipment. Infrequent short-duration peaks with a maximum value of two (2) percent may be permitted for Voltage Unbalance, subject to the terms of the Connection Agreement or Amended Connection Agreement.

B0.2.11.2.11 House load operation (not requested by the Grid Code of Bangladesh)

Each Unit shall successfully go to house load operation in the event of disconnection or complete isolation of such Unit from the Grid.
Each Unit shall be capable of performing house load operation up to a maximum of 2 hours. A Unit that has achieved house load operation shall not be shut down without the prior consent of the NLDC.

1. Within such time, each Unit on house load operation shall be ready to be resynchronized to the Grid System and able to increase output in the usual manner.
2. In the event the Grid System is not energized, each Unit on house load operation shall have the capability to energize a dead bus and to start the other Unit, when instructed by the NLDC. Subsequently, upon instruction by the NLDC, such Unit shall be able to increase output in the usual manner.

B0.2.12 Facility technical limits

The following sections describe the minimum requirements regarding the facility.

B0.2.12.1 Unit start

The facility shall be able to achieve the following operating levels within the same period (in minutes) specified in the following table.

Conditions	Boiler firing to turbine start	Steam turbine start to synchronous	Notice to start to steam turbine synchronous	Synchronous to full load	Total
Cold start after more than 48 hrs outage	TBD	TBD	12 hours	TBD	TBD
Warm start after 8 to 48 hrs shutdown	TBD	TBD	4 hours	TBD	TBD
Hot start after 8 hrs shutdown	TBD	TBD	3 hours	TBD	TBD

Table B0-3: Required start-up times (minutes)[1]

[1] To be determined by the Tenderer

B0.2.12.2 Despatch ramp rates

Ramp rates of 3%/min to 5%/min are expected for the Power Plant when operating between 30% and 100% BMCR. Ramp rates of less than 5%/min are subject to Employer"s approval.

The facility shall be able to achieve the following despatch ramp rates as specified in the following table:

Despatch ramp rates		(Excluding Pulverizer changing over time)	
		Loading (MW)	Ramp rates (MW/min)
Cold start	(0 to 7%)	0 – 42	TBD
	(7 to 30%)	42 – 180	TBD
	(30 to 50%)	180 – 300	TBD
	(50 to 75%)	300 – 450	TBD
	(75 to 100%)	450 – 660	TBD
Warm start	(0 to 7%)	0 – 42	TBD
	(7 to 30%)	42 – 180	TBD
	(30 to 50%)	180 – 300	TBD
	(50 to 75%)	300 – 450	TBD
	(75 to 100%)	450 – 660	TBD
Hot start	(0 to 7%)	0 – 42	TBD
	(7 to 30%)	42 – 180	TBD
	(30 to 50%)	180 – 300	TBD
	(50 to 75%)	300 – 450	TBD
	(75 to 100%)	450 – 660	TBD

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Despatch ramp rates (per Unit) [2]

B0.2.13 Environmental impact requirements

Air pollution
The permissible exhaust gas emissions shall comply with the stipulations of the generating license granted. Compliance for the following pollutants shall be guaranteed and proved:

Emission	Unit	Maximum Threshold
Total PM	mg/Nm^3	50
Sulphur dioxide (SO_2)	mg/Nm^3	200
Nitrogen oxide (NOx)	mg/Nm^3	510

Table B0-5: Emission limits

Note:

- NO_x refers to oxides of nitrogen, referenced to NO_2.

Reference conditions for NOx, SO2, and particulates are 6 % O2, dry (i.e. zero moisture), 0 °C and 1013 mbar atmospheric pressure, that means, unit for emissions is mg/Nm^3

[2] To be determined by the Tenderer

The stack height shall follow the requirements of the Environment Conservation Rules, 1997 of Bangladesh.

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Water pollution
Permissible emission limits for aqueous discharges into the river via the Plant Water Discharge System shall comply with the Waste Water Effluent Standards, see Technical Schedule of **Section B0** and IFC EHSG - TPP - Table 5 - Effluent Guidelines. If there are differences in effluent limits in the two guidelines the more stringent limit should be applied. But limit of TDS with 2100 ppm shall not be followed.

The findings of the Environmental Impact Assessment (EIA) shall be used for Plant design.

Other waste water which is not allowed to be discharged to the requirements waste water treatment plant will have to be disposed externally.

Soil contamination
The Plant should be designed, operated and maintained in such a way to prevent any soil contamination by oil and chemical spillage during subsequent operation and maintenance of the Plant.

Permissible noise levels
The Plant shall be designed and constructed inter alia in accordance with IFC Environmental, Health and Safety Guideline Thermal Power Plants (EHSG-TPP) to reduce the operating noise level as much as possible. No individual within the boundary of the Site shall be exposed to a noise level exceeding the limits stated in the EHSG-TPP and "The Sound Pollution (Control) Rules, 2006".
Far field noise under normal operation of the Plant measured along the Site boundary of the Plant towards the Township shall not exceed 50 dB(A) during daytime and 40 dB(A) during night-time.

For any other point of the Site boundary of the Plant the noise pressure level shall not exceed 60 dB(A) during daytime and 50 dB(A) during night-time. Day time is defined from 6:00 am to 9:00 pm. Night time is defined from 9:00 pm to 6:00 am.

During the engineering phase the Contractor shall award an independent Third Party to conduct noise propagation calculation to prove that the permissible noise levels at the Plant boundary are met.

In addition the statutory requirements of Bangladesh shall be followed as far as stricter as the other standards, such as EHSG-TPP.

Furthermore the following maximum noise pressure levels shall be not exceeded:

dB(A)

- At 1 m horizontal distance from equipment/enclosures and 1.5 m above operating floor 85
- Within turbine building 90 (Note 1 & 2)
- Steam generator 90 (Note 1)
- Within central control rooms in power plants 55.

Notes:

1. At normal operation
2. Generally at maximum 88 dB(A), exceptions are the turbine stop valve and control valves 95 dB(A) and turbine drive boiler feed pumps 97 dB(A).
3. Noise level from non continuous operating valves (like pressure control valve, water separator drain control valve, etc.) shall be limited to 90 dB(A).
4. The noise level for safety valves including ERV shall be limited to 115dBA for the safety valves provided with silencer as per OSHA standard. Noise level around Mill will be 90 dBA.
5. Noise level at the boundary fence as specified must be complied with.

High noise areas (areas with noise levels >85 dB(A)), which require that personal noise protecting gear shall be used when working in such high noise areas, shall be marked.

Electromagnetic Field (EMF)
In accordance with the EHSG-TPP the occupational EMF exposure shall be prevented or minimized.

All technical measures and the required equipment necessary to fulfil the EHSG-TPP shall be provided by the Contractor. Inter alia areas with expected elevated EMF levels shall be indentified and marked.

Fire and explosion, electrical and chemical hazards
In accordance with the EHSG-TPP all technical measures to prevent, minimize and control physical, electrical and chemical hazards shall be include in the Contractror"s scope of services and supplies.

B0.2.14 Provenness Criteria for Critical Equipments and Sub-systems shall be as per Annexure-I of B0 (Refer Amendment no.05 to Bidding Documents).

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B0.3 Supplies and Services

B0.3.1 General

The scope of this specification covers all supplies and services required for meeting the purpose of the Plant, even if these are not expressively mentioned in the following.

The works include the following main components, where the detailed scope of supply is given in the corresponding Sections as listed below:

- **Section B1**: Steam generator plants
- **Section B2**: Steam turbine generator plants
- **Section B3**: Air and flue gas systems
- **Section B4**: Fuel and Ash handling system
- **Section B5**: Plant Water and Cooling Systems
- **Section B6**: Water treatment systems
- **Section B7**: Electrical works
- **Section B8**: Instrumentation and control works
- **Section B9**: Civil Works
- **Section B10**: Electrical Works 400/230 kV Substation
- **Section B11**: Jetty
- **Section B12**: Auxiliary plant systems

The corresponding Annexes and Attachments are contained in **Part C**.

The relevant costs of these supplies and services to be given in the price schedules are to be assigned corresponding to the individual items concerned for each of the sections. The costs of the common equipment and services have to be included in the corresponding Section prices.

B0.3.2 Scope of engineering services

The Engineering services refer to the complete specified Plant and covers following services:

- **Basic and detail engineering**

- **Permit engineering**
  The Contractor shall actively participate in drawing-up of all required licensing applications.

  All services shall be performed by the Contractor to affect the required permits to commence the works and operate the Plant, including but not limited to:

- preparation of all documents as required according to the pertinent laws
- clarifications with authorities
- participation in all clarification meetings
- construction permits
- boiler and pressure vessel approvals
- water/waste water permits
- operation permits
- fire fighting approvals
- and all other services as required.

Furthermore, all other required engineering and other services to meet the purpose of the Project and the agreed project time schedule shall be executed by the Contractor.

B0.3.3 Deputation of Engineers during the Warranty Period

At least seven (7) English speaking graduate engineers, (3 operation experts, 1 Turbine & auxiliary expert, 1 Boiler & auxiliary expert, 1 for I&C, 1 for Generator and Switchyeard area expert),with adequate knowledge and at least fifteen years of relevant experience of pulverised coal fired power plant of 500 MW and above unit size including two years of relevant experience in power plant of same type and technology being offered here from the Contractor, shall be permanently at site during the Warranty Period that means two months prior to PAC of first unit of the Plant upto end of warranty period of second unit. They shall be competent to advise and lead the Employer"s staff on all aspects of engineering, operation and maintenance.

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B0.3.4 Common equipment and services

The following supplies and services are to be included in the corresponding Section prices:

B0.3.4.1 General

- Material and personnel costs for tests and inspections which are mandated in legislation

  Employer/employer representative/TPA will be responsible for their respective expenses in connection with inspection, examination and testing.

- Material and personnel costs for site inspections
- Declaration of conformity with requirements from Bangladesh and markings for all machines
- Engineering design of complete supplied equipment including interface coordination
- All as-built documents (on data carriers; data formats as requested by the Employer)
- Quality control plan and safety plan
- Complete documentation as set out in the tender specification
- Operating manual (5 hardcopies and 3 electronic copies)
- Detailed operating and maintenance instructions/manual (5 hardcopies and 3 electronic copies)
- A maintenance program for all equipment of the Plant instructions (5 hardcopies and 3 electronic copies)

- For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams like P&IDs shall be supplied in ACAD or other editable format, and all lists in Excel format.
- All insurances, such as, but not limited to:
- transport insurance, incl. marine cargo insurance
- installation all risks,
- third party liability,
- automobile liability,
- M.V. Policy for: motor vehicles, private cars & commercial vehicles,
- CPM policy for heavy construction equipment,
- Workmen's Compensation,
- Employer's liability,
- Group personal insurance, for contractor's & subcontractor's employees.

B0.3.4.2 Mechanical

- All necessary pipelines, valves, actuators
- All required line warm-up systems
- All connection and adaptation works for tie-in into general supply systems
- All necessary vents, drains and rinsing connections as well as tundishes with covers, as far as possible aggregated to common groups of on operating level
- All connection elements, screws, bolts, nuts, including gaskets and seals as necessary
- All temporary installations required for tie-in measures including post-weld heat treatment complete etc.
- All temporary pipework as required during connection measures
- Check of required existing structures, plant components and systems and their rehabilitation where they lie within the scope of supply, or definition of required measures in good time if they lie outside of the scope of supply
- All necessary support structures, hangers etc.
- All necessary base frames, mounting plates, grouted in parts, rag bolts, covers etc.
- All required steel parts embedded in concrete
- All couplings and coupling guards for electric motors and other drives
- All necessary lifting equipment and hoists (hooks and provisions for chain blocks to be provided for repair work where loads exceed 50 kg, hoists to be provided for repair work where loads exceed 200 kg, and electrical operated hoist for loads exceeding 2,500 kg)
- Required safety equipment, pressure relief valves etc.
- All thermal and noise insulation including cladding as well as any other noise attenuation measures
- Stairways, ladders, platforms, galleries and walkways to all plant components, including escape routes as necessary

- All necessary steel structures, stairs, ladders on platforms weather protection
- All required ventilation or air conditioning equipment for safe operation of mechanical and electrical equipment, to be supplied
- All necessary corrosion protection measures for plant components and equipment stored or mounted on site up to the time of reliability test run
- Complete primer and top coatings conforming to colour code, clarified with the Employer
- Necessary noise abatements measures
- All required freeze protection and electric trace heating for outdoor installations
- Complete labelling of all plant components according to the Employers system and in plain language
- All fire protection measures
- All necessary lubrication systems
- Initial lubricant filling and sufficient lubricants for commissioning and reliability test run, minimization of lubricant types by screening and coordination with the Employer
- Water and demineralised water for pre-commissioning and commissioning activities,
- Provision of all connections and temporary pipework for acid cleaning, steam purging of the live steam line and flushing / cleaning of systems as necessary
- Flushing of all other lines including disposal of the effluents; protection with wood and/or plastic at all instrumentation and appendages to be installed during construction
- All standard accessories and auxiliary equipment which normally form part of the scope of supplies
- All necessary tests, inspections and works acceptances as well as all certificates and reports of these
- Exchange of filter elements following reliability test run
- Removal of temporary strainers
- Valve trims for purging and subsequent exchange
- Removal of any unused material
- Scaffolding for all work above ground level
- Necessary connection points for on line condition-based monitoring equipment.

B0.3.4.3 Substation control and monitoring system

At least but not limited to:

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- all field equipment such as bay control units, bay protection equipments (described under chapter "Substation Control and Monitoring System) to be installed at the substation. The field equipment for the substation shall be interconnected by separate IEC 61850 fiber optic station busses in ring configurations. (The use of an IEC 61850 optical fiber link is required for all connections of equipments which directly interact with the station bus (the switches). In the particular case where, for example, the IEDs are wired to the BCU and only the latter is connected to the station bus, electrical links (preferably IEC 61850) are allowed for wiring connection of the IEDs with the BCU but an IEC 61850 optical fiber link between BCU and switches is required.
- all equipment to control and monitor the auxiliary equipment of the substation connected to the SCMS by redundant fiber optic links
- common bay unit / station computers
- operator and engineering workstations with TFT monitors and printers to be installed at the substation control room
- all equipment necessary for the implementation of an OPC server/client architecture between the substation and the Power Plant control rooms in order to allow the supervision and monitoring of the substation from the Power Plant DCS facilities. The OPC-server configuration shall be redundant
- Maintenance / service laptop which shall also be used for protection and disturbance analysis by respective log-in.
- data communication gateway to the National Load Dispatch Center (NLDC),
- energy meters for active energy (kWh) with accuracy of 0.2 S and for reactive energy (kVarh) with an accuracy of 0.5 S for tariff metering shall be provided for each outgoing line.

B0.3.4.4 Electrical

- All necessary electrical drives
- Complete installation material, that is wiring, cabling and piping material, all needed fastenings, conduits, brackets and other supports
- All required junction boxes and cubicles
- All field control boxes
- All cubicles, junction boxes, marshalling racks, terminal boxes, etc.
- Complete labelling of electrical equipment (also inside of cabinets)
- Lightning protection
- Electrical earthing of the equipment
- Cable and cable trays
- All necessary cables and wires for power, AC and DC instrument transformers, control, measuring, signals, etc.

- All necessary number plates for identifying the cables (numbering code to be determined)
- All necessary fixing materials
- All necessary fire protection materials for making good the cable openings through walls and ceilings as well as between switchgear and control, measuring, recording and switchgear cubicles, operating panels and desks, etc.,
- All necessary plastic protecting tubes for the cable runs
- All necessary materials for laying the cables in the ground
- All necessary cable connections including compression cable lugs, fixing and clamping materials, etc.
- All necessary cable sealing ends and cable connecting sleeves including fixing materials
- All necessary compression connectors.

B0.3.4.5 Instrumentation and Control

- All necessary control systems and auxiliaries
- All measurements and field control loops (thermometers, pressure gauges, transmitters, sensors, analyzers, local regulating devices, etc.) as well as all instruments for reliability test and checks for the duration of the performance tests
- Other special instruments/ systems like acoustic steam leak detection system (ASLD), acoustic pyrometer, communication systems, ambient air quality monitoring system (AAQMS), effluent quality monitoring system (EQMS)
- Complete installation material, that is wiring, cabling and piping material, all needed fastenings, conduits, brackets and other supports
- All required junction boxes and cubicles
- All field control boxes
- All instruments mounted on instrumentation racks
- All cubicles, junction boxes, marshalling racks, terminal boxes, etc.
- Signal exchange between local control system and DCS as well with instruments/control systems of other lots
- Complete labelling of I&C-equipment (also inside of control cabinets)
- Lightning protection
- Electrical earthing of the equipment
- Clarification of all logic interconnections: sequence, interlocking, protection, safeguarding for coordinated operation/start-up/shut down of individual items of equipment
- Cable and cable trays
- All necessary cables and wires for power, AC and DC instrument transformers, control, measuring, signals, etc.
- All necessary number plates for identifying the cables (numbering code to be determined)
- All necessary fixing materials

- All necessary fire protection materials for making good the cable openings through walls and ceilings as well as between switchgear and control, measuring, recording and switchgear cubicles, operating panels and desks, etc.
- All necessary plastic protecting tubes for the cable runs
- All necessary materials for laying the cables in the ground
- All necessary cable connections including compression cable lugs, fixing and clamping materials, etc.
- All necessary cable sealing ends and cable connecting sleeves including fixing materials.

B0.3.4.6 Civil

- All necessary surveying works including all soil investigations required for safe and reliable design and construction
- Preparation of site, demolition works, removal of underground obstacles
- Earthworks, drainage, excavation and refilling works
- Piling of structures to prevent subsidence
- Concrete and reinforced concrete works, masonry and earthing
- Concreting of maintenance platforms and lay-down areas
- Water proofing works for pressing and non-pressing water
- Fire protection during construction
- Roofing; non asbestos
- Plumbing
- Facade works/glazing works; non asbestos
- Non-load bearing walls/installation partitions/dry construction works
- Metalwork and blacksmith work/raised flooring/doors and gates/sheet metal work
- Flooring work
- Fire protection with plumbing; fire protector
- Painting/varnishing
- Craneway works
- Room air conditioning systems, where required, e.g. control cubicle rooms, etc.
- Potable water, service water and waste water
- Housekeeping during construction
- Staff facilities during construction
- Transport of all dumping material to dump locations
- Performance and interpretation of soil bearing tests
- Temporary fencing of construction site
- Site offices for Employer and Employer‟s representatives
- The Contractor‟s site office
- Landscaping of areas required under this contract.

B0.3.5 Packaging and transportation

- Suitable packaging and transportation of the entire scope of supplies,
- free construction site, on-site transportation and temporary storage including inspections and, if necessary, ensuring the prerequisites for transportation
- Disposal of packing and transportation material
- Customs clearance
- Crane or hoisting facilities at seaport and site
- Transportation to site
- Unloading at site.

B0.3.6 Erection, commissioning and testing

- Complete erection of the scope of supply up to operational readiness: This includes mobilization and provision of the required supervisory staff, skilled and unskilled personnel, as well as of installation scaffolding, cranes, hoists, equipment and materials, personnel accommodation, prescribed tests and inspections.
- Commissioning and optimization of all plant components as well as conducting all necessary measurements.
- Supervision of erection, commissioning and Reliability Test Run of complete supplied equipment.
- All testing as specified.

B0.3.7 Training

The Contractor shall provide comprehensive training for Employer‟s engineering, operating and maintenance staff (Employer‟s staff) covering all aspects of the Power Plant equipment and systems and operation and maintenance.

The Contractor shall train, instruct and supervise the Employer‟s staff to an adequate standard of knowledge and capability for good trouble shooting, repair and of the plant equipment as well as to an adequate standard for safe and efficient commercial operation of the Plant.

The training shall at least include:

- training at manufacturer‟s works during the assembly of the major plant items
- classroom and hands on training
- on the job training during erection, commissioning and reliability test run; and
- simulator training.

The Contractor shall submit the training plan for the classroom, on the job and simulator training including schedule, place, content of lectures etc. for

the Employer"s approval no less than six (6) months in advance to the cold commissioning.

Post training assessment shall be carried out and documented In case the results of the training are below the expectations, which have been agreed upon by both Contractor and Employer before training, the respective training modules shall be repeated in an improved way and the related cost for the repeated training shall be borne by the Contractor. In case the results are below expectations (to be agreed upon by both Contractor and Employer before training) the respective training modules shall be repeated in an improved way.

B0.3.8 Spare parts, tools, appliances, and consumables

B0.3.8.1 Spare parts

Reference is made to Amendment No 3 and Annexure I to Amendment No.3 (both already published on BIFPCL"s Website).

B0.3.8.2 Tools and appliances

The following tools and appliances shall be supplied under this Contract for use by the Employer:

a. two (2) sets of all special tools and gauges required for the operation and maintenance of the Plant
b. one (1) set of special lifting and handling appliances required for the operation and maintenance of the Plant
c. suitable storage bins/racks/shelves for the above.
d. Standard tools according to the relevant Technical Schedules.

For I&C e.g. following special tools and gauges shall be provided (including but not limited): pressure calibrator, portable pressure source, calibration pressure pump, deadweight testers, precision pressure gauges, manometers, temperature baths/calibrator, multimeters, RTD simulator/tester, thermocouple calibrator precision source and simulation equipment, direct temperature indicating meter, standard pH-tester, multi function process calibrator, loop calibrator, voltage/current/temperature reference generator, intrinsic safe multifunction calibrator, depth gauge, feeler gauge, dial indicators, portable handheld tacho meters, double channel digital storage oszilloscope, conductivity meter, electronic stethoscope, general purpose vibration meters, hand-held IR thermometers, humidity & moisture meters, hazardous and toxic leak detectors, field meters (leak and emission detectors), laser distance meters, US distance estimators, US handheld flow meters, US handheld level meters, portable sound level meter, anemometer, barometer, stop watch, standard technician tools etc.

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Deleted: An "Initial Spare Part List" shall be provided with the Bid. The "Initial Spare Part Lis shall contain all those parts which are required to operate maintain and repair the Plant efficiently a which are necessary to achieve the guaranteed availability during the warranty period (that mean 24 months from the date of PAC/COD). The "Init Spare Part List" shall comprise therefore:¶

<#>the "Mandatory Spare Parts", which are required for the normal operation and scheduled maintenance / repairs of the Plant - that means, mainly the "wear and tear parts";¶

<#>the "Recommended / Strategic Spare Parts" which are in Tenderer"s opinion and from Tender

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One set of tool shall be handed over in new condition and one set shall be used by the Contractor for erection/commissioning.

Each tool or appliance is to be clearly marked with its size and/or purpose.

The tools and appliances supplied may have been used for erection and commissioning purposes by the Contractor, but shall be handed over in good working order.

Each set of tools and appliances under category (a) and (d) shall be suitably arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the layout of the Plant and equipment in question. If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be supported on steerable rubber-tyred wheels.

Each cabinet and box shall be painted, fitted with a lock and clearly marked in white letters with the name of the item of equipment for which the tools and appliances contained are intended.

Suitable storage racks shall be provided for all portable lifting tackle in this contract.
Suitable lifting lugs, ears or ring bolts, or tapped holes for lifting rings shall be provided on all equipment items where the weight exceeds 15 kg.

All lifting tackle shall be stamped with a unique identification number and safe working load. A test certificate from an approved authority shall be supplied for each item of lifting tackle.

The Contractor shall provide a schedule of all lifting tackle and tools and appliances being supplied, for the approval of the Employer/Engineer.

The Contractor shall provide all runway beams, trolleys, lifting blocks, special slings etc. necessary for the safe and efficient handling and maintenance of the works. Particular attention shall be paid to high level equipment such as deaerators. Electrically operated hoists and runway trolleys shall be provided for all lifts in excess of 2.5 tons.

The tools and appliances with the appropriate storage racks, cabinets and boxes shall be handed over to the Employer at the time of taking over of the unit.

Where the Contract includes site erection, any special tools or appliances required solely for erection shall be provided by the Contractor for his own use and shall remain the property of the Contractor.

One set of tools shall be handed over in new condition and one set shall be used by the Bidder/Contractor for erection/commissioning.

For handling of the generator stator the following alternative is also acceptable: Tandem/combined operation of two turbine hall EOT cranes for which the necessary arrangements shall be provided. In such case the combined capacity of two EOT cranes shall not be less than the 105% of weight of generator stator, including the weight of lifting beam with swiveling equipment and slings. Main Turbine hall building civil and structural design shall be done accordingly.

Special lifting and handling appliances may be used by the Contractor for erection and commissioning, but shall be refurbished by the Contractor and shall be handed over to the Employer as per in new condition.

B0.3.8.3 Consumables

The Contractor shall supply all chemicals, reagents, resins, lubricants, grease, filters and consumable items for operation up to COD including top up requirement at the time of issuance of PAC/ declearation of COD. All lubricants proposed for the Plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.

All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and a number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, the Contractor shall list at least three equivalent lubricants manufactured by alternative companies.

The Contractor shall submit to the Employer the list and schedule of lubricants, greases, chemicals and consumables items including items qualities and quantities required per month of the Plant operation for the Employer"s approval eighteen (18) months prior scheduled COD of the 1st Unit.

B0.3.9 Documentation

B0.3.9.1 Documentation with tender

General

- If a consortial bid is submitted, documents on the consortial agreement
- Description of options and alternatives offered
- Completely filled in price-, guarantee-, time-, and data schedules of the specification
- List of proposed makes and vendors
- Reference lists for delivery and installation of plants of similar type and size with separate references for the steam generator and steam turbine operating at same or similar parameters
- Requirements of grid code which cannot be met (if any)

- Description of means to accomplish primary frequency control according to grid code
- Description of means to accomplish secondary frequency control according to grid code
- Time schedule engineering for deliveries, erection/installation, commissioning and reliability test run
- Complete description of the Plant offered including description of the process and the equipment
- Layout drawings of the Plant
- Dimensioned drawings and sectional views of the principal plant components including materials
- Schematics of the principal plant systems
- General descriptions of individual systems and descriptions of operation including description of start-up, shutdown and emergency shutdown procedures
- All other documents necessary for comprehension of the offered plants and equipment
- Documents on the quality assurance system, including Quality Assurance Plan (The Quality Assurance Plan shall meet the requirements of ISO 9001:2000 and cover all activities under this FTS.)
- Training program and schedule for Employer‟s personnel
- Space requirement for lay down area, construction site and equipment
- List of personnel including qualification to operate the Plant and to perform day-to-day maintenance
- Initial Spare Part List as described under B03.7
- Equipment maintenance schedules for reliable centered maintenance.

Mechanical
- Process flow diagram of all systems
- Performance diagrams of main pumps and fans
- Plant and major equipment start-up curves for cold (all material on ambient temperature), warm and hot start up to MCR
- Water and waste water mass balances.

Steam Generator
Description for the equipment offered, giving information about:

- general outline of installation
- main control loops
- description of boiler protection system
- graphs showing the performance characteristic versus the load (flue gas temperatures, steam temperatures etc., including h-p-diagram)
- correction curves for ambient conditions and fuel variations
- material diagram showing material, dimensions, highest flue gas temperature and highest steam temperature, design material temperature and maximum admissible material temperature and design pressure for components of the steam/water system

- pulverizer performance diagram showing turn-down range of pulverizers and pulverizer outlet temperatures for different coal qualities.

Steam turbine generator
Description for the equipment offered giving information about:

- general outline of installation,
- main control loops,
- conclusive correction curves for steam turbine and cooling system with variations in:
  - power output with ambient temperature, humidity and river water temperature
  - specific heat rate with ambient temperature, humidity and river water temperature
  - generator efficiency vs. power output for varying power factor
  - degradation curves for the power unit and the Plant
  - diagram showing the output of the turbine, of the generator and of the generator transformer versus the ambient air temperature (from +10 °C to +40 °C), humidity (between 20% and 100%) and river water temperature (from +20 °C to +35 °C).

Deleted: <#>description of boiler protection system

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Electrical system
- Electrical single-line diagram for the Power Plant including LV, emergency, safes AC and DC power supply
- Electrical single line diagram for the 400/230 kV GIS
- Unit protection and measuring single line diagram
- Performance diagrams (circle diagrams) of generator, saturation curves, unbalanced load diagrams
- Diagram with the output of the turbine, the generator and the generator step-up transformer versus ambient temperature
- Preliminary lists of motors and electrical consumers including power demand
- Auxiliary power requirement of the plant unit
- Arrangement of generator bus duct up to generator transformer, H.V and L.V. Cubicles, unit auxiliary transformer
- General arrangement of main electrical equipment within the relevant buildings, rooms, etc., including cross-sections
- Arrangement of connection from generator transformers to 400 kV GIS
- Arrangement of connection from start-up/stand-by transformers to 230 kV GIS General arrangement of the 400/230 kV GIS substation including the related control building and connection 400/230 kV interconnection transformers to 400 kV and 230 kV GIS
- Architecture drawing of the 400/230 kV substation control and monitoring system
- Description of the individual protection relays with related reference lists
- Description of the main electrical equipment (e.g. generator, excitation, AVR, generator protection, generator step-up and unit auxiliary transformer, start-up/stand-by transformer, 400/230 kV interconnection

transformer, 400 kV reactors, 400/230 kV GIS, Substation Control and monitoring System, 400/230 kV protection systems, 11 kV switchgear, etc.)- with related reference lists.

Instrumentation & control system

- Control system architecture showing all components provided for this Plant in their actual structural arrangement
- Layout drawing central control room
- Description of hardware, software and design philosophy of the DCS
- Reference list for the DCS with indication of plant type, system architecture and size of the system
- Data sheets, descriptions and brochures of the offered BMS and BPS
- Data sheets, descriptions and brochures of the offered local control systems, in particular PLCs
- Data sheets, descriptions and brochures of the CEMS including (if applicable) common emission data evaluation devices
- Data sheets, description and brochures of the communication systems as specified in the relevant Sections of **Section B8**
- CCTV system philosophy description and configuration drawing
- Data sheets, description and brochures of the training simulator as specified in the relevant Section of **Section B8**
- Temporary list of all drives, such as unidirectional motors, MOV"s, SOV"s and remotely operated control valves
- List of modulating controls
- List of package systems (black boxes)
- Description of field equipment
- Description of structure of the control functions including list of unit co-ordination level, functional group level, sub-group level
- Description of the interface to the boiler protection system and the steam turbine generator protection system
- Procedure for calculation of the availability of the DCS.

Civil

- Architectural outline drawings for all buildings and building structures showing the arrangement of the complete Plant, inclusive of all levels and Sections
- Site plan of the complete Plant showing all buildings, building elements, roads, landscaping etc.
- Schematic design of main buildings
- Typical concrete block pad and chimney foundation
- Typical pole foundation for HV towers
- Details, with calculations, for the main foundation system proposed
- Basic design of Site infrastructure
- Basic design of the chimney
- Basic detail of the coal storage yard
- Basic detail of the ash pond.

B0.3.9.2 Documentation after Award of Contract

The documents required for design, construction, installation, operation and maintenance of the entire Plant shall be submitted by the Contractor in good time so as to permit the Plant as a whole to be erected in compliance with the specified time table.

All documents, including the installation and operation and maintenance manuals as well as the related software shall be in fluent, legible English. In addition, operation and maintenance manuals shall be translated into Bangla and provided as paper copies and in electronic format.

The Contractor shall list all the drawings and submission schedule for the Employer‟s approval. Only the most important documents are listed below. These documents shall be submitted sufficiently in advance, so that corrections and amendments desired by the Employer as well as resubmission of the documents will not result in any delays with respect to the guaranteed time schedule. The Employer reserves the right to request from the Contractor additional drawings, documents, etc. as may be required for proper understanding and definition of the design and engineering of the Plant.

The overall responsibility with regard to completeness, correctness and suitability for the permit application process remains with the Contractor. In no case any comment, correction, amendment and approval (if any) by the Employer shall relief the Contractor from this responsibility.

The drawings and documents to be submitted during this stage are listed in the various Sections and comprise the following. They shall be submitted within the specified time scale calculated in weeks after Award of Contract. Details shall be agreed according to the approval procedure for drawings and documents above.

The Contractor may propose modifications to the list as given below, in order to ensure timely completion of permit application documents and performance of the works according to the project‟s requirements and in accordance with the specified project time schedule. Any modification to this list shall be submitted for Employer‟s review and approval.

The Employer reserves the right to require detailed information on the progress of drawing and document preparation from the Contractor at any time during this stage.

		Weeks after Contract Award	
Document	**Purpose**	**Preliminary**	**Final**
• **General**			
• Current list of drawings	I	4	every 1 month
• Complete list of documents	I	4	every 1 month

Document	Purpose	Weeks after Contract Award	
		Preliminary	Final
with proposed submission deadlines			
• Progress reports	I	-	every 1 month
• Erection and installation progress reports	I	-	every 1 month after start of site activities
• Quality assurance procedure and program	A	with Bid	24
• structure of Contractors QA&QC manpower at site	A	with Bid	24
• indicative field quality plan for civil works	A	with Bid	24
• Plant layout		with Bid	16
• List of subcontractors/ manufacturers	A	with Bid	12
• Proposed inspection and testing programs	A	12	24
• Noise propagation calculations	A	-	24
• Detailed program for commissioning	A	24	6 months ahead start pre-commissioning
• Studies / surveys regarding water intake and water discharge	A	12	24
• Detailed program of Reliability Test Run	A	24	6 months ahead start Reliability Test Run
• Detailed program of Performance Tests	A	24	6 months ahead start Reliability Test Run
• Testing documents/Report of results of all tests	A	2 weeks after test	6 months ahead start Reliability Test Run
• Training program	A	-	6 months ahead of pre-commissioning
• As-built-documentation including drawings of all equipment	A	-	1 month after COD of the 1st Unit
• Declaration of conformance with all local regulations	I	-	latest with start of pre-commissioning
• Spare part lists	A	with Bid	18 months ahead of COD of 1st Unit
• **Time scheduling**			
• Overall time schedule for design, manufacture, supply, assembly, erection and commissioning broken down for the principal plant components and all	A	with Bid	every 1 month

		Weeks after Contract Award	
Document	**Purpose**	**Preliminary**	**Final**
construction works, stating dates for completion of any preparatory work from others which may be necessary			
• Detailed erection, installation and commissioning schedule	A	12	2 months ahead of erection / pre-commissioning
• **Mechanical Engineering**			
• Arrangement drawings of principal components with ducts and platform layout	A	with Bid	12
• Arrangement drawings of auxiliary equipment (cubicles, etc.)	A	12	24
• Process flow diagrams	A	with Bid	12
• Piping and Instrumentation schematics and isometric drawings, including list of pipelines and valves, stating materials, nominal diameters and pressure, dimensions, insulation thickness of all pipes •	A	8	24
• Plans of main pipelines including location of cable routes	A	8	24
• Characteristics of pumps, fans etc.	I	16	24
• Details of required auxiliary energy sources and consumables (e.g. electricity, steam, chemicals, instrumentation air, working air) with condition data, required qualities and consumption values	I	16	24
• Water and waste water balances	A	with Bid	36
• Thermodynamic diagrams / heat balance diagrams	I	with Bid	24
• Start-up and shutdown diagrams with descriptions (cold, warm, hot)	A	with Bid	2 months before pre-commissioning
• Sectional and detail drawings of all components including materials	I	16	36
• Lifting plan for all lifting operations (repair, maintenance, etc.)	I	24	36
• Limits of coal and high speed diesel properties	I	-	with Bid

		Weeks after Contract Award	
Document	**Purpose**	**Preliminary**	**Final**
• Design calculations of pumps, isolations, piping, etc.	I	12	36
• Water hammer calculation of plant water and cooling water system	I	8	12
• Hydraulic model test procedure of plant water and cooling water systems; institute to perform the tests	A	4	8
• Hydraulic model tests reports of plant water and cooling water systems	A	-	12
• Cooling Tower Recirculation Study	I	-	12
• Sedimentation Study	A	-	12
• Pulverizer performance diagram with pulverizer turn-down range	A	with Bid	12
• Material diagrams for pressure part	A	with Bid	24
• Reference lists with information on successful operating years for: - steam turbines - steam generators - pulverizers - firing systems / burners •	A		with Bid
• System description of firing system	A	with Bid	24
• Final correction curves for Plant and equipment performance tests acc. to ASME PTC46 etc.	A	-	with Bid
• **Electrical Engineering**			
• Electrical single line diagrams	A	with Bid	12
• List of motors and consumers	I	8	every 1 month; final after erection completion
• Electrical equipment sizing calculations (generator main connection, transformers, emergency diesel generators, safe AC and DC power supply, power cables, etc.)	A	12	24
• Cable list	I	16	every 1 month, final after erection completion
• Standard circuit diagrams for all different kinds of electrical	A	12	24

		Weeks after Contract Award	
Document	**Purpose**	**Preliminary**	**Final**
consumers			
• Performance diagram (circle diagrams) of generator	I	with Bid	12
• Circuit diagrams for all individual electrical equipment	I	12	24
• Lists of equipment and devices	I	12	24
• Earthing and lightning plans with calculations	A	12	24
• Lightning protection plans with details of measuring locations and reports of measurements taken following commissioning	I	12	24
• EMC concept with coordinated overvoltage protection	I	12	16
• Arrangement drawings for switchgear and battery rooms, station service transformers, cable floors etc.	A	12	24
• Diagram showing power output of plant generator and related transformer vs. ambient temperature from +20 °C to +40 °C	A	with Bid	12
• Block diagram generator/unit protection	A	12	24
• Block diagram AVQC for the generator	A	12	24
• Line plans of fire alarm system if applicable	A	12	24
• Arrangement drawings showing exact location of fire alarm devices if applicable	I	12	24
• Power and lighting installation plans including related calculation	I	16	24
• General arrangement drawings of the required cable trays, cable laying plans	I	12	24
• Dimensional drawings and erection drawings for generator, transformers, switchgear etc., including frontal and plan views	I	12	24
• Dimensional drawings of generator auxiliary equipment	I	12	16
• Dimensional drawings of switching cubicles, generator leads and star point cubicles, voltage regulation cubicles, excitation cubicles, generator circuit breakers, including	I	12	24

		Weeks after Contract Award	
Document	**Purpose**	**Preliminary**	**Final**
equipment configuration. •			
• Calculation of mechanical stresses of switchgear rooms due to arcing faults	I	12	16
• Short circuit calculation and determination of protection relay settings for generator protection, 400/230 substation and auxiliary electrical supplies under consideration of protection of the entire system •	A	12	24
• Protection and metering diagram for unit protection, start-up/stand by transformer protection, 400/230 kV GIS protection	A	16	24
• Load flow, system transient stability and motor start-up study	A	16	24
• Information for electrical system study by PGCB (see relevant part in **Section B0**)	I	8	16
• Generator charts and exciter characteristics	I	12	16
• **Instrumentation and Control Engineering**			
• Control system architecture showing all components, incl. design concept redundancy	A	with Bid	24
• Operation and control philosophy	A	8	16
• Design concept earthing	A	16	24
• Design concept explosion protection	A	16	24
• List of packaged systems (Black Boxes)	A	with Bid	24
• Layout drawings central control room showing spatial distribution of desks and panels (3 D view)	A	with Bid (2D only)	24
• Layout of electronic rooms showing spatial distribution of cubicles and racks	A	16	24
• Description for all functional group controls, functional schematics (both in machine language and according to ISA-standard)	A	16	24
• DCS/PLC interface	A	16	24

		Weeks after Contract Award	
Document	**Purpose**	**Preliminary**	**Final**
documentation, I/O point assignment			
• Engineering drawings of control valves, control dampers together with their actuators, orifices, nozzles, venturi nozzles	I	16	24
• External connection diagrams, terminal connection diagrams, combined schematic and circuit diagrams	I	16	24
• Communication systems	A	16	24
• As built software programs for DCS, PLC or other systems	I	-	1 month after COD of the 1st Unit
• Instrument list	A	16	24
• Cable routing plan	I	16	24
• **Civil Engineering**			
• 3D model of the complete Plant incl. all civil structures, all mechanical equipment, piping (> 50mm), electrical equipment e.g. cable trays, HVAC, etc.	I	16	24
• 3D model clash checking and walk through	A	3 weeks after 3D model distribution	3 weeks after 3D model distribution
• General layout plan of the Plant site, including all buildings and outdoor installations, roads etc., prepared on the basis of the topographical survey of the site	A	with Bid	12
• Detailed civil arrangement drawings of all buildings and structures, including plan-views and Sections (scale 1 : 100)	A	with Bid	12
• Architectural views (all sides) for all buildings of the Plant	A	4	12
• Arrangement drawings for external systems, including all supply and disposal facilities, roads with manoeuvring areas; outdoor facilities (sewage, drainage, ducts and trenches, fencing and gates; tank farm, outdoor foundations etc.	A	4	24
• **Detailed drawings and documents**			
• Detailed foundation drawings	I	4	12

		Weeks after Contract Award	
Document	**Purpose**	**Preliminary**	**Final**
for all buildings and structures (A. E., turbine, boiler and stack foundations etc.)			
• Detailed structural drawings for all buildings and structures (concrete and steel structures)	I	8	24
• Detailed architectural drawings	I	8	24
• Room books, including external and internal finishes, windows, doors, sanitaries, wall cladding, roof etc.	A	8	24
• Detailed drawings for all internal services and installation works (HVAC; water, sewage, drainage, lighting	I	8	24
• Detailed drawings with embedded parts; anchors, plates, fixings etc.	I	8	24
• Detailed drawings for outdoor installations and services (sewage, drainage; water, ducts, trenches, culverts, pipes, cable routes, manholes, pits etc.	A	8	24
• Detailed drawings for roads, including accesses, footpaths, fencing/gates, landscaping, bridges, pipe racks •	A	8	24
• Checked and approved statical and dynamical analysis prepared/for all buildings and structures of the Plant	I	8	24
• Detailed constructive description of individual buildings with regard to the structural design (structural systems, foundations etc.) •	I	8	24
• Sectional elevations and roof plan	I	4	24
• Underground services and ducts with equipment appertaining to the services	I	8	24
• Principal details and Sections for traffic areas, especially for ramps and retaining walls	I	8	24
• Structural drawings pertaining to river water outfall and intake facilities	A	8	24
• Foundation drawings and other underground concrete works	I	4	24

		Weeks after Contract Award	
Document	**Purpose**	**Preliminary**	**Final**
• **Permit application documents**			
• Documentation for operating permits	A	4	12
• Documentation for other permits	A	4	12
• **Other documentation**			
• Schedules of workshop tests	I	-	1 month ahead of test
• Quality assurance manuals	I	16	24
• Manual of Codes and Standards	I	16	24
• **Operating manual** • operating procedures and instructions of the Plant with description of all systems, processes and functional groups • as built documentation • general and individual control concept description • Plant and equipment protection and signal processing description with all alarm and trip signal settings • all operating conditions including electrical grid supply and connection conditions	A	6 months ahead of pre-commissioning	1 month after COD of the 1st Unit
• **Service and maintenance manual** • maintenance procedures and instructions with description of all equipment and facilities • Equipment data sheets	A	6 months ahead of pre-commissioning	1 month after COD of the 1st Unit
Purpose: A : for Approval I : for Information			

B0.3.9.3 Data and simulation models

The Tenderer shall submit the data of the Plant for transmission simulation to PGCB according to the Bangladesh Grid Code however minimum following data:

Components	Data	Value of data
Generator step-up transformer	Rating	MVA
	High voltage	kV
	High voltage connection	
	Low voltage	kV
	Low voltage connection	

Components	Data	Value of data
	Positive seq. Impedance Positive seq. Resistance Positive seq. Reactance	% % %
	Zero seq. Impedance Zero seq. Resistance Zero seq. Reactance	% % %
	MVA for base impedance	MVA
	Maximum tap	kV
	Maximum tap position	
	Minimum tap	kV
	Minimum tap position	
	Nominal tap position	
	Value of tap step	
	Core loss	kW
	Copper loss at full load	kW
	Auxiliary power	kW
Generator	Type	
	Manufacturer	
	Rated output	MVA
	Rated voltage	kV
	Connection	
	Inertia constant	
	Xd	%
	X'd	%
	X'd	%
	X2 (Negative sequence)	%
	X0 (Zero sequence)	%
	MVA for base impedance	
Turbine	Type	
	Rating	MW
	Inertia constant	
	HP natural frequency and vibration band	Hz
	IP natural frequency and vibration band	Hz
	LP natural frequency and vibration band	Hz
Exciter	Type	
	Range ± % of rated voltage	%
Governor	Type	
	Model No.	
	Droop	%
	Deadband	Hz
Unit auxiliary power consumption	Real power auxiliary load	MW
	Reactive power auxiliary load	MVAR

The Tenderer shall also submit models for simulation studies which are compatible with the software used by PGCB. PGCB is using PSS®E software).

The simulation studies include, but are not limited to:

a. power flow
b. short circuit
c. transient stability.

All characteristics and models shall operate in stable and accurate manner under all frequency range stipulated in this Part B0, including consideration on the following:

a. large frequency variations upwards (increasing) up to 52Hz,
b. large frequency variations downwards (decreasing) up to 47.0Hz,
c. grid system faults,
d. splitting of the grid system into islands.

All simulation models submitted for stability studies must be in the form of fully validated models for the software used by PGCB simulation. The models shall be provided complete with the following documentations:

a. imodel software source codes (flecs) as well as object (binary) codes,
b. description of the models including the engineering of model derivations,
c. user operation manuals
d. user application guides
e. model block diagrams
f. values of parameters
g. input data format
h. criteria for acceptable operation (threshold parameter values such as minimum steam pressure, maximum hydrogen pressure, etc).

The models shall represent closely the on-site response and setting.

Generator and excitation systems
The fully validated control block diagram representation of the software used by PGCB simulation model (including all limiters and power system stabilisers), shall be submitted to PGCB together with:

1. Explanation of all the symbols used
2. Clearly labelled sub-systems of control and protection, such as, Volt/Hz limiter, maximum field current limiter, stator current limiter, minimum field current limiter etc.
3. Input-output relationships, by giving:
   a) Equations
   b) Characteristics/Chart/look-up table
   c) Other input/output relationship (if any).
4. Indication whether the parameters in the block diagram can be measured on the actual system.

Governor

The fully validated control block diagram representation of the software used by PGCB simulation model for the governor systems shall be submitted to PGCB together with:

1. Explanation of all the symbols used
2. Clearly labelled sub-systems of control and protection, such as, additional corrective control against frequency deviations (if any) and other controls (if any).
3. The following variables, states, and limits:
   a) mechanical output
   b) generator output
   c) turbine speed
   d) mechanical output of steam turbine (ST)
   e) MW output of ST
   f) shaft speed of ST
   g) turbine steam pressure of ST
   h) turbine steam pressure deviation of ST
   i) turbine steam temperature of ST
   j) main control valve position of ST
   k) intercept valve position of ST
   l) load limiter signal.
4. Tenderer shall inform values of limits and acceptability (or violation) criteria on the following:
   a) reverse power (cause reverse power trip when violated)
   b) Power Load Unbalance (PLU) (or similar) relay trip (if any which cause trip when set criteria is violated)
   c) operational limits and criteria
   d) others (if any which cause trip when violated).
5. Tenderer shall inform input-output relationships, by giving:
   a) Equations
   b) characteristics/chart/look-up tables
   c) other input/output relationship (if any).
6. Tenderer to inform whether the parameters in the block diagram which exist and can be measured on the actual system.

The above models and documentation shall be submitted in CD-ROM media (read only). One hardcopy of the same is also required to be submitted.

Due dates and versions for data submission and simulation models are as follows:

Due dates	Type of data to be submitted
90 days after signing of this Agreement	Committed Project Data Contracted Project Data
90 days prior to the Initial Operation Date of the First Unit	Estimated Registered Data

Due dates	Type of data to be submitted
30 days after the Commercial Operation Date of the First Unit	Registered Data

B0.3.9.4 Requirements for documentation

Unless agreed otherwise, five (5) hard copies and three (3) sets of electronic copies of all documents are to be submitted in the English language. In addition, operation and maintenance manuals shall be translated into Bangla and provided as paper copies and in electronic format. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files.

The Contractor shall provide, install, operate and maintain a web based electronic data room / data server. The format and filing system shall be mutually agreed between Employer and Contractor.

All documentation shall comply with uniform documentation instructions according to Employer‟s requirements. Detailed requirements for documentation will be determined during contract execution by the Employer.

Contractor shall comply with Employer‟s directive concerning documentation requirements for implementation in an automated plant operation system**.**

The final documentation including but not limited to operating manuals, maintenance and service manuals, component documentation, assembly documentation, drawings and listing, etc. shall be submitted in the English language. In addition, operation and maintenance manuals shall be translated into Bangla and provided as paper copies and in electronic format.

Contractor shall also integrate and submit all the above data for each Unit into the PSS®E load flow raw data file ("raw data") and PSS®E dynamic raw data file ("dyr data") which are ready to be used for studies on operation and planning of the Grid System by PGCB using PSS®E (to be confirm by PGCB/BIFPCL)
Data for each Unit shall also include reactive power capability curve of the Facility, written in the format compatible to PSS®E activity GCAP. For this purpose, at least 10 (ten) pairs of data on the generator reactive power capability curve shall be provided for each Unit.

The final requirements for Transmission lines and Interconnecting Facilities documentation will be subjected to PGCB's approval which will be made known during execution stage.

B0.3.9.5 Approval procedure for drawings and documents

The Employer reserves the right to ask the Contractor to submit drawings and other documents for approval to the Employer or to its representative.

Before submittal of any such drawing or other document, the Contractor shall submit a detailed list comprising all drawings or other documents the Contractor will produce. Based on this list the Employer will decide which drawings or other documents will have to be submitted for approval, information or other purpose.

The documents for approval are primarily basic documents and all documents that are required to check that Contractual and operational requirements are met. It is expected that in total approximately 600 to 800 documents will be for approval.

When submitting drawings or other documents for approval, including any prepared by subcontractors, the Contractor shall certify in each case that he has examined such drawings or documents and that they comply with the requirements of the Contract.

The Contractor is requested to provide Third Party Verification of structural documents, e.g. structural analysis, drawings and connecting details prior to submission for approval. These documents must contain all information necessary for the execution of the works.

Approval of a drawing or other document will imply that:

- They have been examined and appear to be in accordance with the basic design concept of the project and meet the requirements of the specification.
- They have been examined in relation to compatibility of the items and equipment with the specification and respect of interconnections with other items, equipment or systems.
- The Contractor is not relieved of his responsibility under the Contract.

The Contractor is to arrange for the revision history of drawings and other documents as follows. The first revision shall be indexed by the letter “A” followed up by the respective letter in alphabetical order.
Once the drawing or document is approved for construction by the Employer or its representative the document shall be indexed with the number “0” followed up by the respective number in chronological order. Hence, the sequence of the revision index of a design document shall be as follows: A - B - C - […] - 0 - 1 - 2 - [...]. Each revision is to be listed in the revision history with the respective date and a short description of the modification(s). In addition, all modification(s) shall be highlighted and/or marked up as specific and detailed as possible.

Furthermore, each drawing/document shall be indicated with a unique document number according to the following standard:

Maitree – Unit – KKS – DCC - 12345 – XYZ - REV

Where:

Maitree		Project-Denomination
Unit	-	00 (for common), 01 (for unit 1), 02 (for unit 2)
KKS	-	Function Key as per KKS system (1 to 3 letters)
DCC	-	DCC code according to EN/IEC 61355
12345	-	Document number
XYZ	-	Sub-/Contractor number
REV	-	Revision index

For each comment, the Employer will allocate a priority in the TCS (Technical Comment Sheet). The priorities range from 1 to 3 as follows:

1	-	High Priority
2	-	Medium Priority
3	-	Low Priority

The TCSs are to be named with the above described identification key and the supplementary ending "... - RI" ("Revision Income") for TCSs being sent from the Contractor to the Employer and "… - RO" ("Revision Outcome") vice versa.

The Contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other documents supplied by him, whether such drawings or other documents have been approved or not.

B0.3.9.5.1 Documents which require Approval from Grid Operator/BPDB

Documents especially test procedures and protocols, which are due to approval by the grid operator or BPDB required following specific times for submittal and approval.

B0.3.9.5.1.1 Testing Procedure and Protocols

At least one hundred and twenty (120) Days before the scheduled commencement of the testing and Commissioning of the Plant, the Contractor shall, upon request from BPDB, submit to BPDB detailed procedures and protocols to be used during the corresponding testing. BPDB shall have the opportunity to provide written comments, if any, on the proposed procedure and protocols within thirty (30) Days of receipt from the Contractor of said documentation. If BPDB fails to submit written comments to the Contractor within the thirty (30) Days stipulated above, it shall be deemed to have accepted the detailed procedure and protocols provided by the Contractor.

On receipt of such comments, if any, the Contractor shall review and submit the final procedure and protocols, to be used for testing not later than sixty (60) Days prior to the scheduled commencement of the respective testing and Commissioning:

a. if BPDB fails to submit written comments to the Contractor within the thirty (30) Days stipulated above, it shall be deemed to have accepted the detailed procedure and protocols provided by the Contractor; and 35

b. if the Parties fail to reach agreement on the procedures and protocols within sixty (60) Days prior to the scheduled commencement of the respective testing and Commissioning,

the matter may be referred to the Engineer by either Party, and the Engineer shall make the decision on the protocol and procedures within the five (5) Days of the matter being referred to it, and such decision shall be binding on the Parties.

B0.3.9.5.1.2 Start-up and Test Schedules

At least ninety (90) Days before the scheduled commencement of testing and commissioning of the First Generating Unit or the Plant, as the case may be, the intended Start-Up and test schedule for such unit.

B0.3.9.5.1.3 Operating Procedures

a. Not later than one hundred and twenty (120) Days before the then prevailing Scheduled Initial Operations Date, the Contractor shall, upon request from BPDB, provide BPDB with draft operating procedures dealing with all operation interfaces between BPDB and the Contractor including, but not limited to:

- method of Day-to-Day communication
- key personnel list
- clearances and switching practices
- outage scheduling
- capacity and energy reporting
- operating log; and
- reactive power support

which shall be consistent with this Agreement, the designs of the Facility (including the Metering System), the Technical Limits and Prudent Utility Practices (together, the “Operating Procedures”).

b. Within thirty (30) Days after BPDB‟s receipt of the draft Operating Procedures, BPDB shall notify the Company of any requested deletions, amendments or additions.

c. The Company shall make any deletions, amendments or additions that BPDB reasonably requests unless they would be inconsistent with this Agreement, the Technical Limits, the designs of the Facility (including the Metering System), or Prudent Utility Practices and provide such revised draft to BPDB, which shall be treated as final Operating Procedure, not later than thirty (30) Days before the then prevailing Scheduled Commercial Operations Date.

d. Not Used

e. Either Party may, from time to time, request revisions to the Operating Procedures subject to agreement from the other Party.

B0.3.9.6 Quality control procedure

A comprehensive **quality control procedure / quality assurance programme** for all aspects of the works shall be prepared by the Contractor and shall be submitted to the Employer for approval.

The Contractor shall adopt suitable quality assurance programme (QAP) to ensure that the equipments and services under the scope of Contract whether manufactured or performed within Contractor‟s works or at his subcontractor‟s premises or at the site or at any other place of work are in accordance with the specifications. Such QAP shall be outlined by the Contractor and shall be finally accepted by the Employer or his authorized representative after discussions before the start of work. The QAP shall be generally in line with ISO Systems.

The quality assurance program shall consist at least of the following:

- testing during manufacturing
  - workshop inspections and testing
  - factory acceptance tests (FAT)
- testing at site
  - construction inspections and testing
  - erection / mechanical completion
  - pre-commissioning and commissioning tests (cold and hot commissioning)
  - optimization of overall Plant
  - final inspection and testing
  - Bench mark testing
- completion test
  - performance tests
  - reliability test run.

An outline of the proposed comprehensive quality assurance programme is to be provided with the Tender and is subject to review by the Employer.

The Contractor shall provide complete laboratory facilities and staff to perform the required tests. The facilities could be fully or partially on site. Arrangements could be made with an experienced testing laboratory to support the site laboratory, all subject to the approval of the Employer.

Only approved fully qualified and experienced staff shall carry out the quality control all in accordance with the approved quality control procedure.

The Contractor shall appoint a dedicated, experienced and competent QA&QC in-charge at site, preferably directly reporting to the project manager, supported as necessary by experienced personnel, to ensure the effective implementation of the approved QAP. An indicative structure of Contractors QA&QC manpower required to be deployed at site shall be submitted with the Tender.

The results of the tests shall be made available to the Employer within 24 hours of obtaining the relevant test results. Acceptance of the relevant part of the work shall be subject to the performed tests showing satisfactory results. Individual construction completion certificates shall be issued by the Contractor to certify the readiness for equipment erection (see S**ection B0**).

The Employer may instruct tests at no cost provided either the overall frequency governed by the specification is not exceeded and the notification given to the Contractor is equal to that currently being provided by the Contractor for his normal testing in formality and warning, or the Employer has due cause to suspect a change in the quality, such concern having been advised to the Contractor. The Employer may instruct sampling, testing or both which satisfy only some or none of the above criteria.

The Employer shall have the right to carry out independent inspections and testing either using his own resources or those of a third party. Should the Employer require the results to determine the conformance with the specification then he shall notify and inform the Contractor.

As far as is practicable the Employer shall have free access to the site, fabrication areas and suppliers work at all times without notice. Should he discover unsatisfactory work then he will invite a formal joint inspection. Either after such an inspection or if the Contractor declines the invitation the Employer shall issue instructions with regard to the faults and their reparation.

Should any materials, items or complete parts of the works fail to comply with the requirements of this specification when tested in accordance with this Section the Employer may reject such materials or items, or condemn complete parts of the works, and demand of the Contractor such replacement or modification as may be necessary to ensure their compliance.

Should modification or adjustment be deemed a satisfactory alternative to demolition and /or removal, the Contractor shall submit full details in writing such modifications to the Employer for approval, and should such approval be forthcoming carry them out without undue delay.

If however, the Contractor is required to demolish and /or remove any such items or materials this shall be carried out quickly and with as little disruption to the works as possible.

No claims of any sort whatsoever will be entertained arising from the rejection of any part of the works through failure to meet this specification, and repairs, demolitions, removals, additional testing etc. Such modifications, removal, demolitions etc, shall be entirely at the expense of the Contractor. No extension of the Contract period shall be granted for such a reason.

If for any reason materials or other items are received or made on site before approval of them has been granted, these shall be transported, handled and stored separately or labelled in such a way in order to, wherever possible, prevent them being incorporated into the works or, should such prevention not be possible, to accurately define the part(s) of the works in which such materials or items were used.

Approvals previously granted for any materials etc. shall be withdrawn if they are not properly transported, handled or stored and otherwise protected against weather or contaminants which may adversely affect their properties and subsequent performance. The Contractor has the option of removing such materials or having them retested for approval.

The Contractor shall submit to Employer, the quality plans and field welding schedules (for field weld of pressure parts only), along with test procedures and WPS endorsed by designer wherever applicable, for checks to be done during manufacturing and erection, for review and approval by Employer.

B0.3.10 Options and Alternatives

B0.3.10.1 Option 3.1: Absorber made of concrete (Optional Offer)

Deleted: See Section

Refer to Amendment No. 1, B3.

B0.3.10.2 Option 3.2: Combined Limestone System for Both Units (Optional Offer)

Deleted: See Section

Refer to Amendment No. 1, B3.

B0.3.10.3 Option 4.1: Open coal stock yard (Optional Offer)

Refer to Amendment No. 1, B4.

Deleted: This take-out option covers the scope supplies as given in **Section**

B0.3.10.4 Option 4.2: Screw unloader (Optional Offer)

Refer to Amendment No. 1, B4.

Deleted: This option covers the take-out of the scope of supplies for 2 coal blending silos of 100 m^3, as given in **Section B4.**¶

B0.3.10.5 Option 4.3: Open limestone yard (Optional Offer)

Refer to Amendment No. 1, B4.

Deleted: This option covers the full roof covera of the limestone yard, as given in **Section B4.**¶

B0.4 Interfaces

The Contractor shall actively clarify all interfaces with the Employer, the Operator, PGCB and all companies, authorities and any other entity participating in the project.

B0.4.1 Battery limits of the plant

The interfaces for the Plant shall be as follows.

The Contractor shall actively clarify all details of the interfaces with the Employer, the grid operator (NLDC), the coal supplier, the fuel oil supplier, the limestone supplier and all other interfacing companies.

All mentioned equipment, connections, connection materials, counter flanges, shut-off valves, safety valves, seal up material and works are included in the scope of supply:

Designation	Category	Interface / Terminal Points
TP1	HV overhead transmission line (OHL)	• 400 kV and 230 kV OHL conductors on the gantries for connection of the related GIS bushings. • OHL conductors for connection of the Line Traps. The Connection from the generator transformer to the 400/230 kV GIS shall be included in the Bidder's/Contractor's scope of supply. The 400 kV and 230 kV transmission OHL for power evacuation will be provided by PGCB. The limit of supply is at the take-off gantries (to be supplies by the Bidder/Contractor) for the 230/400 kV OHL For detailed scope refer to Section B10.3.3 and B10.3.5.
TP2	OHL Protection	• None

Designation	Category	Interface / Terminal Points
		Remark: The 400 kV and 230 kV OHL protection on the Power Plant end (not on the remote end) shall be included in the scope of supply of the Maitree-STPP Project.
TP3	OHL Telecommunication	• Terminals on the line traps for connection of the telecommunication equipment provided by PGCB on the related gantries • Terminals in the telecommunication panels provided by PGCB and located in the control building of the 400/230 kV GIS for connection of the cables for the signal exchange with the PGCB/NLDC and for the teleprotection. • Terminals in the telecommunication panels provided by PGCB and located in the control building of the 400/230 kV GIS for connection of the cables for auxiliary/control power supply (240V AC, 220 VDC and 48VDC). The cabling between Contractor's cubicles and the telecommunication equipment provided by BPDB in the Control Building of the 400/132 kV GIS shall be in the scope of the Bidder/Contractor.
TP4	Earthing grid	• Terminals on the gantries for connection of the OPGW. • Earthing bars in the control building of the 400/230 kV GIS for connection the protection and telecommunication panels.
TP5	Plant water intake	Intake from Possur river; all required supplies and services in scope
TP6	Plant water discharge	Discharge to Possur river; all required supplies and services in scope
TP7	Coal supply	Coal unloader at jetty (all coal vessel berthing, mooring and unloading facilities within scope of supplies and services)
TP8	Fuel oil supply	At and including Fuel Oil Truck Unloading Station near the Power Plant. All supplies and services in scope The road truck unlading station shall be positioned in the vicinity of the storage tank. Accordingly TP8 is located at the near of HSD oil storage tank.However, the unloading station is included in the scope of the Bidder
TP9	Limestone supply	Coal unloader at jetty (all coal vessel berthing, mooring and unloading facilities within scope of supplies and services) (common equipment with coal supply)

Designation	Category	Interface / Terminal Points
TP10	Fly ash	Outlet connection at: • ship loading from fly ash storage silos • Truck loading from fly ash storage silos • Truck loading from intermediate fly ash silos • ash pond All supplies and services in scope Complete ship loading system from silo with all accessories shall be in Bidder's/Contractor's scope.
TP11	Bottom ash	Outlet connection at: • Truck loading from bottom ash storage silos • Truck loading from intermediate bottom ash silos • ash pond All supplies and services in scope Complete ship loading system from silo with all accessories shall be in Bidder's/Contractor's scope.
TP12	Gypsum	Outlet connection at: • ship loading from gypsum storage silos • Truck loading from gypsum storage silos • Truck loading from intermediate gypsum silos All supplies and services in scope Complete ship loading system from silo with all accessories shall be in Bidder's/Contractor's scope.
TP13	Raw water supply	Pipeline 1 m outside Plant boundary; interface with raw water supplier
TP14	Sewage water	Discharge to Passur river
TP15	Storm water	Discharge to Passur river, outside the Plant area; all required supplies and services in scope
TP16	Waste water for discharge	Discharge to Passur river There shall be no spill water from ash dyke to be discharged to Possur River without treatment. Seepage water from the ash dyke shall be recirculated to overflow lagoon with suitable drainge and pumping system.
TP17	Waste water and scheduled waste for disposal	Interconnection to facility external disposal
TP18	Chemicals supply	Chemicals receiving facility
TP19	Township 11 kV Power supply	Terminals in the 11 kV unit board of the Power Plant For the supply of the township redundant 11 kV feeders (2 x 100%), one from the 11 kV unit boards of each unit, shall be provided as

Designation	Category	Interface / Terminal Points
		per section B7.1.1. Cables and raceways are out of Bidder's/Contractor's scope of supply, however, sufficient free space to be considered by the Bidder/Contractor for later installation of associated cables and raceways towards township area.
TP20	Construction Power	2 terminals at 33 KV line at the border of the Power Plant Site. Construction Power (Please refer to Section V TS, B9, B9.4.2.1): Power supply for construction purposes will be provided at 33 kV voltage (2 no. of lines). The same will be extended to the Contractor for him to develop 33/11 kV sub-stations and construction power supply comprising of: • Two (2) 5 MVA, 33/11 kV step-down transformers, • Two (2) 11 kV switchgears, • 11 kV main ring, design according to plant layout, construction requirement and schedule, • 11kV/415 V step-down transformers (number and sizes as required according to plant layout, construction requirement), • Two (2) 11 kV feeders (minimum 630 A), for usage of the Employer. For improved reliability these feeders shall be connected to separate 11 kV bus systems at 33/11 kV sub-stations. The electricity prices/power tariffs for the case of 33 kV voltage level are defined in the Annex C. Further preliminary details regarding provided construction power system are shown in Annex C.

Construction Water:
As described under Section B9 the supply of construction water is in the scope of Bidder/Contractor. It is not allowed to use ground water. For construction water shall be used only river water suitably treated for his purposes.

B0.4.2 Interfaces to electricity dispatcher

Communication, control, monitoring and voice channels will be provided between the Facility and BPDB"s National/ Regional Control Center by BPDB. The Contractor shall provide interconnection within the Facility for all such communication circuits/ channels.

B0.4.2.1 Interface between the Power Plant and the NLDC

In order to link the Plant to the 400 kV PGCB National Load Dispatch Center (NLDC) the Contractor shall make available all analogue and digital signals in accordance with the requirements of the Bangladeshi Grid Code and as requested by PGCB and the Employer. These will include command signals from the NLDC to the Plant‟s automatic load control systems (AGC, see **Part B8**).

The Contractor shall liaise with NLDC to facilitate necessary interfacing with the SCADA System in NLDC. All necessary firmware and software with suitable communication link through serial interface (to match the protocol of the existing system) shall be provided by the Contractor. Necessary reconfiguration is to be done by the Contractor to establish logical link with the existing SCADA system in NLDC.
Further, reconfiguration of the database and various display builder functions of the SCADA system in NLDC to accommodate additional signals are under the scope of work of the Contractor.

The following reserve requirements shall be taken into account:

- Min. 10% of the equipment installed shall be a reserve to enable handling of an additional 10% of signals without the need for equipment extensions.
- Min. 15% of the equipment installed shall be a reserve to enable handling of an additional 15% of signals by extending the equipment but without the need to modify the existing structure of any of the interface marshalling cubicles installed.

B0.4.2.2 Signal interface to NLDC for automatic generation control

The power plant shall be equipped with terminals to receive command from the BPDB load dispatch center to allow control from NLDC.

The NLDC shall be able to link to the Automatic Generation Control (AGC) via telecontrol facilities so as to act on the turbine load control, adjusting the latter by decrease/increase load commands. All measurement data to indicate if the target load has been matched shall be transmitted by the telecontrol system to NLDC. Type and initial number of signals are defined in **Section B8**.

B0.4.2.3 Interfaces between the 400/230kV substation and the NLDC

The Contractor (in consultation with BPDB) shall provide suitable interface unit for communication links to the PGCB‟s SCADA system for communication, control, monitoring and voice channels to accommodate the PGCB and the National/ Regional Control Center requirements.

The communication interface unit shall be adequate to fulfil the PGCB/ NLDC information requirement. Communication to the National Load Dispatch Center shall be provided by data communication, utilizing both, the IEC 60870-5- 104 and the IEC 60870-5-101 protocols. Settings shall ensure interoperability with the remote National Load Dispatch Center.

For possible future extensions, it shall be possible to interface with two remote control centers simultaneously by using dual port capability.

From the National Load Dispatch Center, all related high voltage apparatus of the substations shall be remote controlled and monitored. Necessary interface shall be provided within the substation automation system for receiving the signals from PGCB grid control.

All signals of the substation required for the control and monitoring from the remote National Load Dispatch Center shall be made available for data transmission via the gateway.

The scope of supply includes all required equipment and installations to enable the substation for the proper connection of the required control and monitoring signals. Communication, telemetry, fiber optical terminal and tele-protection equipment (PLCC) will be supplied and installed by PGCB at Company substation end, matching with PGCB‟s remote substation end requirements. However, line trap and capacitive voltage transformer of required rating along with 48 VDC/AC auxiliary supply at Company substation end shall be provided by the Contractor. The Contractor shall supply and install the necessary cabling and cubicles. Cabling between these cubicles and the telecommunication equipment provided by PGCB shall be provided and installed by the Contractor.

The cabling between Contractor's cubicles and the telecommunication equipment provided by PGCB in the Control Building of the 400/230 kV GIS shall be in the scope of the Bidder/Contractor.

B0.4.2.4 Interfaces between the 400/230kV substation and the Power Plant

The Contractor is responsible for the construction of the interconnections between the substation and the Power Plant. Provision and installation of all control and signal cables between the substation and the Power Plant is within the responsibility of the Contractor.

The Power Plant shall be able to supervise and control the substation via an OPC client workstation installed in the Power Plant‟s CCR. The Contractor shall provide and install the OPC Server/Client architecture as well as all necessary equipment required for the proper translation of the native data (either acquired directly from the IEDs or from connectivity with the station bus) in OPC-format and the data provision at the OPC-client in the Power Plant control room via a TCP/IP communication link.

In addition the SCMS may communicate with the DCS either by serial communication link or by hardwired connection. In the former, dual redundant links and communication apparatus must be provided. However, the watchdog signalling logic must be hardwired so that this will continue to operate effectively even during SCMS failure.

B0.4.2.5 Interface to power transmission system (PGCB - Power Grid Company of Bangladesh)

The interface between the power transmission system of PGCB and Maitree-STPP will be the following points of the 400/230 kV GIS:

- 400 kV and 230 kV Interconnection:
  - 400 kV and 230 kV OHL conductors on the gantries for connection of the GIS bushings. The gantries shall be provided under the Maitree-STPP project.

- 400 kV and 230 kV OHL Protection, Control and Synchronization:
  - None.

Remark: *The 400 kV and 230 kV OHL protection on the Power Plant end (not on the remote end) shall be included in the scope of supply of the Maitree-STPP Project.*

- Telecommunication:
  - Terminals on the line traps for connection of the telecommunication equipment provided by PGCB on the related gantries
  - Terminals in the telecommunication panels provided by PGCB and located in the control building of the 400/230 kV GIS for connection of the cables for the signal exchange with the LDC and for the teleprotection.
  - Terminals in the telecommunication panels provided by PGCB and located in the control building of the 400/230 kV GIS for connection of the cables for auxiliary/control power supply (240V AC, 220 VDC and 48VDC).
- Earthing:
  - Terminals on the gantries for connection of the OPGW.
  - Earthing bars in the control building of the 400/230 kV GIS for connection the protection and telecommunication panels.

B0.4.3 Metering

Sufficient metering devices shall be provided to enable an energetic balancing of the power unit, all fuel consumers and additionally the Plant comprising gross and net electric power, coal flow, fuel oil flow, calorific value of fuels, fuels heat energy, electric power, specific heat consumption, etc. for tariff metering and internal balancing purposes.

Metering devices of electrical signals such as frequency, voltage, active power, reactive power, and energy shall be provided:

i for the power unit for tariff metering at the switchyard
ii for the power unit and additional the Plant for internal balancing purposes at all switchgears and all generators.

The final number and type of metering device, their accuracy and signal interface requirements shall be according to the Employer‟s requirements (see **Part B10** and **Annex E**) and the requirements of the relevant grid code.

B0.5 Technical Schedules

B0/TS Design Conditions
Design Data
List of Major Equipment and Service Suppliers
Guarantees

B0.6 General Technical Requirements

B0.6.1 General requirements

The following directions, information and technical requirements for design, engineering, manufacturing, procurement, construction, commissioning, start-up and testing shall be observed as far as they are applicable for the equipment to be delivered. The requirements stated in this Section of General Technical Requirements are valid for all sections of the specification, except only where additional and/or special requirements are specified.

In case of a contradiction between different Sections of this specification or mentioned standards, the more stringent requirements shall be applicable to Contractor.

Any changes on the design of any part of the Plant, which may become necessary after signing of the Contract, have to be submitted by the Contractor in writing to the Employer for approval, being sufficiently substantiated and justified.

The Plant shall be new and clean, and designed, manufactured and arranged so that it will have a functional design and a pleasant appearance. All parts of the Plant shall be arranged in such a manner as to facilitate surveillance by the operator and to ease maintenance, operation and control.

The parts of the Plant shall be designed and arranged so that they can be easily inspected, cleaned, erected and dismantled without necessitating large scale dismantling of other parts of the Plant. They shall be designed,

manufactured and put into operation in accordance with the latest recognized rules of workmanship, modern engineering practice and with good standards of prudence applicable to the international electricity generation industry which would have been expected to accomplish the desired result at the lowest reasonable cost consistent with reliability, safety and expedition.

The regulations, standards and guidelines listed in the Specification as well as all applicable laws and governmental decrees, regulations, orders, etc. shall be observed in the design, calculation, manufacture, erection, installation, testing, commissioning and start-up of all parts of the Plant.

The following shall be considered in the design and engineering of the Plant facilities:

- All parts of the Plant shall be suitable in every respect for continuous operation at maximum output as well as part loads and expected transient operating conditions peculiar to the site and shall be able to safely withstand the stresses arising from the operating conditions without any reduction in its planned life.
- The Contractor shall familiarize himself with the conditions on site.
- Suitable and automatically acting protection and safety measures shall be provided for automatic load reduction or shut down of equipment in case of abnormal operating conditions.
- Switchover to stand-by units shall be automatically, as far as required for continuous Plant operation without interruption of Plant operation.
- In case of equipment and/or system shut down process conditioned drainage of components (such as pipelines, tanks, etc.) shall be performed automatically from the control room.
- Minor equipment which, in case of failure would cause a failure of a power generation unit and/or the Plant is to be provided with a stand-by facility in order to ensure further operation of the power generation unit or the Plant.
- All live, moving and rotating parts shall be provided with appropriate effective protection in order to avoid danger to the operating staff. All metal parts shall be electrically grounded.
- All equipment shall be designed to ensure start-up from any condition, i.e. from long term shut-down, cold, warm or hot condition without necessitating special or preparatory measures.
- The project language shall be English.

B0.6.2 Standards and codes

The work must be performed according to the most recent relevant codes, standards, accident prevention regulations and local rules and legal regulations.

All materials and equipment supplied and all work carried out as well as calculation sheets, drawings, quality and class of goods, methods of inspection, specific design features of equipment and parts and acceptances of partial plants shall comply in every respect with the applicable standards, codes and regulations to be chosen from the following:

• American Association of State Highway and transportation Officials	AASHTO
• American Concrete Institute	ACI
• American Gear Manufacturers Association	AGMA
• American Institute of Steel Construction	AISC
• American Iron & Steel Institute	AISI
• American Moving and Conditioning Association	AMCA
• American National Standards Institute	ANSI
• American Petroleum Institute	API
• American Public Health Association	APHA
• American Society for Testing and Materials	ASTM
• American Society of Civil Engineers	ASCE
• American Society of Heating, Refrigeration & Air Conditioning Engineers	ASHRAE
• American Society of Mechanical Engineers	ASME
• American Water Works Association	AWWA
• American Welding Society	AWS
• American Wire Gauge	AWG
• Anti-Friction Bearing Manufactures Association	AFBMA
• Architectural Institute of Japan	AIJ
• Association Francaise de Normalisation	AFNOR
• British Standards Institute	BS
• Chlorine Institute	CI
• Crane Manufacturers Association of America	CMAA
• Deutsches Institut für Normung	DIN
• Diesel Engine Manufacturers Association	DEMA
• European Norm	EN
• Expansion Joint Manufacturer Association	EJMA
• Fédération Européene de Manutention	FEM
• Heat Exchanger Institute	HEI
• Hydraulic Institute	HI
• Illuminated Engineers Society	IES
• Institute of Electrical and Electronics Engineers	IEEE
• Instrument Society of America	ISA
• Insulated Power Cable Engineers Association	IPCEA
• International Electrotechnical Commission	IEC
• International Standards Organization	ISO
• Japanese Architectural Standard Specification	JASS

• Japanese Electrical Manufacturers Association	JEMA
• Japanese Electrotechnical Institute	JEC
• Japanese Industrial Standards	JIS
• Manufacturers Standardization Society	MSS
• National Association of Corrosion Engineers	NACE
• National Electrical Code (USA)	NEC
• National Electrical Manufacturer"s Association (USA)	NEMA
• National Electrical Safety Code	NESC
• National Fire Protection Association	NFPA
• National Structural Code for Building	NSCB
• Occupation Safety and Health Administration	OSHA
• Portland Cement Association	PCA
• Properties of Water and Steam	IFC
• Scientific Apparatus Manufacturers Association	SAMA
• Society of Automotive Engineers	ASE
• Standards of Japanese Electrotechnical Committee	JEC
• Steel Structures Painting Council	SSPC
• Technische Vereinigung der Grosskraftwerksbetreiber	VGB
• Tubular Exchanger Manufacturers Association	TEMA
• Underwriters Laboratory	UL
• Uniform Building Code	UBC
• Verband Deutscher Elektrotechniker	VDE
• Verein Deutscher Ingenieure	VDI
• Vereinigung Deutscher Elektrizitätswerke (Association of German Power Plants)	VDEW
• Water Pollution Control Federation	WPCF

Generally, all internationally and nationally recognized standards as above will be applied, except if specific standards called for by:

a) Occupational Safety Board of Bangladesh
b) Department of Inspection for Factories and Establishments, Bangladesh
c) Department of Environment, Bangladesh
d) Bangladesh Power Development Board
e) Bangladesh Energy Regulatory Commission
f) Ministry of Power, Energy and Mineral Resources
g) Bangladesh Fire Service and Civil Defence Ministry
h) All relevant Bangladesh National Statutory Regulations
i) Bangladesh National Building Code
j) Bangladesh Standards
k) Local Authorities.

All steam boilers and unfired pressure vessels together with associated pipework and fittings shall comply with the Bangladesh Boiler Act, 1923 with amendments.

All pressure parts shall be designed in accordance with applicable ASME codes.

All services, supplies and works shall comply with the requirements of the relevant laws of Bangladesh and the IFC/World Bank Group Standards and Guidelines in their latest edition, including but not limited to:

- Environmental Conservation Rules
- Bangladesh Energy Regulatory Commission Act;
- BERC Licensing Regulation
- BERC Technical Quality Standards;
- Bangladesh National Building Code;
- other applicable laws in Bangladesh;
- IFC Performance Standards on Environmental and Social Sustainability;
- IFC / World Bank Group Environmental, Health and Safety (EHS) General Guidelines ;
- IFC / World Bank Group EHS Guidelines for Thermal Power Plants;
- IFC / World Bank Group EHS Guidelines for Electric Power Transmission and Distribution.

It is the Contractor‟s responsibility to provide sufficient evidence that any national or other standard the Contractor proposes (other than those mentioned above) will ensure an equivalent or higher standard.

Immediately after effective date of the Contract the Contractor shall supply an indexed list of all standards, codes and associated standards referred to, to which the work is to be performed. A copy of all applied standards shall be forwarded to the Employer. The Contractor shall supply preferably two (2) searchable softcopies, else two (2) hardcopies each.

B0.6.3 Plant and equipment identification

The Contractor shall apply a plant identification system showing the name and number of each item of Plant and its respective arrangement drawing number and add any additional items necessary to fully identify the Plant.

All design submissions shall include a detailed labelling list indicating the label text, size of the lettering and fixing details for the approval of the Employer or its representative.

The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with

the VGB guideline RDS-PP (Reference Designation System for Power Plants - KKS system).

There is to be only one approved description for any one item of Plant and this must be used consistently for Plant, electrical and instrumentation designations throughout.

The Contractor shall supply all labels (Plant and Equipment Identification Plates), nameplates, manufacturer‟s equipment nameplate, instruction and warning plates necessary for the identification and safe operation of the Plant, and all inscriptions shall be in the English language and Bangla language.

All labels, nameplates, instruction and warning plates shall be securely fixed to items of Plant and equipment with stainless steel rivets, plated self-tapping screws or other approved means. The use of adhesives will not be permitted.

Nameplates for Plant and equipment identification and record purposes shall be manufactured from stainless steel or aluminium with a mat or satin finish, and engraved with black lettering of a size which is legible from the working position.

Warning plates shall be manufactured from stainless steel or aluminium engraved red lettering on a white background and sited in the position where they afford maximum safety of personnel.

All equipment within panels and desks shall be individually identified by satin or mat finish stainless steel or aluminium labels.

Each circuit breaker panel, electrical control panel, relay panel, etc. shall have a circuit designation label on the front as well as on the rear panels engraved with black lettering in accordance with the circuit designation system. Circuit designations must be precise and convey complete information. There should be no doubt whatsoever for the operation as to which area of the Plant a particular feeder is supplying with power. Labels such as interconnector 1 or feeder 2 are not acceptable. Corridor type panels shall in addition have circuit designation labels within the panels.

Pipework systems shall be identified with a colour identification systems in conformity with the colours according to the Employer‟s specification, with colours at the nameplates and, if necessary by colour bands and with KKS numbering and plain language. The direction of flow shall be shown.

Each valve/instrument shall be fitted with a stainless steel or aluminium nameplate indicating the valve/instrument service and reference number in accordance with the approved equipment coding system.

Where possible valve nameplates shall be circular and shall be fitted under the handwheel captive nut. They have to be of such a diameter that there is no danger for persons operating the valve or that they do not prevent lock-off of this valve; on check valves and small valves the Contractor may provide rectangular nameplates fitted to brackets on the valve or attached to a wall or steelwork in a convenient position adjacent to the valve.

B0.6.4 Marking and labelling

Each crate or package is to contain a packing list in a waterproof envelope. All items of material are to be clearly marked for easy identification against the packing list.

All cases, packages, etc. are to be clearly marked on the outside to indicate the total weight, where the weight is bearing and the correct position of the slings and are to bear an identification mark relating them to the appropriate shipping documents.

All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.

B0.6.5 Corrosion protection, coating and galvanizing

This specification shall be used for the corrosion protection of steel structures, components, pipings and equipment in general which are installed in confined areas (indoors) or outdoors.

Surface preparation, as well as protective coatings and coating systems are based on this specification in order to assure that structural parts of different suppliers will get a corrosion protection of similar and high quality.

Coating material shall only be supplied by manufacturers with international experience and their products can be obtained internationally.

Regarding maintenance work (storage), application and supervision of coating work, choice of coating suppliers should be minimized. At any rate, similar parts of structures/components (such as structural steel, containers, piping, etc.) shall only be coated with products of one individual manufacturer.

The materials and equipment used, the methods of application and the quality of work shall at all times be subject to the inspection and approval of the Employer or his Representative.

To mitigate crevice corrosion, the designs and construction of structures and equipment shall ensure that no collection of water occurs in crevices which could lead to crevice corrosion.

It is the responsibility of the Contractor to ensure that, for all supplied equipment (including that from sub suppliers):

- The protection system is perfectly suitable for the Site conditions and for the specific purpose.
- The shop paints provide a sufficient protection during transport, storage and erection.
- The shop paints are suitable for handling and erection conditions (slinging, Site welding works etc.) and are compatible with the Site finishing coats
- All necessary precautions are taken in order to prevent damage to paints during storage, handling, welding.
- The necessary repairs are carefully executed as soon as possible.
- The colour RAL number of the finishing coat has been approved by the Employer, including identification code for piping.
- Standardised equipment will be painted according to the manufacturer"s standard.
- All corrosion protection and coating on site shall be done in a workshop specifically for the purpose of the application of corrosion protection and coating.

Codes and standards
Applicable standards are:

- Product data of coating manufacturer
- DIN 2403 Indication of pipe-lines according to flowing material
- DIN 4762 Surface roughness
- ISO 8503 Surface roughness
- DIN 8201 Part 1-9 tight blasting agents
- DIN 50976 Corrosion protection, hot dip batch galvanizing of single parts, requirements and testing
- DIN 55928 Part 1-9 corrosion protection of structural steel work through protective coatings and topcoats
- ISO 8501 Preparation of steel substrates before application of paints and associated products
- ISO 12944 Paints and varnishes – corrosion protection of steel structures by protective paint systems
- RAL Colour card
- ISO 8501-1 Preparation of steel substrates before application of paints and related products
- SSPC Vol. 1 and 2 Steel structure painting council

Surface preparation and cleaning of surfaces in the shop
Prior to blasting, areas have to be cleaned from oil, grease, paint residues, splatters, welding splashes and welding slag using a suitable aqueous degreaser, or solvent for more severe grease contamination. The cleaning should be to provide a “water break free surface”.

Sharp edges have to be rounded off.

Contaminations caused by salts, acids and alkali solutions shall be eliminated by rinsing with water up to a pH value of 6-8. Soluble salt contamination is to be tested using the Weber Reilly test method (or similar approved) and pH is to be tested using universal indicator paper strips prior to continuation with the blasting.

The preparation of substrates shall be carried out on the basis of the specifications of ISO 12944 part 4 and ISO 8501. The preparation of steel before application of paint and related products shall be in line with ISO 11124 for metallic blast cleaning abrasives and ISO 11126 for non-metallic blast cleaning abrasives. No recycled blast grit may be utilised.

After blasting, an anchor profile of 25 - 50 µm shall be achieved. Blasted surfaces have to be provided with a prime coat of the approved coating system immediately within 4 hours of blasting. All blasting and priming must take place outside of the high humidity periods of the day (i.e. maximum relative humidity of 80%).

Cleaning to be performed on site
Steel work protected by shop primer after arrival on site must be cleaned of salt, sand, oil, etc. before the first coat of paint is applied on site. Shop primer damaged during transport must be rectified by blast-cleaning and coating before application of the site coats.

Wood surfaces shall be sanded clean. All nail holes shall be puttied and sanded before priming, , unless the specific coating system allows for coating onto damp concrete, in which case only with approval from the Employer.

If a protective coating of concrete is required, concrete shall be allowed to cure before painting.

Transport and erection damages, as well as damages which result out of additional welding have to be repaired as soon as possible. The damaged areas have to be derusted with rotating or steel brushes, abrasive wheels, and abrasive blasting according to DIN ISO 8501-1.

Cleaning of prime and intermediate coats (if required)
To prevent contamination by mineral oil products, areas with prime and intermediate coat have to be treated with suitable cleaning agent. Cleaning has to be done free of residues, e.g. with alkaline detergents and thorough washing done with fresh water. Rusty spots have to be removed according to required purity. Metallic areas which are provided with temporary corrosion protection have to be cleaned. No oxidation products shall remain on the surface. Further care shall be taken that on hot components, no destructive or reaction products will be released when heating which could injure insulation.

Application procedure
When using the provided coating material, strict adherence to all application instructions given in product data of coating manufacturer is necessary. To obtain the maximum performance, technical data as well as application instructions for the individual coating material have to be strictly followed. For a multi-layer coating system each layer has to have a different colour shade in order to clearly identify number of coats applied.
The last finish coat has to be applied in the specified colour shade.

All paintings shall be performed according to ISO 12944. The durability of all paintings shall be “high” which corresponds to 15 years.

The interval between applying the different coats has to follow according to supplier‟s precautions. Each layer has to be cleaned and released from spray dust before the next layer will be applied. Prior to applying a further layer, the last one has to be repaired. All coatings have to be applied without retarding.

Following application procedures are allowed:

- prime coats by airless spray
  areas like disconnections, angles, corners, etc. which are difficult to be reached can be applied by brush or roller
- repair of prime coat by brush
- finish coats
  - at works by airless spray, roller or brush
  - at site by roller or brush or airless spray.

When applying coating systems by roller, rollers have to be of kind and quality which make an appropriate application possible.

Control areas in accordance with the coating supplier‟s instructions have to be applied. For this procedure, a schedule for control areas has to be prepared by the Contractor and coating supplier which corresponds with the requirements of the warranty agreement.

Number and performance of the control areas have to be done in accordance with ISO 12944 part 7 and have to be documented in writing.

No application shall take place either in the condition of the relative humidity not within the given limit or in case of poor weather conditions such as fog, dust, rain, snow, hail or when it can be assumed that such conditions of poor weather will arise within 2 hours after application.

Temperature of the coated parts has always to be above 5 °C and 3 K above dew point.

All specified dry film thicknesses (DFT) are minimum thicknesses.

Welding seams executed at site have to be taped with an adhesive tape of about 30-50 mm after surface preparation (blasting or manual derusting) and prior to application in the manufacturing plant and to be coated with stripping coat.

Chequered plates, nap plates, etc. have not to be covered with adhesive tape, but have to be coated with stripping coat in a dry film thickness of at least 150 µm.

Edging lines on steel structure have to be taped prior to application and after blasting in sufficient width or have to be protected with varnish before application. Thickness of prime coat may be 50 µm maximum.

During repairing works at site on shop-primed structures, it is important that different coats will have different colour shades. Numbers of layers have to be the same as the original coating system to be used.

Application of temporary primer on structures which have to be insulated has to be in accordance with a sufficient corrosion protection for the period of storage respectively erection time.

Galvanizing
Galvanizing work shall conform in all respects to ISO 1461 or equivalent standards and shall be performed by the hot dip process unless otherwise specified.

It is essential that details of steel members and assemblies which are to be hot-dip galvanized should be designed to suit the requirements of the process. They should be in accordance with ISO 12944.

Vent holes and drain holes shall be provided to avoid high internal pressures and air locks during immersion and to ensure that molten zinc is not retained in pockets during withdrawal.

Careful cleaning of welds is necessary before welded assemblies are dipped. All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with BS 4360. All drilling, cutting, welding, forming and final fabrication of unit members and assemblies shall be completed, where feasible, before the structures are galvanized.

The minimum coating thickness shall be as specified in Table 1 of BS 729. Structural steel items shall be first grit-blasted to BS 4232, second quality, (Sa 2 1/2) or pickled in a bath, and the minimum average coating weight on steel Sections 5 mm thick and over shall be 900 g/m^2, on steel Sections 2 - 5 mm thick 600 g/m^2.

Galvanized contact surfaces to be joined by high-tensile friction-grip bolts shall be roughened before assembly so that the required slip factor is achieved. Care shall be taken to ensure that the roughening is confined to the area of the mating faces.

Protected slings must be used for off-loading and erection. Galvanized work, which is to be stored at the works or on site shall be stacked so as to provide adequate ventilation for all surfaces to avoid wet storage staining (white rust).

Small areas of the galvanized coating damaged in any way shall be restored by:

- cleaning the area of any weld slag and thorough wire brushing to give a clean surface
- The application of two coats of zinc-rich paint, or the application of a low melting point zinc alloy repair rod or powder to the damaged area, which is heated to 300 °C or the treatment with suitable cold galvanizing paint, such as ORAPI n.z.a.b 706. All zinc rich paint used for such repairs must contain a minimum of 81% by mass of zinc in the dry film.

Connections between galvanized surfaces and copper, copper alloy or aluminium surfaces shall be protected by suitable tape wrapping.

Coating Systems

System-No.	Surface location	Temp. °C	Surface preparation	Coating systems	No. of coats	Generic type	Dry film thickness (DFT) per coat µm	Total DFT µm
1	Structural steel works, piping, vessels, tanks INDOOR	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
				Finish	1	Epoxy High Solid	80	80 **160**
2	Structural steel works, piping, vessels, tanks OUTDOOR	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
				Intermediate	1 – 2	Epoxy High Solid	160	160
				Finish	1	2-Comp.Polyurethane	50	50 **290**
3	Piping, tanks, etc. INDOOR and OUTDOOR, Insulated	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	50	50
4	Pumps, motors, other equipment OUTDOOR	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
				Intermediate	1	Epoxy High Solid	110	110
				Finish	1	2-Comp.Polyurethane	50	50 **240**
5	Pumps, motors, other equipment INDOOR	up to 120	SA 2.5	Primer	1	Zinc-Epoxy	80	80
				Finish	2	Epoxy High Solid	50	100 **180**
6	Piping, reactors OUTDOOR Insulated	> 120	SA 2.5	Primer	1	Zinc Ethysilicate	75	75
7	Stacks OUTDOOR	< 120	SA 2.5	Primer	1	Zinc Ethysilicate	75	75
		< 200		Finish	2	Silicone Acrylic	50	100 **175**

Coating Systems								
System-No.	**Surface location**	**Temp. °C**	**Surface preparation**	**Coating systems**	**No. of coats**	**Generic type**	**Dry film thickness (DFT) per coat µm**	**Total DFT µm**
8	Steel surfaces Uninsulated	200 - 450	SA 2.5	Primer Finish	1 2	Zinc Ethysilicate Silicone Aluminium	75 25	75 50 **125**
9	Galvanized surfaces	up to 120	Mechanical cleaning from contaminants and zinc salts by means of washing or steam jetting or sweep-blasting with fine sand	When Finish Coat is required, such as sea climate with chloride exposure	1	Epoxy High Solid*	125	125
10	Steel surfaces permanently in contact with water, also river water splash zone	Medium temp. °C up to 60	SA 2.5	Prime and Finish Coat in One	1	Glassflake reinforced High Solid Epoxy	500	500
11	Plant / Cooling water pipes	GRP, or steel lined concrete pipes with cathodic protection and coating according to AWWA C 203						

* Additional 1 x Finish Coat 2-Comp. Polyurethane, 50 µm, when exposed to UV or weathering conditions and colour retention is required.

B0.6.6 Vibration

Steam turbine generator
The steam turbine and generator have to be statically and dynamically balanced in the workshop such that the following levels of vibrations can be achieved:

- For the steam turbine and the generator the vibration level, measured on the rotating parts at each main bearing shall not exceed the upper limit of the zone “A” as defined in ISO 7919 at steady conditions.
- For the steam turbine and the generator, the vibration level, measured on the rotating parts at each main bearing shall not exceed the upper limit of zone ”B” as defined in ISO 7919 for transient operation at rated speed.
- In no case (except alarm condition), the vibrations measured on the rotating parts shall exceed 0.5 of the minimal clearance of the bearings, for the measurements installed near the bearings. This requirement is valid for all speed ranges and load conditions. If conflicts exist between the different specifications, the more restrictive value shall be applied.

The location of sensor element shall be according established standards and generally recognised codes of practice.

Other rotating equipment
Unless otherwise stated or agreed by the Employer all rotating equipment must have statically and dynamically balanced in the workshop such that the following levels of vibrations can be achieved:

- For large rotating equipment (boiler feedwater pumps, main cooling water pumps, fans (PAFs, FDFs, IDFs), condensate pumps, etc.) the vibration levels, measured on the non-rotating parts, shall not exceed the upper limit of zone “A” as defined in ISO 10816 at steady conditions. For other areas e.g. min flow or run out flow, zone limit “B” shall be maintained.
- For standard pumps, other rotating equipment and reciprocating pumps, the vibration levels, measured on the non-rotating parts, shall not exceed the zone limit “B” as defined in ISO 10816 at steady conditions. For equipment which is not covered by ISO 10816, the manufacture’s standard shall be applied.
- For all rotating equipment at transient conditions, the vibration levels, measured on the non-rotating parts, shall not exceed the zone limit “C” as defined in ISO 10816.
- For all motors, the vibration levels, measured on the non-rotating parts, shall not exceed the limit as described in the relevant Sections for MV and LV motors.
- The vibrations measured on the rotating parts may not exceed 0.5 of the minimal clearance of the bearings. This requirement is valid for all speed ranges and load conditions. If conflicts exist between the different specifications, the more restrictive value must be applied.

Whenever necessary, equipment shall be put on vibration dampers.

Vibration Monitoring System

Vibration shall be measured at large rotating or reciprocating machinery for protection and predictive maintenance. This includes the turbine, the generator, large rotating equipment (boiler feedwater pumps, main cooling water pumps, fans (PAFs, FDFs, IDFs), condensate pumps, etc.).

Suitable indications shall be provided in the control room for each measurement point and the measurement shall be suitably alarmed where high vibration levels may cause possible damage or affect the safety of the Plant. All the vibration signals, unprocessed, which are present on the machine as well the result of the VMS shall be available in the PADO as well as in DCS.

The vibration monitoring system (VMS) shall be reliable, accurate, easy to maintain, and suitable for use in such ambient conditions appertaining to the intended plant installation. Vibration monitoring signals for trip commands, protection functions or process interlocks shall be hardwired. The VMS shall comprise all the necessary hardware and software modules and shall be configured according the design and the needs of the specific installation and technology.

Standardization and interchangeability of components shall be implemented where feasible.

The following features and requirements shall be considered for the vibration and displacement monitoring system:

- self-checking and single fault tolerant system
- modular and reliable system
- 2 out of 3 voting, if signals shall be used for trips (shaft vibration measurement shall be as per ISO 7919-2)
- hardwired or redundant serial communication have to be foreseen
- All buffered outputs signals shall be passed through to the analysis system as unprocessed (raw) input signals.

The following criteria shall be used as a guideline for rotating machinery such as steam turbine, generator, blowers and fans, mills and main feed water pumps as well as other main pumps, in order to ascertain the monitoring points, principles of what signal shall be measured, what is displayed, and what mechanical conditions entail alarm and/or trip status:

- non-contacting proximity probes shall be provided unless otherwise specified for measuring rotor shaft vibration and axial position,
- vibration measurements shall be in displacement microns peak to peak,

- in cases which, because of process conditions, accessibility or non-critical service, may entail the use of machine casing mounted vibration transmitters, the transmitters shall be of the "acceleration" type incorporating a filter network, if necessary along with integration in the monitor unit for vibration read-out in velocity mm/sec RMS. For alarm only, one transducer may be used. For alarm and trip conditions 3 transmitters shall be used with a voting system (i.e. one high reading out of three = alarm, two out of three = trip). Contacting type of equipment shall meet the requirements of ISO 2954,
- velocity type transmitters shall be used as an alternative to velocimeters when machine rotational speed and generated vibration frequency conditions dictate,
- individual read-out of all channels shall be provided in HMI as well as in the vibration monitoring module. Display shall be by means of a multi-point indicator and digital selector,
- facilities for trend monitoring using trend functions of the DCS shall be provided on the turbo-generator bearings as an aid for predictive maintenance purposes,
- vibration parameters of the turbine shall also be fed in the turbine control system
- buffered signals at the monitor shall be a requirement to enable external data acquisition, if such is necessary,
- facilities shall be provided for the calibration of the instrumentation system.

Further requirements on the analysis functions of the VMS are given in **Section B8**.

B0.6.7 Standardization of makes

The works shall be designed to facilitate access and facility for inspection, cleaning, maintenance and repair. Continuity of supply is a prime concern. The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the works. The Plant shall be designed to operate satisfactorily under all variations of load, pressure, and temperature.

Corresponding parts throughout shall be made to gauge and be interchangeable wherever possible.

No prototype will be permitted. Continuity of operation and lowest maintenance requirements are of prime concern. The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the equipment and plant.

The equipment must be standardized as much as possible.

All equipment performing similar duties shall be of the same type and manufacture in order to limit the stock of spare parts required and maintain uniformity of plant and equipment to be installed. Especially the number of types and manufacturers of actuators, valves and instruments shall be reduced to a minimum.

If a piece of equipment is present several times, then all of these pieces shall be identical. All their constituting parts must be exchangeable between them.

The Employer reserves the right to advise the Contractor of preferred type and manufacture to secure the above-mentioned requirements.

Bidder‟s/Contractor‟s sub-suppliers and vendors shall comply with Provennes Criteria as stipulated elsewhere in the biding document.

Throughout the Power Plant metric units, scales and measures shall be used; this applies especially to all fittings.

B0.6.8 Accessibility

The Contractor shall supply and erect sufficiently large safe platforms, galleries, stairways or ladders and access ways necessary for providing safe and easy access to all the plant items for operation and maintenance. The Contractor shall ensure that the whole of the access ways is of uniform design and pattern throughout the works.

The design of all stairways, access ways etc. shall conform to the requirements of the relevant chapters is **Section B0**.

B0.6.9 Signs & colour code

General
Safety colours, safety symbols and safety signs must comply in construction, geometrical form, colour and meaning with the ISO 3864.

Signs for plant identification during the erection period must be to Employer‟s approval.

The signs should be of a material which is weather-resistant and of sufficient durability for the conditions prevailing on site.

Mounting and installation
The positions for the signs must be chosen so that they are within the field of vision of the persons to whom they apply. The signs should be permanently attached. Temporarily dangerous areas (e.g. construction sites, assembly areas) may also be marked by movable signs. The safety signs

must be mounted or installed in such a manner that there is no possibility of misunderstanding.

Information signs
Information signs should supply the necessary information to acquaint personnel with the physical arrangement and structure of site, buildings and equipment, e.g. floor numbers, load-carrying capacities including marking of floor areas, working loads of cranes, lifting gear and lifts, room identification, etc. The routing of underground pipes and cables is to be indicated by substantial marker blocks showing the relevant identification numbers.
In the choice of information signs in situations not covered by ISO Draft Recommendation 507 the possibility of using pictograms should be considered. Pictograms are particularly suitable for the identification of rooms, areas and buildings in the non-technical areas of the Plant, sanitary and amenities buildings, etc.

Emergency signs
In the event of accidents, all necessary information should be available immediately to those affected. Thus, a sufficient number of signs of appropriate size should be installed, e.g. escape routes (including marking of floor areas), emergency exits, fire alarms, fire extinguishers, instructions for special fire-extinguishing agents, warnings against fire-extinguishing agents (CO_2), first aid equipment, first aid points, accident reporting points, telephones, etc.

Mandatory signs
Signs indicating obligatory actions must be provided installed wherever certain action is necessary, e.g. do not obstruct the entrance; keep right, etc. Signs should also indicate when the wearing of protective clothing and equipment is necessary and obligatory, e.g., protective goggles, protective clothing, helmets, head guards, breathing equipment, ear muffs, etc.

Warning Signs
Warning signs should refer to the existence or possible existence of danger, e.g., flammable substances, explosive substances, corrosive or noxious substances, suspended loads, general danger, width/height restriction, steps, risk of trapping, slipping, falling, etc.
In addition to warning signs, appropriate black-yellow strip markings should also be used where necessary.

Equipment and Piping Colour Code
For colour code for all equipment and piping see table below, for any other items Employer‟s approval shall be obtained. For safety issues relevant standards and regulations shall prevail in case of discrepancy. Final colour selection is to be discussed and approved by Employer.

Colour Code (based on DIN 2403:2007-05 & DIN 5381)

Medium	Base	RAL	Band/ Ring	RAL	Let-tering	RAL
Flammable liquids and solids e.g. high speed diesel, lube oil, seal oil, hydraulic oil, coal	Signal Brown	8002	Signal Red	3001	Signal White	9003
Flammable gases e.g. hydrogen	Signal Yellow	1003	Signal Red	3001	Signal Black	9004
Non-flammable liquids and solids e.g. ash	Signal Brown	8002	Signal Black	9004	Signal White	9003
Non-flammable gases e.g. nitrogen, carbon dioxide	Signal Yellow	1003	Signal Black	9004	Signal Black	9004
Fire fighting, e.g. fire fighting water	Signal Red	3001			Signal White	9003
Water e.g. service-, demin-, condensate, feed-, river-, cooling-, closed cooling water; except fire fighting water	Signal Green	6032			Signal White	9003
Steam e.g. main steam, HRH, CRH, aux. steam	Signal Red	3001			Signal White	9003
Acids e.g. HCl, ferrous sulphate	Signal Orange	2010			Signal Black	9004
Alkali, e.g. ammonia, caustic	Signal Violet	4008			Signal White	9003
Air e.g. station air, service air, instrument air	Signal White	9003			Signal Black	9004
Oxygen	Signal Blue	5005			Signal White	9003
Driven machines (e.g. fans and pumps) including motor; Vents, drains, vacuum	Follow medium color					
Structural steel, steel skids for equipment	Window Grey RAL 7040					
Safety caution, e.g. fall or trip hazards, handrails, head room clearance	Alternating stripes Signal Yellow RAL 1003 / Signal Black RAL 9004					
Panels, cubicles, junction boxes	Light Grey RAL 7035					

B0.6.10 Units of measurement

The Contract shall be conducted in the Systems International d"Units (SI) system of units in accordance with the provisions of ISO 31 and ISO 1000.

In all correspondence, technical schedules, drawings and instrument scales, the following units shall be used:

Quantity	Name of Unit	Symbol
Length	Millimeter	mm
Mass	Kilogram	kg
Time	Second	s
Temperature	Degree Celsius	°C
Temperature Difference	Kelvin	K
Electric Current	Ampere	A
Luminous Intensity	Candela	cd
Area	Square meter	m^2
Volume	Cubic meter Liter	m^3 l
Force	Newton	N
Pressure	Bar	bar
Pressure below 1 bar	Millibar	mbar
Stress	Newton per square millimeter	N/mm^2
Velocity	Meter per second	m/s
Rotational speed	Revolutions per minute	rpm
Flow	Cubic meter per day Cubic meter per hour Kilogram per hour Liter per second metric ton per hour	m^3/d m^3/h kg/h l/s t/h
	For gaseous substance: standard cubic meter per hour	Nm^3/h
Density	Kilogram per cubic meter	kg/m^3
	Kilogram per standard cubic meter	kg/Nm^3
Torque, moment of force	Newton meter	Nm
Moment of inertia (mr^2)	Kilogram square meter	kgm^2
Work, energy or heat	Joule	J
Heat capacity, entropy	Joule per Kelvin	J/K
Specific heat capacity, specific entropy	Joule per kilogram Kelvin	J/kgK
Calorific value	Joule per cubic meter Joule per gram	J/m^3 J/g

Quantity	Name of Unit	Symbol
Power, radiant flux	Watt	W
Heat release rate	Watt per square meter	W/m^2
Thermal conductivity	Watt per meter Kelvin	W/mK
Dynamic viscosity	Newton second per square meter	Ns/m^2
Kinematic viscosity	Meter squared per second	m^2/s
Surface tension	Newton per meter	N/m
Concentration	Parts per million	ppm
Electrical conductivity	Microsiemens per meter at 25 °C	µS/m
Frequency	Hertz	Hz
Electric charge	Coulomb	C
Electric potential	Volt	V
Electric field strength	Volt per meter	V/m
Electric capacitance	Farad	F
Electric resistance	Ohm	Ω
Conductance	Siemens	S
Magnetic flux	Weber	Wb
Magnetic flux density	Tesla	T
Magnetic field strength	Ampere per meter	A/m
Luminous flux	Lumen	lm
Illuminance	Lux	lx
Thermal resistivity	Kelvin meter per Watt	Km/W
Energy	Kilowatt hour	kWh

For the thermodynamic properties of steam and water, “The IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam” or the latest version thereof shall be used.

B0.6.11 Ways, stairs, ladders, balustrades

The Contractor shall supply all platforms, galleries and stairways necessary for providing safe and proper access to the Plant for operation and efficient maintenance. The Contractor shall ensure that the type of flooring, stair treads and handrails conform to a uniform pattern throughout the whole Project.

The loads for the design of platforms, galleries etc. shall be in accordance with the Section „Design Loads“ of the special civil part of these specifications.

All platforms, galleries, stairways and hand railing shall be of galvanized steel unless otherwise specified.

All platforms and galleries shall be designed with a minimum headroom clearance of 2200 mm and shall have a minimum width of 1500 mm clear passageway and shall be enclosed by hand-railing on both sides. Ladders are only to be provided as an extra means of escape.

All aspects of platforms, stairways, ladders and other access ways shall comply with the requirements of applicable DIN standards, BNBC or equivalent.

B0.6.12 Hazardous areas, fire fighting & prevention systems

Hazardous areas
The Contractor shall take full account of any special requirements concerning the nature, handling and storage of all fuels, flammable gases and chemicals etc., and provide plant, equipment, buildings and other services accordingly, including all facilities to ensure the safety of the operating and maintenance personnel.

The Contractor shall provide drawings to define all the hazardous zones taking account of all sources of hazards under normal and abnormal operating conditions (regardless of whether or not these areas are specifically listed in the specification). The zoning philosophy shall be subject to the approval of the Employer. All equipment necessary for mounting in these areas shall meet the requirements of BS 5345 or equivalent.

In particular, equipment directly concerned with Plant which may give rise to a hazardous situation shall be designed to IEC 60079 Zone 1 or 2 requirements with electrical connection safety barriers or intrinsically safe equipment equivalent to VDE 0171 Type Exi. Where required by the Employer/Engineer, certification shall be provided to confirm the suitability of the equipment and devices.

The Contractor shall be responsible for ensuring that all electrical equipment installed in any hazardous zone is designed and tested to suit the relevant zone classification and shall be to the approval of the Employer. Cables shall not be laid in trenches etc. with fuel pipe work.

All electrical equipment part of a following system installed in hazardous areas shall be of flame/explosion proof type:

- fuel oil handling systems
- burner operating floors
- turbine lubrication oil tank area
- generator sealing oil tank area
- diesel generator area
- hydrogen bottle house
- others required by the above standards.

All equipment offered for use in the above areas shall have the necessary certification by the appropriate National Certification Bureau and its proposed application shall fully comply with all conditions of the certificate.

At least all electrical equipment part of the systems in hazardous area as stipluated in the specification shall be of flame/explosion proof type.
For other systems the approach as described by the Bidder/Contractor can be applicable.

All electrical equipment associated with any part of a system within the following areas shall be of dust explosion proof type:

- station bunker rooms,
- conveyor transfer towers,
- 3 meters radius from coal feeders, pulverizers and the center point of pulverized fuel pipes.

Fire Fighting & Prevention Systems
See **Section B12**.

B0.6.13 Maintenance isolation

All major equipment shall be arranged to facilitate safe isolation from all hazards for maintenance purposes. In addition all valves must be capable of being locked either in the open or closed position by means of a chain and padlock.

Non return valves are not acceptable as a means of isolation.

B0.6.14 Materials

B0.6.14.1 General material requirements

All materials shall be new and of the best quality for use in the conditions and the variations in river water quality (refer to **Part C Annexes)**, the temperature and pressure that will be encountered in service without undue distortion or deterioration or the setting up of undue strains in any part that might affect the efficiency and reliability of the Plant.

All materials shall correspond either to the approved standards and the respective code number or to exact analysis data, and full information concerning properties and applied heat, chemical and mechanical treatment shall be submitted.

Special attention must be paid to eliminating the possibility of corrosion resulting from galvanic effects. Design, selection of materials and all methods of erection shall be such as to keep these effects to a minimum.

Materials complying with codes and standards listed below shall be used for the design and construction work.

Unless the materials meet these codes and standards the equivalent ASME/ASTM standard shall be used.

Materials and standards

(A)	a.	Structural Steel Built-up Members	DIN EN 10 027-1	all steel brands S235 and S355
			Formerly DIN 17100 and EN 10 025	Formerly St, USt & RSt37-2, St37-3, St52-3 or Fe360B, BFU, BFN, C & D1, and Fe 510
	b.	Structural Steel Hot Rolled Members	DIN 1024 Series DIN 1025 Series	all steel brands S235 and S355,
			DIN 1026 Series DIN 1027 Series DIN 1028 Series	Formerly St, USt & RSt37-2, St37-3 and St52-3; or Fe360B, BFU BFN, C & D1, and Fe 510
			DIN 1029 Series	
	c.	Structural Steel Tubes	DIN EN 10 210-1,2	S235 and S355
	d.	Crane rail	DIN 4132	
(B)	a.	Bolts and Anchor Bolts	DIN ISO 898, DIN 18 800-1	4.6 (fy ≥240 N/mm²) 5.6 (fy ≥300 N/mm²)
	b.	High Strength Bolts	DIN ISO 898, DIN 18 800-1	8.8 (fy ≥640 N/mm²) 10.9 (fy ≥900 N/mm²)
	c.	Stud Bolts	DIN 32 500, Part 1 & DIN 18 800-1	4.8 (fy ≥320 N/mm²)
			DIN 32 500, Part 3 & DIN 18 800-1	St 37-3 per DIN 17 100, (fy ≥350 N/mm²)
(C)	Electrodes for Arc Welding		DIN 1913/ DIN EN 499	
(D)	Ordinary Portland Cement		DIN 1164-1 / 1164-2 EN 197-1	
(E)	Reinforcing Bars		DIN 488-2 / 488-4	

Material properties and allowable strengths

- **Concrete steel reinforcement**
  High yield steel deformed bars, types as per DIN 488-2
  The max. bar length shall be 12 m.

- **Concrete steel fabric reinforcement**
  Reinforcement quality
  Wire of grade 500 (fy = 500 N/mm²) as per DIN 488
  Welding of reinforcement as per DIN 4099.

- **Fabric types**
  Preferred range of designated fabric types: see part 4 of DIN 488.

- **Concrete grade and specified strength**
  Concrete for blinding grade C12/15 as per DIN 1045. Min. thickness of blinding = 75 mm.
  Concrete for all other structures grade 25/30 as per DIN 1045.
  All concrete grade 30/37 or higher as well as special qualities, like waterproofed concrete, have to be mixed in accordance with a special design concept, approved by a third party assessment.

- **Concrete cover to reinforcement bars**
  The minimum concrete cover for durability to any reinforcing bar shall be in accordance with ZTV-K, **Section 6.**

  Concrete grade 25/30 as per DIN 1045 are minimum requirements, if not mentioned otherwise.

  Note:
  a) Cover noted is to the outside bar regardless of whether it is main or secondary reinforcement.
  b) For concrete exposed to brackish water, brine and seawater splashing a special design concept is required.
  c) For water or liquid retaining structures, the cover should be reviewed in conjunction with design, to limit the allowable crack widths. Linings could also need to be applied.

Structural steel
DIN 18800 / DIN 18801 / DIN 18807 shall be followed.

For all above mentioned material standards, the equivalent standards as per BS, ASME/ASTM are also accepted.

B0.6.14.2 Specific requirements for high temp./high pressure part materials

The purpose of this part is to provide the additional requirements for the purchase, manufacturing and fabrication of:

- austenitic stainless steels used for high temperature superheater and reheater tubing,
- ferritic/ martensitic steels used for high temperature pressure parts.

All manufacturers and suppliers of the base metals, from raw materials until finished products, shall be ISO 9001:2000 certified for the duration of the contract or being renewed during the duration of the contract as appropriate.

Only seamless tubes and pipes are acceptable for power piping. For low pressure systems (< 6 bar (g) welded pipes will be accepted. Welded pipes may be used for sizes above DN500 if the design pressure and design temperature are such that it calls for pressure rating of ASME 300 class or below. The fittings shall correspond to ASTM A234 with Grade corresponding to the pipe material. The welded pipes provided shall be of certified source.

All materials and manufacturing procedures shall be certified by an independent 3rd party. The approval shall be part of the quality documentation.

The use of SA213-T24 material for membrane walls is not accepted.

The material SA213-T23 is known for cracking sensitivity. It shall be demonstrated and documented in the final data package that all such materials are free from any cracks and that all hardness values are within the required limits.

For SA213-T23 the Contractor must provide a detailed procedure for the calculation, design, purchase, manufacturing, erection, cleaning and pressure testing of this material. The relevant ASME code cases must be respected.

For SA213 T91 and SA335 P91 the latest stress values and the latest information according to ASME code cases must be used. Also the EPRI „Guidelines and Specifications for High-Reliability Fossil Power Plants Best Practice Guideline for Manufacturing and Construction of Grade 91 Steel Components“ shall be respected.

Bidder/Contractor at his sole discretion may use ASME SA-335, P-92 or approved equivalent material for superheater/reheater headers and interconnecting piping, i.e. for the components which are outside the flue gas path. However, use of T92 material for boiler tubes is not permitted.

In case it is proposed by the Bidder/Contractor to use ASTM-A-335, P-92 or equivalent material, Bidder/Contractor shall furnish a certificate of provenness of the material certifying the usage and satisfactory performance of the proposed material in main steam/hot reheat piping for a reference plant (or applicable unit of reference plant) having rated main steam and/or hot reheat steam temperature at turbine inlet at least equal to or higher than the rated main steam and/or hot reheat steam temperature at turbine inlet envisaged by the Bidder/Contractor. Such reference plant(s) (or unit) should have been executed by the Bidder/Contractor himself or by others and should have been under operation for at least 50,000 hours or 6 years from date of commissioning of the applicable unit (of the reference plant).

Maximum allowable stress values for ASME SA-335: P-92 or approved equivalent material as per code shall be reduced by 10% for calculating the thickness of pressure parts.

For SA335 P92 the Contractor shall provide a detailed procedure for the calculation, design, purchase, manufacturing, erection, cleaning and pressure testing of this material. The relevant ASME code cases must be respected. SA213-T92 may be used for header nipples outside of the flue gas pass, while meeting the above mentioned requirements for quality control.

The details on preheating for welding and PWHT shall be stated in detail. Special consideration shall be given to record the metal temperatures during manufacturing, erection and operation.

In case of any repair of any of such materials at site the 3rd party engineer must be involved concerning the proposed repair method.

B0.6.15 Pre-service cleaning and protection of plant equipment

This clause covers mechanical and pre-service cleaning and protection of the plant items and equipment at the Manufacturer‟s workshop and at site that are not subsequently to be painted.

Cleaning of fabricated component items shall be carried out after fabrication and final heat treatment or welding at manufacturers‟ works or at site, as appropriate.

In the event of the surfaces not being cleaned to the Employer‟s satisfaction, such parts of the cleaning procedures or agreed alternatives as are deemed necessary to overcome the deficiencies shall be carried out at the Contractor‟s sole expense.
Mechanical cleaning as opposed to alternative chemical cleaning is the preferred method for workshop cleaning except where this is precluded by design or access considerations.

Machined surfaces shall be protected during the cleaning operations. For recleaning small areas, hand cleaning by wire brushing may be permitted. Wire brushes used on austenitic materials shall have austenitic steel bristles.

Austenitic stainless steels, copper and aluminium alloys, cast iron, bimetallic and metallic/plastic items, and components fabricated by spot welding or riveting shall not be chemically cleaned. All weld areas shall be suitably stress-relieved before chemical cleaning.

At an appropriate time, the Contractor shall submit drawings of temporary pipework necessary to carry out the pre-service cleaning simultaneously with a list of works to be carried out on the pipelines, heaters, feedwater

tanks, vessels etc. to connect the temporary pipework with the parts of equipment to be cleaned.

Further, the Contractor shall submit at the same time the basic draft of the cleaning procedure and of the treatment of wastes.

Not less than six months prior to the commencement of any site cleaning, the Contractor has to submit programs covering all procedures, lists of chemicals, calculations which quote the velocities, temperatures hand-pipework forces and movements imposed during site cleaning.

All necessary equipment, provisions, chemicals etc. are to be provided by the Contractor.

All tests, analyses, etc. as required are to be performed by the Contractor.

Besides this, the Contractor shall take over all responsibility for the treatment and disposal of wastes according to the local law and to the satisfaction of the Employer.

The date at which cleaning of plant equipment will be carried out at site shall be notified to the Employer at least 20 days in advance.

The Contractor shall take all necessary precautions to ensure that the internal surfaces of all plant are kept clean and free from injurious matter during erection.

When all plant has been erected and lagged or at such other time as may be agreed with the Employer for sub-assemblies, the installation shall undergo a procedure for site cleaning proposed by the Contractor and subject to the approval of the Employer.

B0.6.16 Welding

All pressure part welding must follow the requirements of ASME and connected standards.

Welding work and related heat treatment as well as inspections and test shall be performed in accordance with the specific and approved welding procedure specifications (WPS) and the respective material specifications.

WPS shall be prepared in accordance with relevant ASME standards, endorsed by 3rd party / inspector and submitted to the Employer.

Welding plans have to be prepared by every manufacturer for his scope of work.

No welding shall be undertaken until the applicable WPS and Procedure Qualification Record (PQR) are approved by the Employer.

The PQR shall be qualified in accordance with relevant ASME standard. Welding procedures must be qualified by a qualified independent testing authority engaged by the manufacturer.

Welding procedures shall be qualified in accordance with the requirements of the construction code/specification for the Item of plant concerned and in the case of critical plant items the tests shall be witnessed by an internationally recognized inspection authority.

Welders shall be qualified in accordance with the requirements of the construction code/specification for the Item of plant concerned for all types/positions of welding he may perform.

Welder tests shall be carried out in accordance with the approved standards within Contractor‟s scope. Test results are available for review in the work-shops.

If at any time in the opinion of the Employer the work of any welder appears questionable, such welder is required to pass additional qualification tests to determine his ability to perform the type of work on which he is engaged. Any welder failing the retest may, at the discretion of the Employer be dis-qualified from further welding on items under this Contract.

The 2 first production welds of every welder shall be 100% examined by volumetric NDE and only when the results are acceptable, shall the welder be released for production welding.

A system of positively identifying the work of each welder shall be maintained and any welder whose work is the subject of multiple rejections shall be required to undergo a requalification test. Any welder failing the retest may, at the discretion of the Employer‟s Representative be disqualified from further welding on items under this contract.

Welded fabrications shall be stress relieved when specified by the applicable standard or for dimensional stabilization prior to machining.

Copies of temperature charts referenced with load items shall be included in the test certification supplied for the relevant items.

All welds shall be visually examined and shall be of smooth contour, free from cracks, undercut and other significant defects. Wherever possible the interior of tubes etc. shall be examined using a suitable optical device where necessary. The manufacturer shall make every effort to avoid any contamination of the tube interior during the manufacturing process. To ensure the tubes are free from obstruction and debris the tubes shall be cleared with a sponge being blown through.

Fillet welds shall be checked for size using suitable gauges which shall be available for use on request by the Employer‟s Representative during an inspection visit.

For single side butt welds, all root passes shall be welded using a TIG welding process.

Preheating shall be in accordance with the applicable WPS and the respective material specification. The preheat temperature shall be in function of welding process, wall thickness, type of welding consumables, ambient temperature and climatic conditions

Welding performed outside a workshop is authorised if an approved wind and rain protection (welding bay) is installed around the working place. Anyway, when ambient temperatures falls below 5°C, preheat is required for all ferritic materials and thicknesses. Gas burners or oxy-fuel torches can be used for pre-heating. Preheat shall be maintained over a distance of not less than 4 times the nominal thickness with a minimum of 75mm on either side of the weld. If the material required pre-heating, the same pre-heating shall be done for oxy-fuel or plasma cutting.

Welding consumables such as TIG-rods, electrodes, wires shall be clearly marked in order to avoid any mix-up of material grades. Positive Material Identification to be carried out on where a doubt for mix-up exists.

Any post welding heat treatment (PWHT) shall be performed in accordance with an approved procedure. The procedure shall describe the method, the heat treatment parameters (e.g. holding temperature and time, heating/cooling rates, heated/insulated band...), the number and location of thermocouples, records and calibration. The procedure shall be available on Site and or in the workshops.

Before welding and/or heat treating valves, valve-manufacturer instructions shall be taken into consideration.

In the case of sensitive materials, grinding of the welds or other grinding work may only be carried out with special grinding wheels so as to avoid overheating or an increase in the hardness of the material.

Welding defects of all kinds must be documented and be available to the Employer on Site or in the workshop.

The Contractor maintains and makes available to the Employer or his representative, both at works and Site, adequately indexed records of all welds, weld inspections, weld controls and repair.

Please refer also to **Section B0** for “Manufacturing tests”.

Additional welding requirements for welding of civil steel structures are stated under **Section B9**.

B0.6.17 Mechanical equipment

B0.6.17.1 Pumps

General
All pumps shall be designed for continuous operation unless otherwise specified.

Pumps shall be installed in positions convenient for operation and servicing. Where multiple pump installations are required, each pump and its associated equipment shall be arranged in such a manner as to permit easy access for operation, maintenance and pump removal without interrupting plant operation.

Pumps installed for parallel operation or as stand-by sets are to be of identical design, i.e. interchangeable.

Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the pump and its components.

General design and construction
All pumps shall be designed to withstand a test pressure of 1.5 times the maximum possible pump shutoff pressure under maximum suction pressure conditions. If a pump can operate at sub-atmospheric suction conditions, the entire pump shall be designed for full vacuum.

All pump shafts shall be of ample size to transmit the maximum possible output from the prime mover. The pump shaft and coupling are to be so dimensioned that the maximum permissible torque of the shaft is higher than the maximum transmissible torque of the coupling. Directly coupled pumps shall be used preferably.

Renewable wear rings shall be provided at points of running clearance and shall be made from appropriate materials.

All pumps and accessories in contact with the pumped fluid shall be constructed of materials specifically designed for the conditions and nature of the pumped fluid, and be resistant to erosion and corrosion.

Product water flushing lines and drains are to be supplied for each pump handling the prevailing river water to avoid corrosion if the pump is out of operation for extended periods.

The pump glands or mechanical seals shall be so arranged that repackaging or fitting of replacement seals can be carried out with the minimum of disruption to plant operation. In case of operating under vacuum conditions liquid sealing is to be provided.

The pump casing shall preferably be split for ease of maintenance and be designed such that the impeller and shaft are capable of being withdrawn from the casing without disturbing any of the main pipework and valves carrying the pumped fluid. In general, all horizontal pumps with draw-out-rotors are to be fitted with a coupling to facilitate disassembly without removing the motor. Pull-out design of the shaft shall be applied to vertical wet pit and dry pit pumps as well.

Each horizontal pump shall be mounted with its drive on a common base plate of rigid construction. Vertical pumps are to be provided with foundation frames. In case of submersible pumps suitable frames shall be provided in the pump sump. It shall however be possible to remove these pumps without entering the sump.

Pumps must be carefully set to ensure that the net positive suction head available under all operating conditions will be adequate for the type of pump employed. The NPSH values are to be referred to the least favourable operating conditions - lowest atmospheric pressure, lowest level of water on the suction side of the pump, and highest temperature of the pumped fluid. An adequate safety margin of normally greater than 1 m to the max NPSH required shall be provided unless and otherwise specified for specific pump. Pumps shall operate smoothly throughout the speed range up to their operating speeds. The first coupled critical speed must be at least 20% higher than the maximum operating speed. The determination of the shaft diameter and the distance between two consecutive bearings must include a sufficiently large safety margin to satisfy this condition.

Where necessary, the pumps are to be fitted with devices to ensure a minimum throughput.

Bearings
For large pumps the bearings shall be of automatic oil lubricated sleeve type, unless otherwise specified. Bearings on vertical shaft pumps shall be so spaced to prevent shaft whipping or vibration under any mode of operation. Vibration sensors and temperature measurements incl. temperature transmitters for continuous monitoring shall be provided for large pumps.

Bearings housings on horizontal shaft pumps shall be designed to enable the bearings to be replaced without removing the pump or motor from its mounting. Bearing housings on horizontal shaft pumps shall be effectively protected against the ingress of water, pumped fluid and dust by suitable nonferrous deflectors.

All bearing oil wells shall be fitted with visual oil level indicators. Non-pressure-oil lubricated bearings shall be equipped with constant level oilers.

Pumps characteristics
When several pumps are installed for the same service, they shall be suitable for unrestricted parallel operation.

The pump flow/head characteristics shall be such that within the operation range the head will continuously increase with decreasing flow, maximum head (shut off head) being at least 10% higher than the duty point head.

Unless otherwise specified all pumps shall be capable of operating at 110% of the rated capacity at the rated delivery head. Maximum size impellers for the pump body in question shall not be quoted for. By installation of a new impeller a head increase of 5% minimum shall be possible. The performance of the drive motor is to be determined according to the above mentioned technical requirements and to the requirements as specified in the electrical part.

Fittings
All pumps shall be installed with isolating valves, a non-return valve and suction and discharge pressure gauges unless otherwise stated. Accessible couplings shall be supplied with removable type guards.
Coupling halves shall be machine matched to ensure accurate alignment. Couplings as well as gears must have a rated capacity of at least 120% of the maximum potential power transmission requirement.
All pumps other than submersible pumps shall have temporary strainers fitted in the suction pipework during all initial running and commissioning phases. Permanent strainers shall be provided where specified.

Venting valves shall be fitted to all pumps at suitable points on the pump casing unless the pump is self-venting, due to the arrangement of the suction and discharge nozzles. Drainage facilities shall be provided on the pump casing or adjacent pipework to facilitate the dismantling of pumps.

All positive displacement pumps shall be fitted with a discharge relief valve capable of passing the maximum pump delivery flow.

B0.6.17.2 Piping and accessories

Design criteria
The pipework shall be designed, fabricated, erected, inspected and tested on the basis of the applicable standards and codes, and the additional requirements as set out below.

For the plant water and cooling water system GRP is preferred, Bona-Pipe and coated carbon steel is acceptable. For saline water and the water treatment systems LPP piping will be accepted also. If a carbon steel system is offered, a cathodic protection system shall be employed for inside and

outside. For steel underground piping where cathodic protection is not feasible coal tar epoxy coating shall be applied. For painting and coating see chapter painting specification. A sufficient corrosion allowance shall be considered.

Plant water and cooling water piping system: If these pipes are buried cathodic protection system shall be employed for inside and outside. Further communicating lines (from above ground to underground and vice versa) will have to be provided with respective insulation joints. In any case protection against corrosion must be provided. GRP or other appropriate material is required.

Screening channel in the plant water pumping station as well as other equipment installed in pumping stations: In case all piping of mild steel is used require cathodic protection.

GRP piping shall be laid under the responsibility and supervision of the GRP pipe manufacturer.

The maximum flow velocities for the individual media must not be exceeded at maximum throughput (unless expressly specified in the documents or proven by the Contractor):

Type of Pipework	**Max. Velocity**
Steam lines:	
High-pressure live steam lines (PN ≥ 63)	60 m/s
HP / LP turbine bypass lines	100 m/s
Intermediate-pressure steam lines (PN 25/40)	40 m/s
Low-pressure steam lines above 5 bar	35 m/s
Low-pressure steam lines < 5 bar	25 m/s
Vacuum lines	80 m/s
Saturated steam lines	20 m/s
BFP drive turbine exhaust	80 m/s
Water lines (Feedwater, Plant water / cooling water, condensate etc.):	
Feedwater suction lines	0.5-2.5 m/s**
Feedwater discharge lines	3-5 m/s
Other suction lines	1.5 m/s
Other discharge lines	3.0 m/s
River water lines	3.0 m/s
Fuel lines:	
Fuel oil / LDO suction lines	1.0 m/s

Type of Pipework	Max. Velocity
Fuel oil / LDO discharge	2.0 m/s
Air Lines:	
Compressed air lines	15.0 m/s
Combustion air lines	20 m/s
flue gas lines	18 m/s

** The design and routing of the feedwater suction lines must be optimized considering the allowable velocity of depressurization caused by load changes.

The maximum velocity for the LP extraction shall not exceed 60 m/s. For those media/sytems where no maximum velocity is given in the specification, the maximum velocity shall be proposed by the Contractor and is subject to approval by BIFPCL during the basic/detailed engineering.

In addition pressure drop criteria shall govern the sizing of the key lines.

Nominal diameters (DN), nominal pressure (PN) and wall thicknesses shall be standardized.

Nominal diameters of < DN 25 shall not be used for pipe lines except for instrument lines, chemical dosing and analysis lines.

For the design of safety valves installed downstream of reducing stations, high pressure bypass valves or equivalent control valves, the maximum throughput of the fully open reducing or bypass valve including injection water quantity is to be taken as the basis for calculation. All cross Sections and lines for safety devices that protect against excess pressure (safety valves, rupture discs and similar items) must be designed to ensure the necessary blow-off rate and fault free functioning.

The design pressure is equal to the response pressure of the devices protecting the piping. In the case of pump discharge lines a pressure corresponding to 1.1 times of the shut-off head of the pump at the ambient temperature is to be taken as the minimum design pressure. The plant water and cooling water systems must be designed according to the water hammer calculation.

The design temperature is the highest possible fluid temperature occurring in the length of line concerned. Possible tolerances of the temperature control system and any temperature allowances provided by the requirements of the standards shall be considered.
For live steam lines the design pressure of the boiler shall be taken as the design pressure of these lines up to the inlet of the turbine main stop valves. In addition to the required wall thickness in accordance with calculations, a corrosion allowance of 3 mm shall be added for unprotected carbon steel, 1.5 mm for alloy steel and 0.5 mm by stainless steel.

For the cold reheat piping downstream of the connection to the HP bypass exhaust, the selection of the design temperature shall also consider the case that the HP bypass station is operated for limited period without spray injection. The Contractor shall prove both operating cases: Operation of HP bypass with spray attemperation and without spray attemperation (limited time period). Both cases shall not lead to any damage to the cold reheat piping and downstream pressure part.

For the piping systems with a nominal pressure specified as PN > 40 as in DIN 2401 or equivalent and for vacuum systems, the drainage and ventilation facilities shall be fitted with double valves.

All vents, drains or dump points with more than 10 bar/100 °C operating pressure/temperature shall lead to the flash tanks and into funnels at visible points with covers.

Guidelines for the design and construction of pipework and accessories

- Design and construction of all parts of the power piping shall be according ASME B31.1 (Power Piping).
- Other piping and accessories should correspond to the present state of the art and shall be based on the latest standards and medium properties.
- The pipework and its accessories shall be designed and arranged so that all parts subject to operation and maintenance can be operated, inspected, maintained and replaced without difficulty and with a minimum of effort. All important parts must be accessible.
- Provisions to allow for isolation and for access must be foreseen on all parts subject to acceptance by the local authorities.
- None of the forces and moments transmitted by the pipes to connected machines, apparatus and other components must exceed the maximum permissible values, given by the manufacturers of these items. Attachments to turbine foundations shall be carried out only as agreed with the turbine manufacturer.
- All steam traps shall be provided with a bypass and lines which open to a funnel.
- As far as expansion joints and other parts of pipework are concerned it shall be borne in mind that differential settlement can occur. The reaction forces and moments of the piping system to be withstood by fixed points, walls, foundations and other civil structures shall be reduced to the utmost minimum by suitable means (e.g. expansion joints shall be provided where required).
- The pipe support structures shall be designed to minimize heat transfer.
- The installed pipework with its supports and other components shall not obstruct gangways (min. 1500 mm wide), maintenance, escape routes etc. Overhead piping shall have a minimum vertical clearance of 2.3 meters, 8 meters above main access roads and 6 meters above any other roadways.
- Pipe spools for HP steam, feedwater piping and all steel pipes ≥ DN 400 shall be cleaned internally prior to delivery by shot blasting at the

workshop with iron particles to SA2 1/2 or by acid cleaning, and shall be properly protected against corrosion.

- Pipe ends and branch connections of underground piping shall be sealed temporarily during installation if the connecting pipe is not immediately installed.
- The Contractor shall submit a detailed description of proposed steam blowing and other cleaning procedures for all pipelines, and no part of this work shall be started until these procedures have been approved by the Employer. Temporary silencers shall be provided for this.
- The cleaning of water - steam system shall comply toVGB R513e „Internal Cleaning of Water-Tube Steam Generating Plants and Associated Pipework“
- The Employer reserves the right to require the Contractor to modify any of his cleaning procedures if found necessary to obtain acceptable results. The Contractor shall furnish, install and dismantle all temporary pipes, hangers, anchors, etc. required for cleaning all piping systems.
- To the extent that hot fluids can accumulate in pipe Sections isolated for maintenance purposes (including control valves with injection water), drains with hand-operated shut-off valves are to be provided for the safety of the personnel (block and bleed systems). Furthermore the Contractor shall safeguard the piping systems against over-pressurization caused by thermal expansion of blocked-in fluids by adequate means.

Welding

- All welding shall be carried out according to relevant standards. The welding procedures of the Contractor shall be supplied before execution of welding works to the Employer for approval. For quality reasons as many welds as possible are to be carried out in the workshop.
- Welding ends of all piping must be carefully prepared before welding. The type of butt welding ends of valves, control devices, orifices, etc. shall be specified by the Contractor and must be given to the manufacturers of these components in due time prior to their start of work if necessary/postweld heating treatment. If there are differences in the wall thickness and/or different materials of piping and valves with butt-welding ends, the necessary transition pieces must be provided by the manufacturer of the valves.
- Socket welds are not permitted for lines above DN 50, for corrosive media lines or for lubricating oil lines.
- After completion of the weld joint, the welder must mark with indelible crayon his identity number and the last two digits of the year in which the work was completed on the pipes. The Contractor shall keep a record of welders.
- Testing of piping and welding shall be as per ASME standard. Minimum requirements for testing of welds are specified in Section **B0.7.2.2.1 Welding tests**.

Piping

- The Contractor shall provide suitable thimbles and flashing where pipelines pass through floors and walls. Floor thimbles shall be installed to provide 90 mm projection above the finished floor surface.
- A stress analysis shall be performed for all piping systems DN ≥ 50 with an operating temperature ≥ 100 °C.
- For cross country low pressure piping with a straight length of more than 200 m a stress analysis shall also be conducted.
- The piping stress and flexibility analysis shall be based on the relevant standards. Recalculation must be taken into consideration as built condition, actual weight and dimensions.
- Tubes, pipes, bends and fittings shall be produced and tested in accordance with the applicable international standards (ASME/ASTM, EN, etc.).
- All pipe lengths under this package, including piping where alloy steel is used shall be subjected to 100 % ultrasonic examination as per material specification standard with acceptable notch depth of 5% of the selected wall thickness (1.5mm maximum) except for the following piping system: LP piping not under “ASME B31.1 Power Piping“ for not dangerous and not explosive media.

Noise abatement measures

The Contractor shall take all necessary measures to limit noise in accordance with the requirements. On no account shall the sound level exceed the values as mentioned under the relevant subsection.

If this requirement cannot be met by adequate construction of the pipework and valves concerned, sound absorbing housing or insulation have to be provided. Where pipework and valves are installed outdoors, the above mentioned requirement may be fulfilled, if necessary, by providing silencers at the safety valve outlets and at the blowing out lines.

Pipe supporting elements

As used herein, the term "hangers and supports" shall include all hanger assemblies, support assemblies, constant support hangers, anchors, guides, sway braces, vibration dampers, trays, brackets, attachments, miscellaneous structural steel and other items required to support the piping in a proper manner.

For supporting points up to 25% variation and 40 mm movement variable spring supports shall be selected.
Constant support type spring assemblies shall be provided at all locations where it is necessary to avoid transfer of stress from that support to another support or to an equipment terminal, and at other support locations where vertical movements of the piping are too large to be properly handled by variable support springs. Constant support spring assemblies shall be of a design that will compensate for the normal variation in the supporting force of the helical coil springs, thus providing constant supporting force through-

out a total travel range which shall be at least 20 mm greater than the actual maximum movement of the piping.

Constant support assemblies shall be equipped with a means of locking the spring(s) against movement during erection, hydrostatic testing etc. The use of counterweights in substitution for support spring assemblies will not be permitted.

Support spring assemblies shall be of the enclosed spring type, and shall have an embossed on factory load indication scale showing the hot (operating) and cold (ambient) positions. Each spring assembly shall incorporate an adjustable hanger rod coupling to permit load adjustment. All support springs shall be designed to permit at least ±10% field load deviation from the factory calibrated load.

The supporting force provided by variable support type spring assemblies shall not change by more than 20% between the cold and hot positions, and supports of this type shall not be used at any point where such a change in supporting force cannot be safely permitted. Variable support spring assemblies shall incorporate springs with maximum working range length in order to reduce the overall length of the assembly.

All pipe hangers and support stands shall be attached to the piping and structural supports such that they will be vertical when the piping is at hot operating condition. So far as practicable, hangers and supports shall be of the same type and component assembly.

All hangers shall be carefully adjusted. After Plant start-up checks shall confirm that all hangers and supports are in the correct position.

The Contractor shall prepare a complete documentation of all pipe hangers and supporting elements. These documents shall contain the following information:

- loads, forces and moments, and their directions at all supports, hangers at normal operating conditions, etc.
- magnitude and directions of the movements at the loading points
- measurements of the loading points referred to the axes of the buildings
- item No. of the supports, hangers etc. according to the piping group
- material specification for the supporting parts.

Trace heating

Trace heating shall be provided for fuel oil pipes and other pipes as required. Electric type trace heating is preferred. The referenced Site Conditions as well as media properties shall be base for the design.

Protection of buried pipework systems

All buried pipework of steel or cast iron or other materials prone to corrosion shall be protected from corrosion by cathodic protection.

The design of the cathodic protection system(s) shall be executed by a specialist and authorized company. The designed cathodic protection shall be a completely functioning system in all respects according to the state of the art and shall also include the appropriate equipment for measurements.

For the plant water and cooling water piping system only: If these pipes are buried cathodic protection system shall be employed for inside and outside. Further communicating lines (from above ground to underground and vice versa) will have to be provided with respective insulation joints
In any case protection against corrosion must be provided. GRP or other appropriate material is required.

B0.6.17.3 Valves, steam traps, condensate drainers, safety valves

The Contractor shall design and supply all valves and their accessories required for the safe, efficient and sound operation and maintenance of the Plant based on the appropriate standards. They shall comply as a minimum with the design criteria of the relevant piping.

For reasons of Plant standardization, the Contractor shall co-ordinate types and makes of all valves in his supply and that of his subsuppliers.

Design, construction, fabrication and testing of the valves shall be in accordance with the ASME B16.34. The stipulations of this Section will take precedence if these are more stringent than the approved standards.

All valves shall be suitable for the media and for the service conditions and those performing similar duties shall be interchangeable.

Acceptance certificates for valves shall follow EN 10204 or approved equivalent codes.

The following types of valves are recommended:

• globe valves	up to and including DN 50
• gate valves	DN 65 and above
• butterfly valves	DN 400 and above as metal seated type for LP steam and exhaust steam (DN 65 and above as soft seated type for waterlines (cooling water, process water etc., operating temp. max. 180 °C)
• lift check valves	up to and including DN 50
• swing check valves	DN 65 and above
• Ball valves (fuel oil, natural gas, compressed air)	DN 25 and above.

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DN means "diameter nominal".

In vacuum service and wherever otherwise necessary to prevent the entry of air, valves shall be provided with suitable sealing facilities. Where applicable, the valves must be suitable for outdoor installation under consideration of the special climatic and environmental conditions of the site.

Unless otherwise agreed, all valves shall be fitted with the spindle in upright position.

All valves shall be positioned so as to be readily accessible for operation and maintenance from permanent floors, catwalks or platforms. Where required, valve spindles shall be lengthened to have the hand-wheel at a height approximately 1 meter above the operation level. All underground valves shall be installed in concrete culverts.

All valves shall be closed in a clockwise direction when looking at the face of the handwheel. The valves shall have rising spindles and non rising handwheels. Plastic valve handwheels will not be accepted.

HP- and large size gate valves to be opened under differential pressure shall be equipped with pressure equalizing valves (globe valves).

All valves shall be fitted with indicators to determine the valve position. In the case of valves fitted with extended spindles, indicators shall be fitted both to the extended spindle and to the valve spindle.

All globe valves shall be equipped with throttling cones with parabolic characteristic.

In general, LP safety valves, butterfly valves, ball valves and orifices as well as all control valves shall be flanged. All valves including valves as mentioned above for steam, feedwater and condensate, HP safety valves (inlet side) shall have welded ends, corresponding to the connected pipes. Also all valves on heater drains and vents and in vacuum systems shall be welded.

Design of valves and materials used must comply with the relevant standards. They must be chosen in accordance with the requirements to be met and to corresponding pipework.

For limiting handwheel forces, for control and operation purposes it may be necessary to install gears and drives.

The maximum handwheel force of 500 N must not be exceeded.
The Contractor shall furnish and install steam traps at each low point. Each steam trap installation shall include a permanent strainer of 20 x 20 mesh

size, upstream and downstream globe valves and a globe valve as free drain. Steam traps shall be supplied with weld ends.
Steam traps shall preferably be of the thermodynamic, thermostatic or bimetallic type with multistage nozzles and selected to suit the service conditions.

Traps which incorporate internal screens or check valves will also be accepted.

Each trap shall be sized to provide ample capacity at the minimum working differential pressure, and to open the orifice at maximum working differential pressure.

Condensate drainers such as used on LP saturated steam or compressed air lines shall be of the ball-float type.

HP gate valves shall be equipped with self sealing lid covers. The self-sealing lid covers shall be equipped with a safety device at the body with shut-off valve and interlocking system. This system must be approved by the authorities.

All valves of the HP/IP piping systems shall be suitable for pickling/acid cleaning (special temporary inserts).

The valves for live steam, HP feedwater and HP injection water shall be made of forged steel. Forged steel or cast steel bodies shall be used for the remaining systems. Valves made of gray cast iron are not acceptable.

Acceptance certificates for piping components and valves shall follow EN 10204.

At the economizer inlet a non-return valve shall be installed, but not shut-off valve.

Technical requirements of Butterfly Valve:

Applicable standard:

- ASME B16.10 2009 Face-to-Face and End-to-End Dimensions Valves
- ASME B16.34 2009 Valves - Flanged, Threaded, and Welding End
- ASME B31.1 2012 Power Piping
- API 609 2009 Butterfly Valves: Double Flanged, Lug- and Wafer-Type
- API 609 2009 Butterfly Valves: Double Flanged, Lug- and Wafer-Type
- ISO 5752 1982 Metal valves for use in flanged pipe systems - face to face and centre to face dimensions
- ISO 80000-1 2009 Quantities and units
- EN 10204 2004 Materials Testing Certificates

Valves assemblies shall be designed for the pressure and temperature rating of the class specified in the Piping Material Classes and Valve List.

Hydrostatic testing for valves shall be in accordance with ASME B16.34 and API 598.

Carbon steel having carbon contents of more than 0.25% shall not be used in Welded construction valves.

Lug type valves shall not be used.

Valve stem packing, trim and bonnet gasket material shall be manufacturer's standards, unless otherwise specified.

The maximum force requested at the hand wheel shall not exceed 300N (30kgf).

The manually operated valves in the sizes and pressure classes shall be provided with a gear operator as minimum.

- Class Butterfly
- 150 DN 200 & larger
- 300 DN 150 & larger

Gear operator type: Worm-gear type

All valve actuators shall have local indicators fitted to show whether the valves are in an open or shut position. Where extended spindles are used, indicators shall be fitted to both the extended spindle and to the valve spindle.

Plastic or bakelite valve hand-wheels are not permitted.

The stops limiting the travel of any valve in the "open" or "shut" position shall be arranged externally to the valve body.

All valves shall be closed by turning the hand-wheel in the clockwise direction when looking on top of the hand-wheel.

The face of each hand-wheel shall be clearly marked with the words "open" and "shut" in English, with adjacent arrows to indicate the direction of rotation to which each refers.

Each valve hand-wheel shall be fitted with a name-plate of an approved material, indicating in English the valve reference number and function. The name-plate shall incorporate the colour code corresponding to the particular service of the piping.

B0.6.17.4 Thermal insulation

General
The thermal insulation shall be designed and installed in accordance with AGI, VDI and DIN or equivalent standards, considering the following minimum requirements:

Insulation shall be provided for personnel protection, heat conservation, noise reduction and for prevention of the formation of condensation on all pipework and equipment whose external surface temperature exceeds 60 °C.

For personnel protection all surfaces with a temperature above 50 °C and which are within the reach of personnel shall be provided with protection insulation and the maximum insulation surface temperature shall be 60 °C.

- All insulation material has to be made from non-asbestos materials.

Following design criteria for insulation shall apply: Design ambient temperature:

- Inside buildings: Ambient temperature of 40°C and wind speed of 0.5 m/s
- Outside buildings: Ambient temperature of 45°C and wind speed of 0.25 m/s

Thickness of the insulation shall be calculated according to ASTM C-680.
The Emissivity of the cladding shall be 0.2.

Type of insulation materials
The mats shall be stable in shape, chemically inert, free of sulfur and alkali, resistant to water and steam, non-flammable and capable of withstanding continuous exposure to the pipe design temperature. The mats used for insulation of stainless steel equipment shall have a chloride content of less than 0.15%. Under no circumstances may asbestos or asbestos containing materials be used.

The material will have the following physical/chemical properties (± 10% allowance):

- service temperature up to 650 °C
- density 120 kg/m^3
- water adsorption 0.5% weight
- specific heat capacity 0.84 kJ/kg °C
- compressive strength 20 kPa
- conductivity versus temperature:

Average temperature	Blanket (W/m °C)
0	0.034
50	0.040
100	0.048

Average temperature	Blanket (W/m °C)
150	0.058
200	0.070
250	0.083
300	0.100

For temperatures above 300°C the conductivity required shall be determined by linearly extrapolation of the values presented in the above table.

- conductivity allowance is limited to + 5%.

For special purposes such as for turbines, boilers, etc. spray type insulation or insulation brickwork (for example calcium silicate) may also be applied. The special insulation materials shall be stated by the Contractor and their design shall match the overall design and guarantee the requirements stated in the specifications.

Type of insulation setting materials
The surface cladding shall be made of aluminium sheets, manufactured in sheets with the following minimum thickness:

- Outer insulation diameter up to 150 mm Sheet thickness 0.7 mm
- Outer insulation diameter up to 450 mm Sheet thickness 0.9 mm
- Tanks and other large equipment Sheet thickness 1.2 mm

Tank tops shall be provided with insulation strong enough to support a man's weight.

The sheets shall be secured and connected at the longitudinal seams with at least five stainless steel self-tapping screws per meter run.

Plain sheets for flat surfaces shall not exceed 1 meter square and shall be stiffened by crimping.

At the longitudinal and circumferential joints, the sheets shall overlap by at least 50 mm so as to drain off the liquid and not to trap the liquid in the insulation.

Places at which the metal sheets are penetrated for pipe hangers, thermometer sockets, etc. shall be sealed with funnel-shaped recesses or sheet metal rims.

The seams and penetrations of any sheet metal insulating jacket installed outdoors as well as in the boiler and turbine house in areas with risk of water spray etc., shall be sealed against penetration of water by means of a suitable silicon based sealant.

In the case of pipe insulation thicknesses greater than 60 mm, where insulation blankets are used spacers shall be provided at maximum intervals of 950 mm to ensure a uniform insulating thickness on all sides and a perfectly circular shape of the sheet metal jacket. The sheet metal jacket shall be supported by support webs (for pipe diameters below 100 mm) and enclosed support rings (for pipe diameters 100 mm and above). If the enclosed support rings are not provided with ceramic spacers, the spacers made of steel shall be insulated with one heat insulation strip in the case of operating temperatures of up to 200 °C, and with two heat insulation strips where the operating temperature exceeds 200 °C.

To provide protection against contact corrosion, the external circumference of the support ring shall be fitted with heat insulation tape 1 mm thick with two woven edges.

Insulation of flanges, valves and fittings
All flanges, valves and fittings shall be provided with two-piece or multi-part caps made of aluminium sheet of the specified thickness. Each piece or part shall be double jacketed and the various parts shall be held together by quick release clamps or lever hooks to facilitate assembly and disassembly.

All caps of the welded-in fittings shall be made longer by approximately twice the insulation thickness so that the welding seams will be exposed after removal of the cap.

All manholes shall be provided with heavy duty hinged covers which are to be protected from overheating and corrosion. Such covers shall be secured with easily accessible clamps. In addition, metallic stand-offs shall be provided for personnel protection.

Insulation of tanks and process equipment
Tanks and process equipment shall be insulated in the same way as pipes, except that the insulating material shall not be attached by wire but by using strong galvanized steel bands.

Spacers shall be welded to process equipment only if this is essential for satisfactory retention of the insulation. Welding of spacers to process equipment is subject to approval by its manufacturer in writing.

Insulation for personnel protection
Wherever insulation is necessary only for the protection of personnel, it shall be applied around that portion of the pipeline length or to that surface of the equipment that is located within 2.50 m above the passage way floor, or within 1.20 m horizontally to the side or at the end of any floor, platform, walkway, stair or ladder.

Where necessary, drain lines and valves shall be provided with a contact guard of minimum 30 mm thickness against accidental contact, and this shall be installed in the same way as the other insulation.

Where insulation is provided for heat conservation it shall reduce the heat loss to an economic minimum. The maximum heat loss shall be 200 W/m^2 at an ambient temperature acceptable at 30 °C and a wind speed of 2 m/s. For personnel protection all surfaces with a temperature above 50 °C and which are within the reach of personnel shall be provided with protection insulation. The maximum insulation surface temperature shall be 60 °C.

B0.6.17.5 Vessels

All vessels shall be designed in accordance with the applicable standards and regulations.

The Contractor is held responsible for the correct design and dimensioning of the apparatus.

Connections shall be provided for all pipework, together with connection and tapping points for instrumentation. Manholes, vents, drains, safety devices and any platforms necessary for safe operation and easy maintenance have to be included in design and supply.

If under any operation conditions vacuum can occur in the vessels, they shall be designed for max. pressure and full (= 100%) vacuum.

The welding factor for all vessels is fixed to v = 1.0. The minimum wall thickness should not be less than 10 mm, and an appropriate corrosion allowance based upon the particular material, but not less than 1 mm.

Instrumentation and control equipment shall be provided according to the safe service requirements. A minimum requirement is to equip each vessel with a local level indicator, a temperature and a pressure indicator.

Manholes shall be provided as follows:

1. manholes (minimum nominal bore 600 mm) for vessels of 1.0 meter diameter and above
2. handholes (minimum size 200 mm) for vessels below 1.0 meter diameter

All nozzles shall be provided with flanges and shall be so arranged that practical pipe connections are possible. The stub length for all stub pipes shall be at least 200 mm, measured from the tank wall to the flange sealing surface. In the case of insulated vessels, the length shall be chosen so that there will be a clear space of at least 100 mm between the cover of the insulation and the underside of the flange. Nozzles below DN 25 are not acceptable.

For insulated vessels, provisions must be made for fixing and supporting the insulation.

All tank internals must be replaceable through the manhole unless by approval of the Employer. Prefabricated vessels must as a minimum have a coat of primer applied before transport. They shall be cleaned and internally dry. All openings must be secured closed before transport.

Tank and vessel capacities given for process relevant documents and for basic design calculations shall be *usable net* volumes and shall be in the relevant documents clearly referred as such.

B0.6.17.6 Heat exchangers

Heat exchangers are to be designed, manufactured and erected in accordance with the applicable standards.

Only proven products shall be delivered. No cast iron components are permitted.

It must be possible to install and remove the heat exchangers without undue difficulty. Lifting lugs and eyes and other special tackle shall be provided to permit easy handling.

Tubular heat exchangers or plate and frame type heat exchangers are acceptable where no specific requirements expressed. Where necessary the tubes are to be protected by impact shields. An adequate number of visual inspection ports are to be provided in critical areas to facilitate condition monitoring.

Unless otherwise specified, all heat exchanger tubes and casings must be designed to withstand 1.2 times the zero flow pressure of the relevant pump at cold conditions, or 1.2 times of the maximum positive operating pressure, as applicable. The test pressure must be 1.5 times the design pressure.

The heat exchangers shall be designed for the maximum temperature incurred plus 20 K.

Heat exchangers must be capable of continuous unrestricted operation with up to 10% of plugged tubes, and a corresponding factor of conservatism of at least this amount must be used in the design of the heat transfer areas.

Considerable importance will be attached to the ease of cleaning the heat exchangers.

Where any heat exchanger part in contact with liquid can be isolated, and there is a possibility of being heated from the other side, safety valves are to be provided for pressure relief.

Pipes from drains, vents and safety valves are to be grouped together, and routed to easily observable points equipped with covered funnels or to the flash tanks.

The overall design and conception of the heat exchangers and accessories is to be such that they are suitable for the degree of automation envisaged for the individual system.

B0.6.17.7 Instrument and service air

To meet the compressed air requirements of the Plant two different compressed air systems, - instrument air and service air, will be provided.

The service and instrument air system shall produce and deliver compressed air for the following main consumer of the Power Plant and desalination plant:

- Service air for atomization of HSD (High Speed Diesel) and for operation of mechanical air tools, wrenches and other consumers during all operation modes of both units and for maintenance purposes.
- Instrument air for all pneumatically operated plant instrumentation and control devices and other consumers. The instrument air quality shall meet ISO 8573-1 Class 2".

For detail instruction on compressed air see **B12 Part 7**.

B0.6.17.8 Cranes, hoists and lifts

B0.6.17.9 Cranes

For erection and maintenance works, overhead travelling crane per unit shall be installed in:

- One EOT Crane for each turbine hall (Refer the below note)
- One EOT crane for the compressed air station building.

Note: If Bidder/Contractor intends to provide one EOT crane then turbine generator stator shall be moved by special device (to be handed over with special tools).

For handling of the generator stator the following alternative is also acceptable: Tandem/combined operation of two turbine hall EOT cranes for which the necessary arrangements shall be provided. In such case the combined capacity of two EOT cranes shall not be less than the 105% of weight of generator stator, including the weight of lifting beam with swiveling equipment and slings.

HP heater shall be moved by turbine hall crane.

For erection and maintenence works in the plant water screening and pumping station two (2) travelling bridge cranes shall be installed, one for pump and header bay area and one for screening plant area. The cranes shall

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be calculated and designed in accordance with the principles of DIN or equivalent standards.

EOT crane shall only be used in closed pumphouses.

For installation and repair works in the cooling water pumping station one (1) gantry crane shall be installed.

Additional overhead travelling cranes are to be installed in pump houses, central work shop and all other locations and buildings for equipment of this Contract where cranes are needed. Refer also to the individual technical sub-sections of this specification.

The nominal carrying capacity of the cranes must be such that the heaviest object to be lifted including the spreader bar and other necessary auxiliary lifting devices can be transported with safety.

Cranes with a span of more than 8 m and/or a nominal carrying capacity of more than 5 t shall be in the form of double-girder cranes with the crab running on top.

Smaller cranes shall be in the form of single-girder cranes with the crab running on the lower flange or in the form of suspension cranes.

Cranes with a nominal carrying capacity of 30 t and above shall be fitted with an auxiliary hoist.

The overhead travelling cranes shall be fitted with gangways on the crane bridges or with gangways fitted to the sides of the crane.

The end-carriages of all cranes shall generally be of welded box-girder construction. Buffers shall be provided at the faces on the end-carriages. The end-carriages shall also be fitted with wheel-breakage supports designed to prevent derailment as well.

The deflection of the crane bridges at nominal load shall not exceed 1/1000 of the span for cranes with capacity of 50 t or more, or 1/900 of the span for cranes below 50 t capacities.

The crab assemblies shall be of rigid steel construction. Buffers shall be provided at the faces of the crabs.

The crabs shall as far as possible be covered with smooth sheet-metal and fitted with handrails.

The crane switchgear shall be accommodated in switchgear cabinets to be arranged on the crane bridge.

The crane and crab running wheels shall be made of cast or forged steel and shall have double flanges. The wheels should have rolling bearings lubricated for life.

For cranes used for the removal and installation of pump rotors in vertical pumps (e.g. cooling water pumps), it is important to ensure that there is no lateral drift of the hook during lifting and lowering.

All cranes shall be equipped with pendant control units. The pendant control units shall be suspended on the bridge so that they can travel along it independently of the crab.

All pendant control panels shall be fitted with rocker-type or push-button switches for the crane functions. A key switch and an emergency stop switch shall also be provided on each panel. Additional switches or push buttons shall be provided as required.

The crane and crab drives are to be designed as two-corner drives with electric gear motors. 2 (two) motors are to be provided for the crane drives. The crab drives may consist of one motor and universal joint shaft.

All travelling and traversing drives are to incorporate pole-reversible squirrel-cage gear motors with sliding armature and brake.

The lifting gear may consist of standard electric hoists with sliding armature motor and cone brake or disc brake.

The precision speed control shall be provided for all crane and lifting gears.

Speeds for cranes shall be as below:-

- For TG hall crane-
  - Main hoist - 1.6 m/min (creep speed 0.16 m/min thro VFD)
  - Aux hoist - 7.5 m/min (creep speed 0.75 m/min thro VFD)
  - CT - 15 m/min (creep speed 1.5 m/min thro VFD)
  - LT - 30 m/min (creep speed 3.0 m/min thro VFD)
- For other cranes-
  - Main hoist - 3 m/min
  - CT - 10 m/min
  - LT - 10 m/min.

B0.6.17.10 Hoists

Hoists shall be provided throughout the entire installation where machines or other components provided under this contract are to be installed, removed, repaired, serviced or transported and these parts are not in the working area of a crane (refer also to the individual technical subsections of this specification).

The final number of hoists to be supplied will be proposed by the Contractor, according to the requirements of the equipment. The Contractor has to include in his offer the number of hoists for the whole Plant. Any necessary change of hoists must not lead to any price change of the contract price.

The hoists used shall be standard production hoists.

The hoists shall be designed and calculated in accordance to applicable standards.

The nominal carrying capacity of the hoists and of their attachment points shall be such that the heaviest object to be lifted can be transported with safety.

For electric hoist, trolley travel speed and hoist speed shall be 15 m/min and 6 m/min respectively.

Manual hoists shall take the form of chain tackle blocks with load and drive chains. The crabs shall be fitted with a drive also operated by a chain. The runways shall be designed according to approved standards.

Electrically driven hoists and crabs shall be equipped with squirrel-cage motors. An inching control shall be provided on all electrically driven hoists and crabs.

The crab power supplies shall be in the form of sheet-steel-enclosed safety power tracks, which can be easily bent to follow the form of the hoist runways.

Electrical switchgear and control gear shall be mounted directly on the hoists in cabinets.

The electric hoists shall be operated by pendant control units fitted with pushbutton or rocker-type switches, which shall be fixed to the hoists in such a way that safe operation is guaranteed.

The control panels shall be equipped also with a key-operated switch and a mushroom-shaped emergency "off" switch.

Limit switches shall be fitted to all lifting and travel gear.

The electrically operated hoists shall be installed in a permanent location.

Where hoists are not easily accessible by simple means such as ladders or mobile scaffolds, maintenance platforms with means of access shall be provided.

B0.6.17.11 Lifts

One (1) lift in each steam generator building for goods transport (minimum capacity 3,000 kg) and one (1) no. conventional passenger elevator in each the steam generator building for personnel transport (minimum capacity 16 persons and minimum 1,100 kg) shall be installed, reaching the highest accessible platform. Outdoor hoisting arrangements shall be included at one side of each boiler house for lifting long items of up to 4,000 kg.

Deleted: A minimum of one (1) outdoor type li shall be provided in order to transport persons an goods. At least one (1) outdoor type lift shall be i the boiler house, with a minimum capacity of 4,0 kg

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Further Elevators shall be provided in the following building, reaching the highest floor of these buildings:

Deleted: power house or bunker

- 2 x elevators TG building
- 1 x elevator for service building
- 1 x elevator for crusher house
- 1 x elevator for highest transfer point before main plant.

For administration building 2 x nos. of 16 person capacity (minimum 1,100kg), panoramic type elevator shall be provided.

Lift for light material store shall be provided as follows:

- Quantity = 1
- Type = Goods lift
- Capcity = 1,000 kg.
- Speed=0.5 m/s.

The basic requirements for conventional passenger elevators are:

- Capacity: 16 person (minimum 1,100 kg)
- Speed: 1 m/s

The lift installations shall be designed as cable-operated lifts with traction machine. The car shall be provided with automatic telescope sliding doors.

The lifts shall be designed, manufactured, erected and tested according to OSHA (Operational Safety and Health Administration) and applicable standards.

During the construction period, the sides of the cars (without doors) and the floor of the cars shall be provided with protective coverings (hardboard panels or similar). The protective coverings shall be removed by the Contractor after the construction period.

The motors and switchgear must be designed for at least 180 starts/stops per hour. The type of enclosure of the switchboards and motors shall comply with the relevant requirements of **Section B0**.

B0.6.18 Electrical equipment and works

B0.6.18.1 Standards

The design and manufacture of all electrical equipment shall comply with the latest editions of the IEC Recommendations if not specified otherwise elsewhere in the specification. Compliance with ANSI/IEEE/NEMA, BS, EN or VDE standards will only be accepted in case no applicable IEC standards are available and subject to approval by the Employer/Engineer.

The Plant shall comply with:

a. the Essential Electrical Requirements of the PPA
b. the latest edition of the Electricity Grid Code of the Bangladesh Energy Regulatory Commission; and
c. the Great Britain Grid Code.

In case of contradictions the order of precedence shall be as follows:

a. Essential Electrical Requirements of the PPA;
b. Electricity Grid Code of the Bangladesh Energy Regulatory Commission;
c. Great Britain Grid Code.

Any other requirements of BPDB/PGCB shall also be considered (if available).

B0.6.18.2 Voltage levels

The following voltage levels shall apply:

• 400 kV and 230 kV, 50 Hz	connection voltage to the public grid
• 18 to 27 kV, 50 Hz	generator voltage, depending on manufacturer˝s standard
• 11 kV ± 6%, 50 Hz	voltage for motors equal to/bigger than 1500 kW and for power distribution within the Plant
• 3.3 kV ± 6%, 50 Hz	voltage for motors equal to/bigger than160 kW and for power distribution within the Plant
• 240/415 V (+/-) 10%, 50 Hz	standard voltage for power supplies to small electric power consumers and motors below 160 kW lighting and domestic power outlets
• 240/415 V (+/-) 10%, 50 Hz	voltage for power supply of essential electric power consumers - the system shall be operated with ungrouded neutral
• 220 V DC + 10%/-15%	voltage for emergency users of electricity, like turbine emergency oil pumps, circuit breaker control, inverters

- 240/415 V ± 10%, 50 Hz — uninterrupted voltage supplies to consumers, which require uninterrupted infeed like DDCMIS components, control actuators, burner control panels, VDUs.
- 24 V DC ± 15% — for power supplies to the DDCMIS system components
- 24 V ± 10%, 50 Hz — for erection work in enclosed plant items of metal

The general arrangement of the particular voltage level for each part of the Plant within the scope of the Contract and the connections of the power supply systems can be seen from the Key Single Line Diagram (Annex E).

B0.6.18.3 Insulation levels

- The 400 kV system shall be designed to limit the switching surge overvoltage to 2.3 p.u. and the power frequency over-voltage for the 400 kV system and the 230 kV system to 1.5 p.u. The lightning arrestors associated with the 400 kV reactors shall be of 336 kV.
- Following insulation levels shall be considered:

.	Description	400 kV	230 kV	Generator *	11 kV	3.3 kV
1.	Highest voltage for equipment	420	245	24 or 36	12	3.6
2.	Power frequency withstand voltage	650*/630	460	50 or 70	28	10
3.	Lightning impulse withstand voltage	1425	1050	145 or 170	75	40
4.	Switching impulse withstand voltage (phase to earth)	1050	-	--	-	-

* According to manufacturer standard

The creepage distance of the outdoor insulators shall be minimum 31 mm/kV.

- 400 kV level:
  - rated switching impulse withstand voltage 1050 kV
  - (phase-to-earth);
  - rated lightning impulse withstand voltage 1425 kV;
    *rated power frequency withstand voltage for GIS 650 kVand for transformers 630 kV.
- 230 kV level:
  - rated short duration power-frequency withstand voltage 460 kV;
  - rated lightning impulse withstand voltage 1050 kV.
  - Remark: The insulation coordination study shall be carried out by the Contractor.

B0.6.18.4 Installation conditions and protection class for electrical operational equipment and control and monitoring equipment

If not specified otherwise the electrical operational equipment must be designed to meet protection classes stated below.

Switchgear, housings for electrical equipment and electrical equipment itself must be designed according to IEC 60529 at least to:

- Class IP 41 if located indoors in air-conditioned/ventilated areas
- Class IP 42 for ventilated enclosure of DDCMIS equipment if located indoors in air-conditioned/ventilated areas with suitable cannope ontop to prevent ingress of dripping water
- Class IP 22 for non-ventilated enclosure of DDCMIS equipment if located indoors in air-conditioned/ventilated areas with suitable cannope ontop to prevent ingress of dripping water
- Class IP 54 if located indoors
- Class IP 65 for all I&C field devices
- Class IP 55 for motors located outdoors and in indoor areas with high dust and humidity
- Class IP 65 for other outdoor electrical and control system equipment such as cubicles or panels with additional measures) if located outdoors in accordance with IEC 60529 (degrees of protection provided by enclosures (IP Code) or equivalent). The additional measures shall consist of sunshades, protection covers against splashing water, additional sealing, special acid resistive coating etc., depending upon the particular site conditions at the place of installation, subject to the approval of the Employer.
- Class IP 21 if located indoors with open doors.

The lamps for external lightning and internal lighting of not completely closed buildings must have protection class IP 55W. Furthermore for dust prone areas the lamps shall have protection class IP 65.

Electrical operational equipment which must be installed in areas exposed to danger from explosions must have the required explosion-proof design appropriate to the flash-point group classification of the explosive mixture as laid down in IEC 60079. Attention must be paid with respect to the use of electrical operational equipment in workshops and storage premises exposed to the risk of explosions.

In all rooms and areas where the local and operational conditions and surroundings can lead to the accumulation of gases, vapors, mists or dusts which, in combination with air, form explosive mixtures, the operational equipment and installations to be used in these circumstances must be of explosion-proof design. All operational equipment must be designed to comply with the class of protection dictated by the ignitable mixture (e.g. compression-proof casing, external ventilation, inherent safety, etc.).

Electrical operational equipment should be located indoors in adjoining buildings rather than inside buildings or other structures exposed to the risk of explosion. Whenever operational equipment has to be installed within areas liable to the risk of explosion, protection against explosion must, in general, be applied wherever explosive mixtures can arise. In this connection, the ignition of explosive mixtures must be reliably prevented by adopting the correct choice of design and construction of the operational equipment and the incorporation of supplementary safeguards where applicable.

Electrical, chemical, thermal and mechanical influences must on no account impair, in any way, the protection afforded against explosion. In particular the high ambient temperatures and the influence of nearby heat sources at the installation point must be taken fully into account.

B0.6.18.5 Protective measures, earthing and lightning protection

In view of the potential dangers of electrical power, the following measures are required for the protection of life, equipment and materials. Basically, all 'live' parts, i.e. all parts of electrical, operational equipment at an electrical potential above or below earth potential when in operation, and with a rated voltage over 24 V, must be insulated or covered so that they cannot be touched accidentally.

In addition, measures must be taken by the Contractor to prevent the occurrence or persistence of excessively high contact potentials on conductive parts of electrical operational equipment (frames etc.) brought about by faults in insulation.

For installations up to 1000 V, voltages over 50 V are considered to be excessive contact voltages. Within enclosed electrical installations, with voltages over 1000 V, the contact potential shall be according to the values given in EN 50522 (VDE 0101-2) Earthing of power installations exceeding 1 kV: enclosure B.

The following rules and regulations are to be observed in carrying out protective measures and in earthing procedure:

- IEC 60079 and 60364 for installations up to 1000 V,
- EN 50522 (VDE 0101-2) Earthing of power installations exceeding 1 kV.

In areas exposed to the hazard of explosion, the protective measures outlined in IEC 60079 and IEC 61241are to be adhered to in the erection and installation of electrical plant and equipment.

B0.6.18.5.1 Protective measures for installations up to 1000 V

Protection against direct contact
All 'live' parts of electrical operational equipment that can be reached by hand must be protected against direct contact either by means of insulation or through constructional design, position or arrangement, or by means of special devices. If, in the case of enclosed switchgear or control cabinets, access is required in the course of normal operation (e.g. for replacing fuses), protection against direct contact must still be ensured when the switchgear or control cabinet has been opened up.

Protective insulation
Protective insulation is to be provided by means of additional insulation over and above the insulation provided for operational purposes. This measure must prevent the occurrence of a dangerous contact potential.

Use of low voltages as a safety measure
This safeguard applies to all equipment, which is required to operate in metal enclosures, boilers, tanks etc. The operational voltage of tools and lighting equipment must not exceed 24 V AC.

Isolating transformers shall be provided by the Contractor for the purpose of producing the protective low voltage. A separate 24 V system will not be provided.

Connection of the neutral
The LV network shall be of the TN type, i.e. the LV neutrals of the auxiliary transformers are earthed directly.

Neutralization (protective multiple earthing) is intended to prevent the persistence of an excessively high contact potential on conductive parts of the installation which do not form part of the actual operating circuit.

Protective multiple earthing as a protective measure requires the neutral to be earthed close to the transformer. However, wherever possible the neutral shall be earthed at the main LV board. In this case the connection transformer to LV main board shall be carried out as TN-C type, i.e. three phases plus PEN:

The LV system for symmetrically as well as unsymmetrical connected power consumers shall generally be of the TN-S type, i.e. a five wire system. The separation of N and PE shall be carried out at the main LV board. Because of the clear demarcation between the neutral conductor N, carrying operational current, and the protective earthing conductor PE, which - under non-fault conditions - carries no current, NO connection between either N and PEN or N and PE is permissible beyond the point of separation of the PEN conductor into PE and N.

The LV system for supply of essential consumers (emergency diesel supply) shall be of IT type. All required isolating transformers shall be included in the scope of supply.

The neutral conductor is to be insulated in the same manner as the phase conductors. The use of constructional parts of the switchgear as a neutral conductor is not permitted.

All earthing conductors have to be rated depending on the value of earth-fault current (see EN 50522 (VDE 0101-2) enclosure D). Separate installed earth conductors must be at least 16 mm² for copper and 100 mm² for galvanized flat-iron.

The earth electrode resistance shall ensure that potential contact will not be higher than 50V (see IEC 60364 - 4 -41).

B0.6.18.5.2 Protective measures for installations over 1000 V

Protection against contact
At least the following measures are to be taken for all parts that are 'live' when in operation:

- Protection outside of closed electrical operating areas:
  - complete protection from all sides against contact, the degree of protection shall be at least IP23D according IEC 62271-202 and IEC 60529
  - protective devices may only be removed by means of tools.
- Protection inside closed electrical operating areas:
  - protection against contact with 'live' parts within reach of personnel,
  - protection against accidental contact outside the reach of personnel.

The above-mentioned measures for protection against contact are also to be applied to 'dead' parts of the Plant where, in the case of a fault, a dangerous contact potential might arise, however, where the parts must not be connected to the protective earthing system for operational reasons.

Protection against contact voltages
Protective earthing is to be used as a safeguard against excessively high contact potentials for conductive parts of the installation, which do not form part of the operational circuit. Here, all normally 'dead' parts equipment and apparatus shall be earthed if it is possible for them to come into contact with 'live' parts as a result of faults due to the occurrence of surface leakage paths, arcs or direct connections to a 'live' part of the equipment.

In considering the dimensioning of the protective earthing system, the thermal loading and voltages on the earthing equipment are decisive factors and these should be based on the maximum possible earthing current, which can arise.

Connection of the neutrals

- 400 kV system: neutrals of the 400 kV windings of the transformers shall be directly grounded
- 230 kV system: neutrals of the 230 kV windings of the transformers shall be directly grounded
- 11 kV system: neutrals of the 11 kV windings of the transformers shall be grounded by means of 400A resistors
- 3.3 kV system: neutrals of the 3.3 kV windings of the transformers shall be grounded by means of 400A resistors.

B0.6.18.6 Earthing and lightning protection

B0.6.18.6.1 Earthing and potential equalization system

The earthing system and potential equalization shall comply with the following standards:

- IEC 60364-4-41: Electrical Installation of Buildings – Protection for Safety: Chapter 41: Protection Against Electric Shock
- IEC 60364-5-54: Electrical Installation of Buildings – Part 5-54: Selection and Erection of Electrical Equipment - Earthing Arrangements, Protective Conductors and Protective Bonding Conductors
- EN 50522 (VDE 0101-2) : Earthing of power installations exceeding 1 kV
- VDE 0845, Part 1: Protection of Telecommunication Systems Against Lightning, Electrostatic Discharges and Over-voltages from Electric Power Installations; Provisions Against Over-voltages
- IEC 61643: Low-voltage Surge Protective Devices

For earthing, protective earthing, functional earthing, potential equalization and lightning protection-potential equalization, a common system shall be established.

Within all buildings, internal earthing rings shall be installed. These shall be linked by way of connection tags to the foundation ground and outdoor earthing system.

All system and plant components which are to be earthed as well as electrical components, like protection and control cubicles, sub-distribution boards, control systems, motors and transformers, shall be connected to the earthing rings/bars. All steel structures within a welded Section shall be connected to the main earthing system.

At pipelines for flammable liquids or gases, earthing tags shall be provided at each flange. All bolted flanges shall be bridged using a flexible braided copper conductor. Each pipe shall be connected at least once to the main earthing system.

No framework parts or other structural components shall be used for the ground bus.

An earthing cable shall be included in all main cable runs.
Protective earthing and potential equalization of electronics cubicles, frameworks, racks etc. shall be executed as follows:

- Earthing rings shall be installed in the I&C rooms as buses, to be connected at several locations – at least two – to the earthing network.
- For each row of cubicles, at least two connections shall be made to the earthing ring. Cubicles in a row shall all be connected by conductors to each other.
- If cubicles are attached to a raised platform flooring of steel structural parts, it shall be ensured that these are electrically connected to each other throughout the area. The raised floor shall be connected to the earthing ring at several locations, and as a minimum at two corners of the room.

Foundation earthing
All buildings, including those with a steel skeleton, shall be equipped with foundation earthing. The foundation earthing shall be installed in addition to reinforcement that is likewise connected together with braided conductors.

The foundation earthing shall be used in connection with the other earthing systems like protective, operational, functional and lightning protection earthing.

In the case of pile foundations, earthing rods of the same length as the piles shall be installed along with the foundation piles at intervals of around 10 m and connected at around every 2 m to the pile reinforcement using braided conductors. The earthing rods shall project beyond the top of the piles and then be connected to the earthing system of the ring foundation.

In addition to the closed ring of the foundation earthing system, a net of mesh size around 10 x 20 m shall be embedded in the bottommost concrete layer. The foundation earthing shall be connected to the reinforcement by a braided conductor at intervals of about 2 m.

At intervals not exceeding 20 m, and with at least two in every room, connection tags from the foundation earthing shall be foreseen for connecting the internal earthing ring. Connection tags shall likewise be foreseen for connection to the external earthing system and to the lightning rods. Optionally, lighting rods can be connected to the external ring

earthing, with connections then made from this ring earthing to the foundation ground by way of the internal earthing ring at intervals not exceeding 20 m.

Earthing material

- Refer to Part B7.

Screening

The measures described in the following serve for screening and potential control within (see EN 50522 (VDE 0101-2) Annexes E and F) and for lessening overvoltages.

- For reinforced concrete buildings, at each corner of the building including the bottom slab, an additional mesh of rebars, of approximate mesh size 10 x 10 m, shall be provided at the topmost reinforcement. The meshes shall be produced by welding. This additional reinforcement, connected so that it is electrically conducting, may be dispensed with if it is ensured that the existing reinforcement is so connected by welding at appropriate points that it is electrically conducting.
- At intervals corresponding to the mesh width, earthing wires from the reinforcement shall be incorporated into the building pillars, rising from the foundations to the roof, and so welded that they are continuous. These earthing wires shall terminate at the roof parapet. The meshes and earthing wires shall be welded to each other.
- For steel skeleton buildings, equivalent measures shall be taken. Framework Sections shall be welded to make up a defined, electrically conducting connection or shall be bolted together so that they are electrically conducting.
- Metal façades and coverings shall be preferred over non-conducting materials and at their topmost and bottommost points shall be connected at an adequate frequency to the lightning protection system.
- Reinforcement of cable ducts of reinforced concrete shall be connected to parallel running earthing cables. These earthing cables shall be connected to the screen of the building earthing system or to the foundation earthing system.

B0.6.18.6.2 Lightning protection

All buildings and structures shall be equipped with a lightning protection system. Lightning protection level I (LPL) according to IEC 62305 shall be considered.

The **building lightning protection system** is to be executed according to:

- IEC 62305-1
- IEC 62305-3 and
- IEC 62305-4

and alongside protection of human life to prevent damage not only to buildings, but also to electrical and electronic installations.

All buildings and structures are to be protected against lightning strikes by means of lightning collectors and conductors. The collectors are to be arranged in such a way that, as far as possible they collect all lightning strokes without these directly striking the parts to be protected. This condition is considered to have been fulfilled if no point on the roof surface is more than 5 m away from a collector. Collector lines suffice as collectors, e.g. along the ridge and at gables and eaves.

Ridge conductors must be taken right to the end of the ridge. Moreover roof conductors should run as natural continuations of all main conductors. Conductors at the gable extremities or eaves must be laid in the closest possible proximity thereto. In the case of steel-framed structures the ridge conductors must be connected to the roof supporting structure at least every 20 m. Lower level annexes are also to be provided with collectors.

Roof lines and other conductors are to be laid and fixed in such a way that they can withstand the stresses expected from storms, lightning strokes, roof work, etc.

One main conductor between the lightning collectors mounted on the top of the building and the potential grading ring laid in the ground is to be provided every 20 m of the before-mentioned lightning collector. The maximum spacing between conductor fixings may not exceed 1 m for horizontal runs and 1.2 m for vertical runs.

Lightning protection material
In case of buildings with steel structures and sheet steel cladding, the steel columns and the sheet steel cladding shall be used as lightning conductor. In case of masonry buildings or buildings with concrete structure, external lightning conductors made of copper or stainless steel shall be used. Lightning arrestors (arrestor tips and roof conductors) or Lightning air terminal shall also be made of copper or stainless steel rods. The conductor supports of the lightning protection system must be copper or bronze. Nuts and bolts at isolating or other points which are to remain detachable must be made of copper-nickel-silicon-bronze.

B0.6.18.7 Technical conditions for high voltage motors

If not specified otherwise all electric motors must be designed to meet IP 54 enclosures.

All motors with rated power (referred to 40° C ambient temp.) of 160 kW and above must be designed as HV motors.

B0.6.18.7.1 Constructive features

The following constructive features shall apply:

a. Climatic protection provisions for mounting in the open in a humid and hot climate. Insulation class F. During operation at rated power of the driven machine, the motor insulation must only be stressed in accordance with the requirements of class B insulation.
b. Motor parts made of iron internally and externally sandblasted and surface-protected.
c. Paint finish resistant to chemicals and seawater.
d. Bolts with adequate corrosion protection.
e. All joint faces and gaps sealed.
f. Anti-condensation heating to be switched into operation when the motor feed circuit is in the 'off' position. Heater supply power 'on' indicating lamp is to be provided.
g. Special treatment of windings with resin impregnation plus immersion in varnish.
h. Varnish-insulated laminations.
i. Pressboard material protected by varnishing.
j. For motor ratings the cooling air available at the specific location has to be considered.

   All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA) type. However, motors rated 3000 kW or above can be Closed Air Circuit Water cooled (CACW). CW motors can be screen protected drip proof (SPDP) type.

k. Condensation outlets to be provided at the lowest point in the housing.

Deleted: Totally enclosed fan cooled (TEFC) ty

Design and construction of the motors shall comply with IEC 60034-1, 60034-5 or VDE 0530 and DIN 40050.

B0.6.18.7.2 Electric features

The following electric features shall apply:

a. Motor rating to be at least 110% of the maximum required electric power consumption of the driven machine.
b. Continuous delivery of rated power at voltages of 90 - 110% of the rated voltage and allowable frequency range within the limits of thermal class F.
c. Rated power output at ambient temperatures existing at the particular site of installation and under continuous running conditions.
d. All motors shall be designed as 3-phase squirrel-cage motors suitable for direct on line starting. It must be possible, with 100% residual voltage, to switch them on to a large and stable power supply network without incurring damage or deformation. The motors must still be capable of

faultless running up to speed with a voltage drop to 80% of rated voltage and rated loading.

However, 75 % starting voltage shall be allowed for motors above 4000 kW. Mill motor being high starting torque motor, is specially designed and shall be suitable to operate at 85% rated voltage for 1 minute only, provided that the mill motor is suitable for starting/running with voltage variations for which aux. power supply system is designed.

e. Motor starting current must not exceed 5.5 times rated current (referred to motor rating at 45 °C ambient temperature) for motors up to 2 MW and must not exceed 4.5 times rated current (referred to motor rating at 45°C ambient temperature) for motor ratings above 2 MW. The voltage drop at direct-on-line starting should be limited to 20% at the motor terminals except rating above 4000 kW. However starting of any motor shall not cause tripping of any other consumer. However, Bidder/Contractor is free to design his system with starting currents up to 600% maximum.

f. From the cold state four consecutive starts up to full speed must be possible. The second start must be possible immediately after the first start, the third 20 minutes after the second, the fourth 20 minutes after the third.
g. A minimum frequency of starting cycles of 1000 per year must be guaranteed.
h. In general, motors must be capable of running without overheating when subjected to three consecutive starts within one hour after having run for an extended period on a voltage of 95% nominal voltage. Thereby the second start must be possible immediately after the first start and the third 30 minutes after the second start. In individual cases where operation depends on signals from pressure switches or other such sources, then a more severe duty with respect to the frequency of starting cycles per hour shall be necessary and the design of the motors must be carried out accordingly.

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B0.6.18.7.3 Protective features

The following protective features shall apply:

a. High voltage motors must be fitted with measuring points for the determination of slot and bearing temperatures.
b. Six Pt 100 resistance thermometers (2 per phase) are to be provided for slot temperature measurement, and a double thermocouple or resistance thermometer per bearing must be provided for bearing temperature measurement. Type of temperature elements shall be finalized by the manufacturer.
c. Each Pt 100 shall be connected, potential free, to a terminal strip. The connections to the thermometer as well as the associated over-voltage cutouts shall be brought into separate terminal boxes.

d. Where motors have closed-cycle cooling, temperature-measuring points must be fitted in the cold air stream.
e. The winding temperatures have to be detected with RTD's at high temperature and alarm to be produced, at extra high temperature the motor to be tripped.
f. All motor gaps and joints between it and other units must be sealed.
g. Earthing clamps at both sides of the stator have to be provided.
h. All HV motors bearings shall be equipped with vibration sensors for vibration monitoring.

Considering the rating of CHP HT motors vibation monitoring is not required. For Coal Crushers vibation isolation & monitoring shall be provided.

i. Temperature transmitter to be provided for all temperature measuring devices.

B0.6.18.7.4 Other features

Terminal Boxes
The main terminal boxes on the high voltage side shall be provided with a pressure relief joint for the purpose of reducing the danger of an accident as a result of short-circuits, and shall be fitted with a terminal block suitable for any desired type of connection.

Cable connecting boxes must be longitudinally divided to facilitate fitting of cable sleeves and end caps. Protection class shall be IP 55.

Inside the terminal box an earthing clamp for connection of the cable shield must be foreseen.

The opened terminal boxes must have provision for local earthing to be carried out.

All terminal boxes shall be provided with a removable undrilled gland plate. The gland plates shall be of non-magnetic material if single core cables are to be installed.

Connections, star-point terminal boxes etc.
All motors must have the star-point connection brought out separately to terminals.

For all motors with a rating of 2000 kW or above a differential relay for winding protection shall be provided and installed in the associated switch-gear. In that case the star-point connection shall be brought out separately to terminals. The differential current transformers are to be designed to class 5 P10 with a rating matched to the protection system. The CT"s shall be accommodated in the star-point terminal box.

Coupling
The motor shaft halves of the couplings, finish-bored, balanced, and complete with key ways are to be drawn on to the motor shaft and balanced out together with the rotor.

Cooling
Air cooling for the motors is the preferred method. Where water-cooling is applied, conditioned and treated, water shall be used.

Motor air exchanger circuits should be suitable for the prevailing atmospheric conditions, i.e. ambient temperature, content of humidity and salt in the air, etc. are to be considered.

Running quality
The running quality must be within the classification of "Class C, Zone A" according to the ISO 10816-1 or equivalent, i.e. the vibration velocity must be not greater than 1.8 mm/s (rms).

Reverse speed
If reverse running, can occur in the case of equipment driven by a motor (e.g. cooling water pump), the motor must be designed for maximum possible reverse speed.

A reverse rotation alarm and starting-circuit interlock are to be provided to ensure that the equipment cannot be started while running in reverse.

Lubrication
All MV and HV Motors shall preferably be equipped with on-line lube oil purification and auto-grease facility. These systems shall preferably be procured from one single manufacturer.

The above requirements of the specification to be considered only as a preferred solution. However OEM recommandation will be accepted.

B0.6.18.8 Technical conditions for low voltage motors

If not specified otherwise all motors must be designed to meet IP 55 enclosure according IEC60034-5.

All motors with rated power (referred to 40 °C ambient temp.) less than 160 kW must be designed as LV motors with premium efficiency class IE3.

The equipments which are only operating for short period shall not be covered under IE3 such as:

a) Sootblower Motors- operates only during sootblowing sequence
b) Seal air fan motor for damper sealing operation-operated only during maintenance.

B0.6.18.8.1 Constructive features

The same features as for high voltage motors shall apply.

Anti-condensing heating shall be provided for motors of 55 kW and above.

B0.6.18.8.2 Electric features

All motors shall be designed as 3-phase squirrel-cage motors suitable for direct on line starting.

The motors must be capable of being switched on to a large and stable network and with phases in opposition.

The electric features a), b) and c) of high voltage motors also apply here.

Motors starting current must not exceed 7.0 times rated current (referred to the motor rating and 45 °C ambient temp).

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The Starting current of LV Motor (IE3) shall be inline with IEC 60034-30. Applicable de-rating factor for design temperature of 45 Deg C shall also be applied.

B0.6.18.8.3 Protective features

An earthing clamp inside the terminal box has to be provided.

B0.6.18.8.4 Other features

Cable leads
All cable connecting boxes are to be designed to meet the requirements of IP 55 or IP 58 protection class respectively.

The cable connecting boxes are to be installed easily accessible on the motor. The connecting boxes must be capable of being turned by 90° or 180° and of being opened up longitudinally. The connection boxes are to be fitted with a terminal block.

Shafts
Where not otherwise specified, motors must be fitted with a free shaft end.

Protection against explosion hazards
Low-voltage motors, which are to be installed in areas exposed to the risk of explosion, must comply with the rules laid down in VDE 0165/0170/0171 for explosion-proof design in relation to the flash-point group classification for the particular explosive mixture.

B0.6.18.9 DC motors

The use of DC motors is to be avoided and must be agreed by the Employer. The maximum starting current must not exceed 1.8 of the rated motor current (referred to the motor rating at 45 °C ambient temperature). However any other value of starting current proposed by Bidder/Contractor during basic/detailed engineering shall be subject to Employer"s approval

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B0.6.18.10 Actuator drives

As far as applicable the above "Technical conditions for low voltage motors" shall apply.

In addition, all actuators for valves, dampers etc are to be fitted with socket and plug of well-established make to IEC 60309 or equivalent for the power cable connection. For the control cable connection separate socket and plug shall be provided.

Self-cooling at respective ambient temperature conditions is mandatory. Fan cooling is not accepted.

Actuators shall have integrated starters. Regulation type shall be continuous modulation type (min. 3000 starts per minutes).

B0.6.18.11 Frequency converters

General
On the basis of the requirements of the driven equipment, the Contractor shall design, supply, install and commission a complete, fully operative, variable-speed converter drive (frequency converter and motor, for motors up to 400 kW, for motors 400 kW and above in addition to the converter a converter transformer shall be provided).

Converters made by reputable manufacturers are to be used.

Technical requirements
The design of the converter (maximum continuous rating) is to be based on the maximum shaft output required by the equipment assembly.

Maintenance work and cable connections must always be possible from the front of the converter cubicles.

The terminals on the input and output sides are to be rated such that parallel cables can be connected.

The converter allows the speed of three-phase asynchronous motors to be adjusted steplessly. It must be fully equipped for remote control and monitoring in the control room.

An on-load disconnector and a power contactor are to be provided at the power input of the converter.

For motors with a rating up to 400 kW the frequency converter shall be designed in at least a six-pulse circuit on both the line and motor sides.

Frequency converters using Insulated Gate Bipolar Transistors (IGBTs) should preferably be provided on both the line and the motor sides.

For motors with a rating above 400 kW the converter should be designed in a 12 pulse circuit supplied via converter transformer.

The converter is to be disconnected if the voltage drops to less than 80% of the rated voltage or if one or more phases of the line voltages are missed. When the line voltage is restored, the converter is to be connected again automatically, providing the break in the power supply did not last longer preferably than 5 seconds. The Plant check back signals (floating change-over contacts) must continue to be received during this period, while alarms are to be suppressed. It must be possible for the converter to be connected at any coasting-down drive speed and with in-phase voltages. The specified frequency set point is to be resumed automatically.

If the voltage reduction or the power failure lasts for a long time, the drive must remain switched off; in this case, it must subsequently only be possible to switch it on again either manually or by means of the higher order control.

The converters are to be designed for 10% more than the maximum power output required by the system. The purpose of regulating the converter is to ensure that the indirect current and voltage remain within the permissible limits during all control processes. This should apply both when the motor is started up and when the speed is adjusted during operation.

Forced ventilated converters are to be equipped with redundant fans (two double fans).

Flow monitors (not air vanes) are to be used to monitor the fans. Positive control is to be provided for fan drives with a master drive.

Converter transformers
The transformer shall meet the requirements in the IEC standards 60076-11 and 60146-1-3, shall be of cast-resin type and are to be installed in protective casings made of sheet steel, cooling method AN, thermal insulation class F (utilized according to class B only), type of protection at least IP 2l.

The transformer output shall correspond to the power requirement of the frequency converters.

It should be possible to vary the high-voltage side within a range of 2 x ± 2.5%, by means of reversible clamp connectors.
The connections on the high-voltage side have to be carried out using cables.

Busbar connections with short-circuit protection are to be provided to the current converters on the low-voltage side.

Suitable earthing studs are to be provided for maintenance purposes (earthing and short-circuiting).

All accessories - especially sensors and terminal connections - must be arranged so that they are readily accessible.

The windings must be flame-retardant and self-extinguishing. The cast-resin mixture must not contain any flame-inhibiting additives which develop toxic vapors or gases either under the influence of secondary fires or in the electric arc. A report on this subject has to be enclosed with the bid.

Moisture-proof design:
It must not be necessary to dry the winding after shut-off periods. The protection against voltage surges and short circuits, the noise levels and the freedom from partial discharges up to twice the rated voltage must be verified by means of type tests.

The windings are to be protected by means of a temperature monitoring system, comprising the following minimum components:

- 3 PTC resistors (1 for each phase)
- 1 tripping unit with isolated change-over contacts for remote signalling (alarms).

Temperature transmitter to be provided for all temperature measuring devices

Instrumentation and control
The instrumentation is subdivided into a local Section in the converter cubicle and into a "remote" Section in the control room. All the measures necessary to enable the drive to be remote-controlled and remote-monitored must be implemented, i.e. all the 24 V DC interposing relays which are required to convert the on/off commands from the instrumentation and control system, signal transducers, etc (see also “remote control and remote indications” below).

A suitable automatic compensation facility is to be provided, to ensure that the transfer between LOCAL mode and REMOTE mode is bumpless in both directions. The emergency shutdown function of the equipment must act on the converter directly, regardless of whether 'local' or 'remote' mode is set.

Local instrumentation and control
The following are to be provided as a minimum in the converter cubicle:

Controls
a) Local/remote converter control (key-operated switch)
b) "On" and "off" converter controls
c) Set point adjuster (speed)
d) Incoming master switch, "on-off"
e) All the controls necessary for internal converter settings and adjustments, as specified by the manufacturer

Indications, signals, monitoring
a) Line voltage indicator
b) Output frequency
c) Output current
d) Operating status signals, in accordance with the specifications of the instrumentation and control supplier, though at least "Ready", "Drive running" and "Zero and set speed reached"
e) Motor temperature monitor - alarm Motor temperature monitor - shut-down
f) Signals concerning internal operating states of the converter, in accordance with the manufacturer's standards, though at least:
   - Overtemperature
   - Line voltage monitoring
   - Line undervoltage
   - Overcurrent
   - Control voltage monitoring
   - Converter protection
   - Fan monitoring
   - Incoming air temperature
   - Motor feeder interruption
   - Motor feeder short circuit
   - Earth fault
   - Motor blocked
   - Other faults.

Remote control and remote indications
Account must be taken of the following types of remote control and indication in the control room, and suitable interposing relays, transducers and switchgears are to be provided in the cubicle:

a) Converter "on/off" and "local/remote"
b) Set point adjuster for speed (4 - 20 mA)
c) Remote indication for speed as 0/4 - 20 mA standard signal
d) Motor current as 4 - 20 mA standard signal
e) Combined fault
f) Remote indication of the set speed potentiometer as a 0/4 - 20 mA standard signal
g) All Switchgear faults and “Racked-Out” events

h) Other controls and indications

All event signals and check back signals must be made available on the terminal strip as floating change-over contacts.

System perturbation
The perturbation caused by the voltage harmonics in the feeding three-phase system, which are a result of the converter drives, must not exceed the specified limit values, i.e. 5% for the 5th harmonic voltage, 4% for the 7th and 2% for each of the l1th and 13th. IEC 60801.1 - 60801.4 are also to be observed in this connection. The system perturbations are to be curbed by means of suitable measures if necessary. The contractor is responsible for demonstrating conformance with the above-mentioned limit values.

B0.6.18.12 Cable and cable trays

B0.6.18.12.1 Cable laying and routing requirements

The Contractor responsible for cable routing and laying has to observe a strict unit separation. The cables must be routed in different cable channels or, as the minimum requirement, on different cable trays, so that in case of a fire or any accident in a cable channel or tray two units will not be affected. Further in case of two critical drives of the same unit with both drives operating in normal conditions cable for the same shall be routed through two completely redundant routes.

On vertical cable risers, walls and ceilings the cables must be secured with corrosion-resistant cable clips (e.g. cable clamps with cable protecting cable sleeves).

Cable risers near gangways or in electrical rooms that are exposed to possible mechanical damage are to be protected up to 1 meter from ground by suitable metal cover.

All holes in ceilings, floors and wall made for cable routing must be sealed fire-resistant, when the cables have been laid. This also applies to switchgear panels and cubicles, passages between cable ducts, at vertical risers etc. As there is an increased danger of fire during the construction period the holes shall be fire-resistant sealed at that stage already. This applies especially to vertical runs.

When the cables are no longer supported on cable trays or risers etc. the power, DC and instrument transformer cables must generally be run singly in galvanized steel conduit. With lighting cables, measuring and control cables and telephone cables, several similar cables can be run in one conduit. Surface-mounted conduits must be secured every 1.5 m.

The control and communication cables must be laid sufficiently apart from the power cables so that no interference will occur and the transmission of fault signals is excluded. For this purpose the following minimum separations are to be observed:

- 300 mm between low voltage power cables and measuring and control cables at voltages of 60 V and below,
- 300 mm between power cables and measuring and control cables at voltages above 60 V,
- 600 mm between medium voltage power cables and measuring and control cables at voltages of 60 V and below.

The laying of cables outside of buildings should be preferably on cable bridges that preferably are to be naturally ventilated.
If the cables are laid in the ground, after excavating the trench a layer of sand must be introduced. On the sand the cables are laid separately from each other according to voltage systems. The cables must be laid at a depth of 0.8 m at least. The trench is filled with sand and covered with concrete covers or bricks. The thermal resistance of the backfilling shall not exceed 150 Kcm/W. A ground temperature of 28 °C has to be considered. Where cables have to pass under streets cable duct blocks with a suitable bore(s) should be provided. The marking of cable routes by cable warning tapes must be provided.

When laying the cables on cable trays, cable risers, cable channels, etc. and when choosing the size of the cables care must be taken that sufficient ventilation is available and that there is no possibility of thermal overheating, or strain on the cables.

Cables that must move with connected apparatus owing to thermal expansion (e.g. boilers) must be provided in a flexible form or they must have sufficient slack at the location.

All the ends of the cables must be prepared according to the particular requirements of the manufacturers and connected to existing terminal strips, terminal screws, apparatus terminals, etc.

The necessary cable sealing ends and the stripped and fanned-out cable ends, where no sealing ends are provided, must be fixed to the appropriate supporting structures.

B0.6.18.12.2 General cable construction requirements

The medium and low voltage cables shall be of Fire Retardant Low Smoke (FRLS) with XLPE insulation. For cables that are exposed to ambient temperatures above 60°C, teflon or silicone cables are to be provided.

For safety related equipment fire surval cables shall be provided.

The cables must be suitable for laying indoors, in the open (direct or indirect sunlight), in ducts, on trays, in the ground and in water. The cables must be resistant to solar radiation, the effect of oil, seawater, bacterial action, insects and rodents. Outer sheaths are to be manufactured from non-combustible or flame retardant low smoke material.

Manufacturers testing standard related to resistance to solar radiation, effect of oil, seawater, bacterial infection, insects and rodents, will be accepted.

All cables must be provided at both ends, at every 20 m and every bend with identification in the form of numbered labels corresponding to the coding system. The individual cores will be numbered or identified by colour-coding.

The cables must be laid to ensure that they can be replaced or renewed in a simple manner.

B0.6.18.12.3 Medium voltage (MV) power cables

The design of the MV cables shall be screened, stranded, single-core or three-core copper conductor cables of FRLS with XLPE insulation. The cable shall be sealed with a red, non-fading PVC outer sheath. Three-core cables shall be designed with individually screened cores.

The MV power cables must be designed for the thermal and short-circuit characteristics of the electrical systems, taking into consideration the following minimum short circuit duration:

- for incoming cables and cables to sub-distribution: fault clearing time of the back-up protection.
- for all other cables: the fault clearing time of the main protection.

The cables must be terminated and connected to the indoor metal-clad switchgear or the sealing ends are installed in cable connection hoods mounted on the power transformers.

In the event of outage of the air-conditioning plants of the switchgear buildings the internal and external conditions will become the same. Therefore, sealing ends are to be used which shall be suitable for the maximum conditions at site.

B0.6.18.12.4 Low voltage (LV) power cables

The low voltage power cables shall be standard single and multi-core cables of FRLS with copper conductor and XLPE insulation.

To ensure the elimination of excessive contact potentials on any object, effective earthing must be carried out as a safety measure and suitable 3-core, 4-core and 5-core low voltage power cables must be provided. The minimum conductor cross-section of the low voltage power cables is 2.5 mm^2. If 3 1/2-core cables are used, the reduced conductor for protective neutral must have a cross-section of at least 16 mm^2. In lighting systems (especially discharge lighting circuits) the use of a reduced conductor for the protective neutral is to be avoided.

Depending on the site conditions the DC cables must be single-core, 2-core or 4-core. Between batteries or rectifiers and the DC switchgear single-core power cables should in general be used.

The LV power cables must be designed for the dynamic and thermal characteristics of the electrical system and for continuous operation.

B0.6.18.12.5 Current carrying capacity of power cables

The ratings for continuous loading of the cables shall be calculated according to the relevant IEC regulations. The Contractor must submit corresponding tabulations for all cables to be used.

The maximum voltage drop under normal conditions shall not exceed 2.5%.

Voltage drop during starting shall be considered as 15% & during running 3%.

The voltage drop between the the MCC and the terminal of the load shall not exceed 2.5%. It is asumed that the switchgear and the MCC are connected by bus-bars/- ducts means the voltage drop is very low.

The voltage drop for MV Cable Shall be limited to 3% and for LV Cables:

- The voltage drop on the LV cabless from Main Distribution to subdistribution shall not exceed 2.5%
- The voltage drop up to the LV motor terminals shall not exceed 5% at normal operation and 15% during starting.

B0.6.18.12.6 Measuring and control cables above 60 V/ instrument transformer cables

For voltages above 60 V the cables shall be of Fire Retardant Low Smoke (FRLS) with PVC insulation and a mini-mum conductor cross-section of

1.5 mm^2. If they lead to outlying buildings, cables with a common core screen and protection against induction must generally be used.

For instrument transformer cables inside buildings the minimum conductor cross-section must be 2.5 mm^2.

Instrument transformer cables leading to outlying buildings must have a minimum size of 4 mm² and must generally have a common core screen.

The maximum voltage drop shall not exceed 2%.

B0.6.18.12.7 Measuring and control cables below 60 V

For voltages up to 60 V, measuring and control cables shall be of FRLS with PVC insulation and shall have stranded or solid copper conductors of minimum 0.8 mm diameter. Multi-pair control cables with paired lay-up of the leads and lay-up of the pairs themselves shall be used.

Instrumentation cables shall be identified by colour codes and bank marking as per VDE 0815.

Wherever necessary, e.g. for all cables leading outside the relay rooms and/or control rooms, the control cables shall have a common screen (Al-foil or Cu-foil).

Cables must generally have appropriate electrical protection against inductive/resistive influences and lightning.

The required compensating wires for temperature measurements must be at least 0.5 mm^2.

The maximum voltage drop shall not exceed 2%.

The individual cores of the multi-pair control cables shall be identified by numbers or a colour coding system.

Minimum size of 0.5 sq mm shall be considered for wiring including for control cabinets.

B0.6.18.12.8 Fiber optic cables (FOC)

All fiber optic cables as well as their deployment and the entire test procedure shall comply with IEC 60794. The cables shall be able to operate continuously in temperatures up to 70°C. The fiber optic cables shall be loose tube type with the fibers fed into tubes. The tubes shall be sufficiently strong to hold their shape and provide protection for the fibers against deformation and friction. Each fiber shall be colour coded acc. to IEC 60304.

Buried fiber optic cables shall always be laid inside adapted conduits. Installation shall ensure rodent protection and be water tight. The conduits system shall supply all equipment necessary for the deployment acc. to FOC manufacturer‟s specification. Occupancy shall allow future cable installation.

For out-door applications cables shall be suited for out-door deployment, longitudinally water tight, filling material standardized for all cables, yield minimum 3,000 N.

The fiber optic cables shall be complete with non metallic strain relief elements. Fiber optic cables that are installed outdoors shall be armored. Cables used indoors shall be reinforced with a steel wire braid.

Graded index fibers cables and monomode fiber cables shall comply with IEC 24702:

Graded index fibers cables shall consist of always 24 fibers

- fiber - type 50/125 µm, OM-3.

Monomode fiber cables shall consist of always 24 fibers

- fiber - type 9/125 µm, OS-1.

19” patch panels shall be used for termination, connectors shall be LC-Duplex as standardized by IEC 61076-3-106 var. 4. All fibers shall be terminated / connected.

Each fiber of all FOC shall be deployed and tested according to IEC 60794. Resulting test protocols of all single fibers of all FOC shall be handed over to the Employer, stating all details in written.

B0.6.18.12.9 Cable supporting structures

Construction requirements
Basically, pre-fabricated cable trays, cable risers, hanger rods, screws, clamps and all fixing material of corrosion-resistant finish, hot-dip galvanized, shall be used. If in certain sections the use of trays and risers is not possible, cable racks are to be provided in such places. These shall be made of corrosion-resistant, steel angle Sections, hot dip galvanized. The steel angles must be cut to size on site and exposed cut surfaces must be suitably treated on the spot to prevent corrosion before being fitted. The minimum requirement for this treatment is the application of an anti-corrosion layer of zinc coating.

All cable tray T-junctions, cross-overs, vertical and other shelving, bends, etc. must consist of pre-fabricated tray elements so that crushing of the cables at these transition points is avoided.

The cables laid on the trays must be carefully arranged and ordered. All cable tray routings consisting of several individual cable trays that are located outside buildings and exposed to the sunlight shall be provided with sun-shades made of the material as described for the cable tray equipment. In all areas where an accumulation of coal dust must be expected, e.g. coal handling plant, conveyor belt ways, bunker area, the cable trays shall be installed vertically.

The trays and risers must be installed in such a way that in accessible manways an escape route at least 800 mm wide by 2100 mm high is available for the personnel.

For safety reasons the lower parts of the hanger rods and all other exposed parts in manways and escape routes must be fitted with plastic covers.

In indoor installations hot dip galvanized material with an average coating thickness according to ASTM A123/123M is to be used.

In all external areas, in semi closed buildings and in areas with corrosive gas or steam, Fibre Reinforced Plastic (FRP) cable trays tested according to international standards shall be provided.

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The cable trays must be designed to ensure that there is 5% spare space on all trays when commissioning and handing-over is complete.

The fixing materials for the cable trays and risers must be corrosion-resistant or at least be hot-dip galvanized. The rods, brackets and risers must be fitted with appropriate support brackets to be fixed to anchor rails or fixed by dowels and screws in walls and ceilings.

Welding to steel structures and the welding together of hot-dip galvanized cable-laying accessories is not permitted.

After completion of the cable-laying work the maximum deflection of the cable trays shall not exceed 2.5 mm per 1.5 m (specified distance between two hanger rods).

B0.6.18.13 EMC measures

All EMC measures shall ensure that during subsequent operation, no impermissible malfunctions or damage to equipment occurs due to violating electromagnetic compatibility.

The description of the measures is not limited to this chapter, but also forms a part of other chapters, in particular ”Protective measures”, ”Earthing and lightning protection” and ”Cabling”.

The EMC requirements are set out in the following.

Under consideration of the conditions and constraints, the equipment used shall emit the lowest interference signals and exhibit the highest immunity to interference.
All equipment items shall operate properly when connected to networks with a power supply corresponding to the maximum permissible tolerances as laid down in EN 50160 (as regards, harmonics, voltage fluctuations etc.).

Priority is given to reducing sources of interference.

Additionally, by means of high-capacity screening, generation of overvoltages due to inductive or capacitive coupling shall be reduced. Influencing by electrical and magnetic fields shall be reduced.

Earthing and potential equalization systems designed for low-impedance shall reduce generation of overvoltages due to ohmic coupling.
If EMC resulting from the measures named above is still not adequate, further measures shall be taken within buildings, for example by isolation and suppressor circuits.

Thanks to the lightning protection and screening measures taken at the buildings, within them an EMC protection zone is formed.

All installations penetrating this protection zone, that is where they pass through the external walls of buildings, shall be incorporated into a lightning protection-potential equalization system as close as possible to the points of entry and exit of the building. This applies also for conductors carrying a potential. At entry or exit, these shall be included in the lightning protection-potential equalization system by way of suppressor circuits.

Cable runs to outdoor plant components and between buildings may also be screened by appropriate measures, and so form a part of the protection zone. If this is done, the suppressor circuit can be dispensed with.

A suppressor circuit shall be provided at all low-voltage main distribution boards.

Overvoltage protection shall be foreseen within the power supply for both central and distributed power supplies to electronic cubicles.

All conductive parts of the structures and installation within the scope of the contract must be connected to the main earthing system.

All steel Sections or frames must be provided with at least two earthing straps for every frame or Section that is fabricated from parts welded together. The earthing straps shall be located at the ends of the beam Section or frame Section in every case.

The Contractor must provide earthing straps in front of and behind the screwed connection in every case and these straps must be interconnected, using stranded copper, and connected, at least at one point, to the main earthing system, except the Contractor verifies that the type of screwed connection applied is a permanent electrically conducting one.
Tanks and vessels containing flammable liquids or gas shall be earthed by a connection to the earthing grid or by bonding to earthed metal structures.

Each pipe shall have a minimum of one connection to the earthing system. In areas where flammable vapor-air mixtures may exist, electrically isolated Sections of metallic piping shall be connected to the earthing grid.

All flange connections in these lines shall be bridged by flexible stranded copper. Earthing tabs shall be provided at each flange.

When connecting differing materials together the required material transition plates must, in general, be inserted. All connecting materials must be corrosion-proof and suitable for the conditions prevailing at the installation point.

Railway lines, together with electrically conducting pipelines leading outside the power station place must be insulated or be fitted with intermediate insulating links or elements.

Each cable tray and cable riser of less than 20 m length have to be earthed once; structures of more than 20 m length have to be earthed twice.

B0.6.18.14 Requirements for local cubicles and local housings for e.g. switchgear, control, measurement and signalling equipment

Steel-clad cubicles and enclosures with fixed, integral switchgear and apparatus must be provided.

The switchgear cubicles must be partitioned off and incorporate a busbar system, the necessary instruments, control switches, switch panels of the individual switch and apparatus chambers. The main busbars are to be installed on the rear face, top side of the switchgear cubicle in a lockable shuttered compartment.

Connections to switching devices, MCB's fuses etc. are to be made from these busbars. The lower part of the cubicle will house the terminal strips and connecting blocks, the clamps for the cable terminals and, if required parallel connection copper straps for the connection of more than 2 cables in parallel. An adequate number of ball studs must be provided within the

switchgear cubicle suitable for earthing the main and distribution busbars as well as the switchgear itself by means of portable earthing and short circuiting equipment (to be provided once per switchgear panel row).

The space in the interior of the cubicles must be divided into a Section with 'live' parts, 'live' switching elements etc. and a Section with control and measuring equipment. The Sections are to be separated by reinforced sheet-steel.

Care must be taken that in the event of arcing hot gases will not escape to the front of the cubicles (the operational side).

Ammeters are to be provided on the cubicle front panel for the cubicle feeders and the supply outlets for motors higher than 55 kW or motors of lower rating, but particularly important for the process. A single voltmeter with 4-position voltmeter changeover switch must be provided for measurements of busbar voltage between each phase and neutral. Measuring instruments should, in general, be square in shape.

All cubicles, cabinets, panels, etc. shall be designed for an ambient temperature of 40 °C (outside the enclosure) in non-air conditioned areas. Special precautions shall be taken in the design of electronic devices for protection and control systems housed in the cubicle in order to allow for these conditions.

Heating elements are to be provided generally in each local cubicle or cabinet and shall be humidity controlled.

It must be possible to disconnect power supplies to the cabinets by means of manually operated power circuit-breakers (MCBs).

For easy monitoring and a rapid grasp of the operational state, collared mimic diagrams with the required switch position indicators, apparatus symbols and pilot lamps must be provided in every case on main process cubicles and switchgear cubicles. Lamp test facilities for all signed lamps connected shall be provided. All cubicles shall be provided with the required earthing screws.

Plastic-insulated, stranded conductors must be used for wiring within the switchgear cabinets, which must be numbered at each end with special tabs so that change by mistake is impossible.

Preferably plug-in type auxiliary relays are to be used. Apparatus being sensitive to impact must be protected against shock and vibration.

On completion of hand-over the cubicles must contain at least 5% of fully fitted spare terminal capacity and 5% of spare space for the future installation of extra equipment. It shall be possible to replace indicating lamps on the front panels of cubicle feeders and motor-supply outlets

without isolating the equipment concerned. Furthermore the control system must be designed in such a way that lamps operate at less than their rated voltage in order to avoid their being overheated.

Incoming and outgoing cables have to be fixed by suitable metallic cable glands.

B0.6.18.15 Local control points and level control cabinets

B0.6.18.15.1 General

Any electrical consumer unit, which is not controlled automatically or from the central control room, is to be fitted with a suitable local control cabinet. The local control cabinets are to be installed in the immediate vicinity of the motor drive to be controlled.

Pump motors, which are level controlled locally, will be given an automatic and manual control. The respective level control cabinets are to be fitted in the immediate vicinity of the pump motors, gauge glasses or level monitoring instruments.

B0.6.18.15.2 Construction requirements

In general local control cabinets and level control cabinets with plastic casings resistant to impact, sand, light and water, mounted on walls or hot-dip galvanized supporting constructions, are to be provided. Hot-dip galvanized casings will be acceptable.

Protection class must be at least IP 54 if installed indoors and IP 55W if located outdoors. The necessary earthing terminals must be provided for earthing purposes.

The cabinets must be equipped with the necessary mini circuit breakers, fuses, auxiliary relays, power contactors, terminal blocks and cable attachment components.

For motors with pre-selection control (operation/stand-by) operation hours counters are to be provided.

In hazardous areas, the necessary explosion proof control cabinets and level control equipment must be provided in accordance with IEC 60079, IEC 61241 and VDE 0165/170/171.

B0.6.18.15.3 Local control points

The local control points are to be equipped as the minimum requirement with:

- ON button
- OFF button
- Running lamp
- FAULT LAMP
- TRIP HEALTHY indication
- Lamp test.

When two motors are installed, serving as operation and stand-by unit, then in addition to a double set of the above items, the following equipment has to be installed as the minimum requirement:

- MOTOR 1 - MOTOR 2 (running motor/stand-by motor) pre-selection switch,
- automatic transfer to the stand-by motor in case of failure of the running motor.

B0.6.18.15.4 Level controls

In the case of pump motors controlled by levels, in addition to the level control in each case the MANUAL - AUTOMATIC selector switch and the necessary local points are to be fitted. Control of individual pump motors must be effected as follows as the minimum requirement:

- MANUAL- AUTOMATIC selector switch
- level control with maximum and minimum contacts
- low level contact on motor - OFF
- bottom maximum contact on motor - ON
- top maximum contact as warning to the central control room
- low-low level contact as pump dry-running protection and alarm signal to the central control room
- local control point with ON and OFF button, running and fault lamp.

When two pump motors are installed for the same purpose the control is to be effected as follows, as a minimum requirement:

- MANUAL - AUTOMATIC selector switch
- PUMP 1 - PUMP 2 (running pump / stand-by pump) pre-selection switch
- level control with three high level contacts:
- first (1): high level contact for pre-selected ON
- second (2): high level contact for alarm signal to the central control room
- low level contacts for pumps OFF
- low-low level contacts as pump dry-running protection and alarm signal to the central control room

- local control and lamps as listed above for local control cabinets, for each motor

B0.6.18.16 Terminal boxes and terminal cabinets

In order to minimize the amount of cables and distribution of signals and to centralize connections in the Plant, terminal boxes or, wherever necessary, by larger amounts of terminals, terminal cabinets shall be fitted on all the necessary

- cable crossover terminal points
- central collecting points for individual analog and binary signals and local transmitters
- signal collecting and distribution points for fire alarm, telephone, loudspeaker and clock system
- central distribution points for local signals.

Terminal boxes and cabinets must at least have class of protection IP 54 if installed indoors and IP 55W if installed outdoors and must be equipped with the necessary terminal strips, cable glands and fittings components for the connection of the cables.
The necessary earthing terminals are to be provided for the earthing of the boxes and cabinets.

In any area subject to the danger of explosion, the necessary explosion-protected terminal boxes and cabinets are to be provided in accordance with IEC 60079 and IEC 61241 and VDE 0165/0170/0171.

B0.6.19 Instrumentation and control equipment

B0.6.19.1 Main design criteria

This Section applies to the design of the general Instrumentation and Control equipment. The following general requirements shall be strictly observed with regard to design and execution. In the event of contradictions the Contractor shall be responsible for obtaining written clarification from the Employer/Engineer.

Reference within this Section does not automatically indicate that the particular form of instrumentation is required on this project or will be acceptable for a particular application. The particular requirements for control and instrumentation shall take preference in the event of any disagreement between the two Sections.

Only requirements for technical performance of the equipment are stated herein, whilst the detailed requirements of the tasks to be performed by the control systems and the scope of delivery for each individual item of plant is stated in the relevant Sections of this specification.

This specification does not however relieve the Contractor of his responsibility for the basic design and execution of the instrumentation and control system per scope of supply in relevant Sections of this specification. The rules of good engineering practice and the relevant approved standards and regulations shall be observed.

A consistent instrumentation and control philosophy shall apply throughout the Plant and shall be implemented in terms of a range of equipment exhibiting a minimum diversity of type and manufacture. The objective shall be to standardize all measurement and control equipment throughout the Plant in order to rationalize operation, maintenance and reduce spares holding.

Generally equipment shall be supplied from one composite range of measurements and control equipment as marketed by a reputable manufacturer of international standing and shall have a minimum of two years operational use on similar projects. Where particular equipment is not included in the products of the manufacturer thus necessitating diversity of supply, this equipment shall be identified by the Contractor.
The equipment shall be of modern, compact design incorporating the latest developments in proven technology. All instruments whether for local indication or remote transmission shall be of good quality and shall have an accuracy and repeatability appropriate to their duty. All fittings shall use metric threads.

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Measurement and control instruments shall be matched to the main plant equipment ratings in all aspects. Instrument ranges, installation codes of practice and precautionary measures for safety of the Plant and the operating and maintaining personnel shall be observed.

Special attention shall be paid to the Plant safety. As a general rule, measuring points and measuring equipment for critical protection shall be separate from and not combined with measuring equipment for the automatic control equipment.

The material of all equipment installed in pipes, tanks, etc., shall correspond to the material of the relevant pipes, tanks etc. and shall fully meet the requirements regarding safety and operational conditions of the media to be measured. All the equipment shall be suitable for the location in which it is to be mounted and in particular all outdoor equipment shall be suitable for the prevailing climatic conditions.

The diversity of makes and types shall be kept to a minimum. The Employer/Engineer reserves the right to stipulate make and type following award of contract.

Any equipment to be installed within potentially explosives atmospheres shall comply with the requirements of international standards and codes, e.g. IEC-60079, NEC 500 etc.

The instrumentation and control equipment shall have high electro-magnetic and radio frequency interference immunity and shall not be affected by portable radio transmitters operated in the vicinity of the equipment. Any limitations shall be stated.

All instruments shall be protected by cases. The cases shall have enclosure classification not less than IP 42 according to EN 60529 when mounted indoors in totally enclosed rooms with provision for limited ingress of dust, IP 54 else in a enclosed building and IP 55W for mounting outdoors.

Electronic instruments shall not be located close to hot lines, vessels or other hot equipment. Ambient sun temperatures exceeding 80 °C shall not result in calibration difficulties or rapid deterioration of electronic components.

B0.6.19.2 Distributed Digital Control, Monitoring and Information System (DDCMIS)

The Plant will be controlled generally through a DDCMIS. The DDCMIS contains of process stations, operator workstations, engineering workstations, archiving facilities and signal exchange to management and third party systems. In general the DDCMIS will be DCS based hardware only in some exceptions PLC based systems may be applied.

For detailed technical specification and design requirements please refer to **Section B8** of this technical specification.

B0.6.19.3 Programmable logic controllers

Programmable logic controllers (PLC) shall be deployed in subsidiary installations and systems of higher complexity and shall provide a more open access for operation. Standard products of PLC manufacturers shall be used for which software developed by the process suppliers and proven for the specialized process is available.
The diversity of makes and types shall be kept to a minimum. The Employer/Engineer reserves the right to stipulate make and type following award of contract.

The use of auxiliary packages with PLCs or local controls for ancillary plants or systems shall be limited and minimized. Only some special cases can be considered subject to the Employer/Engineer‟s approval.
Typical and acceptable reasons for a specialized control system can be high speed of response or special safety requirements, which may require a separate safety-related system.

For signal exchange with the main DCS, PLCs shall be compatible with this system. Depending on the amount of information to be exchanged, parallel or serial interfacing shall be considered. The sequence of events signals should be directly physically connected to Sequence of Events Recording System (SER).

If only few signals are to be exchanged, parallel interfacing is preferred. Binary signals shall be exchanged via volt free signals. Analogue signals (4 - 20 mA) must be suitably decoupled.
If serial interfacing is used, the interface equipment between the PLC and the DCS must be capable of communication using an industrial standard protocol. The transmission baud rate shall be selected dependent on the application (minimum 19200 baud or higher). If commands are issued from the DCS to the PLC, the time between operator command input and PLC signal output shall not be more than 1.5 seconds. The same requirement goes for answer back signals from the PLC and updating of displays of analogue values coming from the PLC on the DCS monitor displays.

As a minimum requirement, the offered serial link shall have a data integrity checking and retransmission facility in case of error detection, independent of the DCS or external system software. Hardware and software failures during data transmission shall be monitored and alarmed onto the DCS.

The communication link shall be redundant. In case of failure in the communication, quick manual automatic switch-over to the standby communication link shall be possible with automatic switchover and fault reporting and diagnostic facilities.

The functions realized in the PLC and the method by which they are invoked shall be represented graphically similar to IEC 61131-3.

Additionally, a verbal program description supported where required for easy understanding of complex functions with functional diagrams according to IEC 60848 shall be provided.

Programming devices with keyboard, VDU and printer for ease of programming, effective on-line monitoring and diagnostic functions, together with the necessary equipment to write in and to erase EPROMs shall be provided.

The Contractor shall guarantee that spare parts for the offered PLC system will be available for at least 15 years after commissioning of the Power

Plant as well as upward/forward compatibility for future upgrades of the system. If necessary, the Contractor shall provide successive system upgrades to ensure spare part compatibility for that time span.

For local operation and monitoring a panel or desk mounted Human Machine Interface (HMI) unit, operable by keypad or touch screen with LED-displays shall be provided. Protection class of panel mounted HMI (front side) shall be IP 22 according to IEC 60529.

B0.6.19.4 Control cubicles

DCS, PLC hardware and other associated control equipment shall be installed in suitable control cubicles. The cubicles shall be set up in local switchgear/ electronic rooms (CER or LER) or in local control centers (LCC). The protection class required is specified under **Section B0.6.18**.

Outdoor installed cubicles shall be provided with thermostatically controlled heating elements in order to prevent the formation of condensate which may occur due to large variations of ambient conditions, if necessary. Adequate lighting and sockets for hand tools protected by 30 mA Residual Current Differential Switch (RCDS) shall also be provided for cubicles and panels, if necessary.

The cubicles shall be secured in such a way that failure of one node cannot cause the failure of the whole system.

The required control elements and displays (annunciation and status lights, analogue displays, switches etc.) shall be so configured that as far as possible they can be viewed from the associated secondary system. Should it be necessary to place the control and monitoring elements in the field, these shall be installed in separate, robust housings (protection class IP 55W). All alarms/ annunciations shall as well be available in DCS.

In preference LED displays shall be used. Ease of access and operation of the equipment shall be ensured.

Visual display unit (VDUs) will be employed for field operation and monitoring.

All cubicles shall be adequately ventilated in order that the heat generated by the equipment mounted there shall remain within the specified limits, even in the case of high ambient temperatures that may occur in the event of failure of the air-conditioning system.

Locally installed cubicles shall be suitable for the location in which they are situated and shall provide adequate protection against dust, moisture or mechanical damage for the equipment mounted therein. Cubicles shall be designed in such a way that vibrations of the building shall be absorbed to a large extent. Sunshades shall be provided for all cubicle located outdoors.

Cable connections to cubicles, panels and desks shall be made via suitable seals so as to prevent the ingress of dust, vermin or the propagation of a possible fire. During installation period, a provisional sealing of cable penetrations shall be ensured.

B0.6.19.5 Racks, junction boxes

Marshalling racks

Separate cubicle type marshalling/ termination panels shall be provided, i.e. field signals shall not be terminated in the rear side of the system cabinets.

Open type racks constructed of angle steel may be used for the marshalling and termination of low voltage control cables within the Central Electronics Rooms (CER & LER). Cubicle type marshalling racks may also be considered.

For voltages exceeding 60 V, a suitably separated Section with isolation cover shall be provided.

Instrument racks

Wherever possible, instruments and devices, e.g. transmitters, thermo element cold junctions, terminal boxes, located in the field, shall be mounted on local instrument racks. The instrument racks shall be installed with due regard to control engineering needs, material-saving assembly and easy accessibility for maintenance and checking work, and shall be constructed of standard angle Section steel.

Junction boxes

In order to simplify local collection of cables and distribution of signals and to centralize connections in the Plant the junction boxes shall be fitted on all the necessary:

- cable crossover terminal points,
- electrical actuators,
- central collecting points for individual analog and binary signals and local transmitters,
- central distribution points for local signals.

The necessary intermediate terminal boxes must at least have degree of protection IP 55 in accordance with EN 60529 and must be equipped with the necessary terminal strips and attachment components for the connection of the cables. The necessary earthing terminals shall be provided for the earthing of the boxes. In hazardous areas, terminal boxes shall be in accordance with EN 50019 or 50020, depending on zone classification.

After commissioning, the junction boxes, marshalling racks, instrument racks, etc. must contain at least 10% of spare space. The Contractor shall furthermore provide at least 10% of fully fitted spare terminal capacity.

B0.6.19.6 Mimic diagrams

Mimic diagrams shall be offered where specified or alternatively where their presence would assist Plant operators in assimilating the operational state of the Plant.

Where used, the mimic diagram shall harmonize with the other equipment in the control room. Mimic diagrams shall be of the mosaic type.

On mimic diagrams for electrical systems, the different voltage levels shall be distinguished by the use of mosaic elements having an inlaid colloured strip. These elements shall be fitted together to show the location of the different busbars. The operational position of circuit breakers and isolators shall be indicated by semaphore indicators, and the operation of switchgear from the mimic diagram shall be by means of discrepancy switches or pushbuttons designed to operate in a similar manner.

On process mimic diagrams, methods shall be used to clearly indicate the path of the various media, the preferred technique being by means of raised plastic strips which shall have a distinctive colour. Also a uniform scheme of colours for different media shall be adopted.

Where pushbuttons are proposed for operation, enabling pushbuttons shall also be provided and it shall require the operation of both the pushbutton actuating the device and the enabling pushbutton to operate the device.

The Contractor shall propose the mimic colour code for process and electric system identification of the P&ID and electric single line mimics in the VDU or mimic panel.

B0.6.19.7 Power supply and fusing

The power supply for the equipment requiring uninterrupted supply (UPS) (e.g. emergency valves, flame monitors, measuring and control system, recorders, printers, VDUs, OWS and servers) shall be taken from the safe AC as described in other parts of the specification, especially **Section B0** and **Section B7**..

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The 24 V DC independent supply systems shall be provided for the control cubicles of independent control systems. Ni-Cd or lead-acid planté batteries shall be used in the main plant area whereas in offsite plant areas only Ni-Cd batteries shall be used.

The 24 V DC systems shall consist of 2 sets of power supply with each set consisting of 1 x 100% battery charger, 1 x 100% batteries for 1 hour duty and 1 x 100% DC distribution board.

Each individual consumer shall be provided with an infeed from each set with diode decoupling at the consumer.

The supply voltages for the control cubicles within the central electronic rooms (CER & LER) shall preferably be 24 V DC and must be arranged as separately fused double infeeds. The individual feeders can serve either a single cubicle or several cubicles combined as a logical group.

Intelligent Battery health management system shall be provided for each set of 24VDC power supply system and UPS batteries (except mini-UPS). It shall be connected to DCS.

All battery systems shall be provided with a manual discharge resistance bank.

All equipment shall be adequately protected against overcurrent by means of fuses or other current protection devices. The main power supply fuses shall be located in functional groups within separate power distribution cubicles. Fuse ratings and time characteristics shall be such that in all cases, a fault within an individual item will cause the fuse associated with that item to rupture and thus disconnect that item from the power supply, before the main fuse is affected.

Failure of a main fuse shall affect the overall operation of the Plant as little as possible and shall be indicated in the central control room (CCR) by means of an alarm. This alarm shall state the identity of the failed main fuse.

Failure of an individual cubicle, module or component fuse shall be indicated by a general alarm and a detailed diagnostic message. The Section of the control cubicle in which the fuse is located shall be indicated. It shall also be possible to locate visually the fuse that has failed.

The design of the electrical power supplies and fusing system must ensure that any faults in modules or other devices, which may block sequence logic interlocks, automatic control systems or other control systems, are restricted to the system in which the fault has occurred.

All electronic devices shall be protected against transient voltage levels which would otherwise damage the device.

B0.6.19.8 Transmitters

All transmitters shall have an impressed output signal of 4 - 20 mA corresponding to zero to full range input. However, digital communication shall also be acceptable.

Generally, 2-wire transmitters shall be used. If for some special purposes (e.g. analyzers) 230 V AC power supply is required, the output circuit shall be isolated.

As far as possible, all transmitters shall be of the SMART-type. This applies also to field mounted temperature transmitters.

All transmitters shall be fitted with a local analog or digital indicator displaying appropriate physical units which may be read clearly from an easily accessible position.

Transmitters with accuracy class "0.5" or better must be used. The repeatability shall be within a range of ± 0.1% of full span.

The output signal of all transmitters must be independent of the burden of the transmitter output circuit including cable resistance over a wide range.

The removal of connected devices must not open the transmitter output circuit or cause malfunction of this circuit. In the case of failure and return of the supply voltage within a measuring circuit, no false signals endangering the system shall be issued. All transmitters shall be individually fused. If not specified otherwise, local parameterization at the transmitter or via modem and PC/laptop or hand held communicator using HART-protocol shall be possible.

For the continuous remote position indication of valves, dampers etc. also transmitters with impressed output signal of 4- 20 mA shall be employed.

All transmitters shall be suitable for field installation and shall have strong, moisture and dustproof cases of IP 65 or better according to EN 60529. This applies also for temperature transmitters when installed in the field.

Diaphragm seals shall be provided to serve as a barrier for corrosive process fluids, slurries or highly viscous oils. The seal shall be of the flanged type, suitable for the same conditions as those for the transmitter. The material selection shall be according to the requirements of the fluids to be measured. The seal shall be provided with a flushing connection.

Transmitters to be used in hazardous areas shall be explosion proof. Suitable intrinsically safe circuits are to be provided in accordance with EN 60079-11.

All transmitters potentially subjected to vacuum shall be capable of withstanding 100% vacuum without damage.

No stress shall be imposed through the connections between Plant and the transmitter. As far as possible, the transmitters shall be grouped together into enclosed racks or panels for easy access. Sunshades shall be provided for all outdoor panels.

Individually installed transmitters shall have their own weather proof enclosure of robust construction and be suitable for the proposed

environment. All field equipment terminals shall be wired to a terminal box using screwed connections.

Transmitters shall be provided with all necessary isolating, vent and blow-down valves and facilities shall be provided for the connection of test instruments at the input and output of each transmitter, to enable calibration to be carried out.

In general limits (for alarms or switching actions) shall be derived from the analogue measurement value in the DCS (use of switches shall be avoided). Where binary signals cannot be derived from an analog value, **binary transmitters** e.g. temperature switches, pressure switches etc. may be used. Indicators with integrated limit switches are allowed within package units. Preferably limit switches shall be of the proximity type.
All switches shall be of robust design and reliable performance. Temperature switches, pressure switches, level switches, and etc. shall be of the snap-action and change over type. The switches shall have an adjustable switching hysteresis. Parity checks shall be supplied for switches. (Note: Parity checks refer to the supervision of switches, i.e. it shall be supervised that switches have one defined state and are not undefined e.g. neither open nor closed. Finally this means that there have to be 2 DI to be used for each switch, one for "open" detection and one for "closed" detection.)

The set point and the deadband (reset point) of each switch shall be adjustable from inside the case, over the full range specified. The set point and reset point shall be indicated on the adjusting mechanism.

For the sensing of level in tanks, vessels or bunkers float switches, vibration level switches or other suitable switching devices with conductive or capacitive electrodes shall be provided.

For monitoring of machine coolant or lubricant flow (dry running protection) suitable flow or level sensors shall be employed.

The switches shall be housed in robust, dust and moisture proof cases having glanded cable entries and shall be suitable for the ambient conditions local to the equipment on which they are mounted.

B0.6.19.9 Temperature measurements

Glass thermometers, bi-metallic and capillary remote thermometers are to be used for local temperature measurement. For both, class 1.0 shall be provided.

Glass thermometers are to be inserted into pockets provided for the purpose. The use of mercury is forbidden.

Capillary remote thermometers shall be with a case diameter of preferably 160 mm and must be mounted on fixtures or instrument panels in such a

way that they are protected from vibration, jarring and sprayed water. The capillary tube must be laid in a protected position.

If possible, resistance thermometers (Pt-100) in accordance with IEC 60751 shall be used for remote measurements. All resistance thermometers shall be wired according to the four-conductor principle.

Otherwise, thermocouples with appropriate heat resistance in accordance with DIN IEC 60584-1 or equivalent may be used for remote measurements.

All thermocouples shall be of the quick response type, ungrounded and preferably of double element type.

Thermocouples shall be arranged in such a way that the ambient temperature of the head is lower than 100 °C, and that the measuring inserts can easily be exchanged.

All thermocouples and extension leads shall be terminated with a suitable gland and the conductor to sheath resistance shall be greater than 100 M-Ohms when tested after termination.

Thermometers and thermocouples shall generally be fitted in protective wells. They shall be provided with weatherproof terminal heads and shall be installed so as to totally prevent the ingress of foreign matter.

High speed response pockets shall be provided for all applications involving control of critical process temperatures. Thermowells with high speed of response shall be used.

Where more than one temperature measurement e.g. for redundant loops, recording, indication, automatic control is to be made at one location, individual protective wells with sensors shall be provided at the common place of measurement. Protective wells for unoccupied test measuring points shall be arranged with the opening inclined downwards wherever possible and shall be provided with a screw-on protection cover.

Insofar as local conditions or extreme temperature do not require otherwise, screw-in immersion wells for exhaust gas and air shall meet the following requirements:

- nominal length not less than 0.5 m
- attachment of the well in the wall of the exhaust gas channel or air duct must be gas-proof.

For the measurement of temperature of other media the following requirements shall be observed:

For all pipework a minimum immersion depth of 55 mm in the internal pipeline cross-section and a minimum distance of 15 mm from the opposite

pipe wall must be provided. If the diameter of the pipeline does not allow the thermometer to be inserted perpendicular to the pipe axis while still maintaining the above mentioned measurements, another solution must be found in cooperation with the Employer/ Engineer. When determining the lengths of the insertion and connecting tubes the insulation thickness is to be taken into consideration.

For all remote temperature measurements (i.e. for RTDs and TCs) transmitters shall be installed locally in a transmitter protecting box on a DIN rail.

B0.6.19.10 Pressure measurements

Pressure gauges of class 1.6 or better must be used. The standard measuring ranges must be selected with regard to the maximum operating pressure.

A pressure instrument installed for measurement of steady pressure at varying pressure shall operate in a band centered on 60% of its maximum range.

When the pressure impulse line is liquid filled the measuring unit shall be compensated for static head. The head correction shall be stated on the unit.

Pressure gauges shall have a dial size of 160 mm and shall be located in such a way that they can be easily observed or shall be combined in groups on local gauge boards or cubicles.

Pressure gauges shall be resistant against vibrations. Furthermore, pressure gauges shall be designed in such a way that the measured value may reach the end of the indicating range without affecting the calibration of the gauge.

Pressures to be remotely indicated, recorded or used for automatic control loop inputs shall be measured by means of pressure transmitters (refer to relevant part of **Section B0**).

Pressure measurement tapping points shall generally be in accordance with the specification for the pipeline in which they are installed and shall be equipped with one, and for high pressure installations (45 bar) two, isolating valves arranged directly at the tapping point. Excluded from this stipulation are measuring points for vacuum and measuring points for combustion air and exhaust gas.

Piping shall be of approved quality and sized for the particular service. In all cases the pipe size shall be chosen to ensure strength and freedom from blockage. Instrument impulse pipework shall be manufactured from a suitable grade of stainless steel to the approval of the Employer/Engineer.

Pressure transmitters for remote measurement shall not be mounted directly at the tapping point, but shall be arranged at a distance from the tapping

point by means of enclosures. The impulse line between tapping point and transmitter shall be arranged in such a way as to form a siphon loop, when steam pressure measurements are involved.

A valve combination or multiway cock shall be provided directly on each pressure gauge or transducer connection. They shall be equipped with a connection for test gauges, and it shall be possible to shut off the test connection without isolating the service pressure gauge at the same time.

Open blowdown / drain connections shall not be arranged within panels and local equipment. Instead it shall be led to a drain external to the panel. All valves shall be installed so that they are accessible for in-situ maintenance from a floor or permanent structure landing.

Transmitters are to be protected from the measuring media, if required.

In addition to the above requirements, special valve block equipment shall be provided, where differential pressure is to be measured. Alternatively, differential pressure type transmitter can be considered.

B0.6.19.11 Flow measurements

Remote flow measurements of water, steam, combustion air, flue gas etc. shall, unless otherwise specified, be carried out by means of differential pressure, ultrasonic, electromagnetic, annubar, corriolis, turbine meters, oval-wheel flow meters.

The transmitters shall be as specified under **Section B0**. Changes in density, pressure or temperature of the measured medium shall be compensated wherever necessary.

Tags on orifice plates shall be stamped with the basic design information (i.e. flow rate, pressure and temperature of the passing fluid, the orifice diameter and the pressure differential generated).

Primary elements such as orifices or nozzles located in steam or high pressure feed water pipes shall be of the weld-in type. Material, dimensions and installation of orifices, nozzles and tapping points etc. shall be in accordance with the specification for the pipes in which they are installed.

Orifice Plate installation using Weldneck Flange assemblies shall be offered. Tappings shall be on the flange and not on pipe.

Isolating valves shall be provided at the tapping points of the orifices/ nozzles. In the case of steam flow measurements condensing vessels (steam traps) shall be provided between the tapping point and the isolating valve.

The material and dimensions of the piping shall conform to those laid down for the piping concerned. The welds shall be executed in such a manner as to avoid turbulence that can affect the measurement.

In order to achieve exact installation, the vendor supplying the orifice plate or nozzle for high pressure pipes shall install the orifice plate or nozzle in its own works in a Section of pipe of about 3.5 times the pipe diameter (1.0 x NB in the outlet, 2.5 x NB in the inlet). For orifice plates or nozzles installed in pipes with a nominal bore smaller than 80 mm, complete meter runs shall be supplied.

Orifice plates and nozzles shall be manufactured of ANSI 316 Stainless Steel unless specified otherwise. Orifice plates shall be sized according ISO 5167-2.
Orifice plates shall be sized for a d/D ratio not less than 0.20 and not greater than 0.70. Higher rather than lower d/D ratio are preferred to minimize line restrictions. All sizing calculations shall be submitted to the Employer/ Engineer for approval.

Tags on orifice plates shall be stamped with the basic design information (i.e. flow rate, pressure and temperature of the passing fluid, the orifice diameter and the pressure differential generated).

Venturi tubes according to ASME MFC-3M shall only be considered when operating economy requires low permanent pressure losses.

The erection welding seams shall be executed in such a manner that no turbulence, which will affect the measurement, can occur.

Rectangular venturi tubes may be considered where other measuring devices are impossible or impractical (e.g. in large rectangular air duct of boilers).

For flow measurements in LP-systems e.g. water or condensate, orifice plate installation using slip-on orifice flanges shall be provided. All orifice plates for installation between flanges shall have their own tapings for differential pressure measurements incorporated in the plate. Simple orifice plates with the tapings situated in the pipe are not allowed. The flow direction shall be consistently marked on the orifice or nozzle by means of an arrow.

Special conditions may dictate the use of devices such as:

- venturi tubes for low pressure gases
- pitot tubes such as Annubar.

Ultrasonic flow sensors shall provide a double transmitter/ receiver system and be for installation with a calibrated pipe. The tube lining material shall be as required for the fluid and its temperature and be as specified in other chapters of this **Section B0**. The use of ultrasonic clamp on flow meters shall be avoided and requires dedicated approval of the Employer/ Engineer.

The accuracy shall be 1% of the calibrated span. An overpressure security shall be provided of 50% above the maximum pressure range.

Electromagnetic measurements may be used for flow measurements of inhomogenous liquids with or without solids content in completely filled pipes. The limits of application of the measuring system due to the medium parameters planned on a case-by-case basis shall be observed. Inductive flow sensors shall be of alternating field or pulsating DC field type and be for inline installation with a pipe.
The tube lining material shall be as required for the fluid and its temperature and be as specified in other chapters of this **Section B0**. The accuracy shall be 1% of the calibrated span. An overpressure security shall be provided of 50% above the maximum pressure range.
Corriolis measurements shall be used for mass flow measurements of homogenous liquids and gases without solids content in completely filled pipes, in particular for natural gases, fuel oils and solvents as well as other media with fluctuating densities. The accuracy shall be typically at 0.5% of the measured value.

B0.6.19.12 Level measurements

Where detection of discrete levels is required, the simple float operated switch should be used, however each switch shall have snap action with limited hysteresis to prevent contact bounce caused by small fluctuations in level. For sumps the level should be measured using non-contactive measuring principles such as ultra sonic with local control box.

Switches used for level detection shall provide facilities for testing the mechanical and electrical operation of the switch without its removal from the process. Isolation by means of shut-off valve will be allowable during testing.

Generally, the use of switches shall be avoided. Instead limit values shall be derived from analog transmitters.

For measurement of large storage tanks, the load indication and transmitting mechanism shall be located at the base of the tank.
For the measurements of boiler separator water level, feed water tank levels etc., differential pressure transmitters shall preferably be used.

The transmitters shall be as specified under **Section B0**.

For special applications such as chemical tanks, techniques such as ultrasonic, radar, capacitance probes, etc. should be considered. For level measurement in tanks with underpressure (vacuum) guided wave radar shall be used.

For level measurement of the fabric filter (FF) hopper dust radio frequency (RF) / Capacitance type level switch can be considered.

For measurements where a reference leg of process fluid is used, the design of the system shall ensure that the reference leg is fully maintained at its prescribed height during all conditions of process level change and changes in process conditions and the density of the reference leg does not vary from that of the process fluid due to temperature changes or other reasons.

All measurement transmitters for differential pressure shall be provided with:

a. shut-off valves to be arranged directly at the condensing vessels and active pressure tapping points
b. valve blocks enabling the transmitter to be isolated from the active pressure and enabling the transmitter zero point to be checked
c. separate blow-off valves for cleaning the active pressure tubes.
d. 2 ways for relative pressure, 5 ways for DP.

The aforementioned valves shall be of the weld-in type.

Where a standpipe exists, the level transmitters or level switches must be connected to the standpipe by means of shut-off valves, so that the units can be replaced easily in service.

Local level indicators for water shall be provided with an illumination device and indicators shall be designed so that the water column can be seen as whole, i.e. level indicators only showing the level as a point will not be accepted. Level indicators shall be equipped with shut-off valves which permit exchange or replacement of glasses or mica during operation.

The indicating range of local level indicators shall cover all switching points of level switches mounted on the tank or similar as a minimum requirement.

On all forms of measurement all parts of the switch, transmitter, etc. in contact with the process fluid shall be made of material compatible with the process fluid. Stainless steel shall normally be used for all corrosive duties.

B0.6.19.13 Analysers and monitoring systems

B0.6.19.13.1 Analyses of steam and water (SWAS)

The steam and water analyzer core instruments shall comply with EPRI (Electric Power Research Centre Inc.) guidelines.

The main analyzers for steam and water shall be arranged in groups in such a way that excessively long process pipes will not be necessary.

If required by the medium to be analyzed, all samples shall be adequately cooled and pressure reducing devices shall be provided where necessary. Manual sampling shall be possible.

A protective device shall be incorporated in the sample cooler to isolate the analyzer in the event of excessive temperature.

In order to eliminate the influence of conditioning agents on the conductivity measurement, cation filters shall be provided. The cation filters shall have visible colour indicators to show when they have to be regenerated.

For all analyzers temperature compensation shall be provided, with the temperature sensor being an integral part of the probe.

Chlorine residual monitors and hypochlorite concentration meters shall preferably be able to measure high and low concentrations. Measurement of hypochlorite concentration shall not be affected by the presence of other oxidizing components in the sample.

Individual or multiple prefabricated analyzer installations shall be used to reduce site installation work. This prefabrication shall include sample conditioners, analyzers, air and electrical distribution, cooling water distribution or coolant circulating system all piped and wired on a common frame. Interconnecting pipework and accessories shall be of stainless steel. The arrangement shall permit testing of the entire assembly before dispatch to site and shall be arranged for convenient removal from on-line operation to facilitate routine maintenance and calibration.

The sampling system shall include but not be limited to all probes, valves, filters, coolers, drainage facilities, flow regulators, flow meters, piping and pumps as necessary, to give the analyzer a representative and suitably conditioned sample.

Analyzers shall be provided as follows:

Sample Point	Analyzing Required
Condenser make up water	specific Conductivity
Condensate pump discharge water	pH, cation Conductivity, DO
Condensate at deaerator inlet water	pH, specific Conductivity
Deaerator effluent water	pH, DO
Economizer inlet water	pH, cation Conductivity, DO
Boiler blow down steam	pH, specific Conductivity
Saturated steam	cation Conductivity, SiO2, Na
Main steam	cation Conductivity
HP5 heater drain water	pH, specific Conductivity
Closed cooling water	pH, specific Conductivity

Note:

DO: Dissolved Oxygen

Chemical reagent for the sampling system commissioning period but not exceeding 180 days shall be provided.

Each automatic analysis sampling point shall be provided with a manual sampling point to permit a sample to be easily taken. Manual sampling shall not interrupt automatic sampling. All sampling lines shall be run to common sampling racks on which shall be fitted all the analysis associated equipment.

The sampled points of analyzers shall be indicated and monitored at the local panel.

The corresponding analogue measuring signals (4-20 mA) and the status signals (24V DC) shall be transmitted over serial link to the DCS.

The SWAS system, for both Units should be located at ±0.0 meters in an air conditioned room.

B0.6.19.13.2 Effluent Monitoring

The operational philosophy of water supply/ distribution system shall be based on a continuous Possur river water quality analysis, potable water quality monitoring, sampling and analyzing concept and shall consider preventive and active measures against water pollution and adaption of operating mode(s) to changes in water conditions.

Sample Extraction for Laboratory Analyses:
A tapping shaft for extraction of samples for laboratory test shall be provided and installed at the various measuring locations, before the waste waters are mixed with the circulating cooling water and discharged to the sea.

Continuous Effluent Monitoring:
A continuous monitoring shall also be implemented for water quality measurements of all kinds of discharges to the river.

The sensors for continuous monitoring of effluent parameters shall be located within the sample-tapping shaft. Additionally flow and temperature sensors shall be mounted within the discharge lines.

Following kind of analyzers shall be considered at least:

- pH analyzer
- conductivity analyzer
- chemical oxygen demand (COD) analyzer
- biological oxygen demand (BOD) analyzer

- total suspended solid (TSS) analyzer
- oil in water (OIW) analyzer

Continuous quality monitoring system shall be installed at the CES. The corresponding electronic equipment shall be mounted in a weatherproof container to be located nearby the point of measurement at the discharge pipes of waste water.

The corresponding analogue measuring signals (4-20 mA) and the status signals (24V DC) shall be transmitted by multicore cables to the DCS.

B0.6.19.13.3 Potable water quality monitoring system

Water quality control and monitoring of the Plant"s drinking water shall be performed at the Plant interface (downstream the potable water tanks).

The water quality monitoring system shall at least consist of, but not be limited to the following online metering, measurement, sampling and analyzing equipment, including data acquisition and data storage facilities:

- alkalinity
- conductivity metering
- pH monitoring
- temperature measurement
- turbidity monitoring
- residual chlorine monitoring
- TDS (computed value)
- LSI (computed value)
- sampling points and equipment for potable water sampling at the online measuring units.

B0.6.19.13.4 Quality monitoring for fuel

For fuel oil a sampling point for discontinuous manual analysis shall be provided for the facility at the fuel oil storage tanks.

B0.6.19.13.5 Analysis of exhaust gas (CEMS)

The analysis of O_2, CO, CO_2, NO_X, SO_2, particulate matter (opacity) in the exhaust gas shall be performed by appropriate analyzers of proven type.

The equipment shall be constructed for operation in dusty and humid environments at high ambient and exhaust gas temperatures. The use of equipment capable of multi-parameter measurement shall be considered.

The reliability and response time of the O_2-analyzer shall be of the quality required for closed-loop control. The accuracy of the system shall be better

than 2.0% of the span and the drift shall be not more than 0.1% O_2 per week. A zirconium oxide measuring cell shall be used. Maintenance shall not be more than once a week.

Analyzers provided shall have auto-calibration for zero and span as well as self-diagnostic functions. Analyzers and sensors can be of extraction or insitu type.

All equipment of the continuous emission monitoring system (CEMS) shall be suitable for operation in dusty and humid environments at high ambient and flue gas temperatures. Continuous Emission Monitoring System (CEMS) shall be provided for each unit.

If sampling of exhaust gas is used, sampling probes shall preferably be vertically installed on the top of horizontal exhaust gas ducts, in order to avoid blockages.

In order to keep the sampling lays to acceptable limits the analyzers shall be located close to their sample take-off point, so that easy access to the sample take-off point and to the analyzers shall be provided for maintenance.

The exhaust gas sampling lines shall be heated to prevent condensation and shall not form a siphon in the case where condensate may be collected during heater failure. Condensate drainage facilities shall be provided at the analyzers.

Generally, the analyzers and the sampling probe equipment shall be suitable for mounting in ambient plant conditions, e.g. within a standard cubicle. However, if this is not feasible, the equipment shall be mounted in an air-conditioned room or container.

Power failure and system failures of analyzers shall be monitored in the DCS by a group alarm.

Measured values and certain status signals shall be processed by an emission evaluation computer via serial interface, to be installed within the central control room. The emission data shall be calculated, converted, printed out and stored according to the governmental requirements. Possibilities for on-line data readout for authorities shall be provided.

B0.6.19.13.6 Ambient air quality monitoring system (AAQMS)

An ambient air quality monitoring system shall be provided consisting AAQMS stations and metrological stations. A centralized data acquisition PC shall be installed to collect all information from the AAQMS. The AAQMS stations shall be suitably distributed on the Plant area.

The AAQMS stations shall contain at least the following:

- Analyzers for SO_x, NO_x, CO, O_3, mercury
- Multi gas calibration system
- PC based data logger
- UPS
- Suspended particulate monitors (TSP)
- Sampling inlet heads

Metrological station shall include at least:

- Metrological sensors such as wind speed, wind direction, air temperature, relative humidity (rH), solar radiation, rain gauge
- Metrological mast

All ambient gas analyzers and dust monitors shall conform to the US EPA reference of equivalent method. A proof of approvals and certificates of the compliance of internationally reputed agencies such as US EPA, German TUV, etc shall be provided.

A sampling system compatible with the analyzers shall be provided. The system shall be compatible with analyzers for Pb (which the Employer may procure in the future). The system shall have the facility for moisture removal.

Built-in calibration facilities shall be provided for all analyzers. To cross check the built-in calibration facilities of the analyzers/ monitors, a standard multi-gas calibration system for each AAQMS station with fast response time shall be provided.

The metrological sensors for wind speed and wind direction shall have an accuracy of 2% of full scale. The accuracy of the relative humidity sensor shall be 3% for the range between 10 and 90% rH.

The rain gauge shall be of self recording type and of reputed make. Electronic recording facilities shall be provided. The instrument shall have automatic functions for computing rainfall for pre-set time periods. The gauge shall be rugged and be of material resistant to atmospheric corrosion. The accuracy shall be 1% for rainfall ranges above 125 mm/hr and 5% below this value.

A metrological mast shall be provided for mounting of the metrological sensors. It shall be complete with all necessary hangers and holders along with electrical earthing for the installation of the sensors. Material and construction of the mast shall be robust and shall be resistant to atmospheric corrosion.

There shall be PC based data loggers for each AAQMS station. The entire data capture and mean value calculation as well as control of analyzers shall be through user friendly software and operate on the latest Windows operating system. Diagnostic features shall be included in the software and

any unauthorized access shall be prevented by appropriate measures such as password protection.

Data loggers for the metrological station shall be provided with the necessary analogue and digital inputs and internal memory for all collected parameters. The data loggers shall have the capacity for future extension with additional sensors.
Location for centralized data collection PC stations shall be decided during basic/detailed design stage

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B0.6.19.14 Electrical value measurements

For the processing of electrical values such as voltage, current, power, frequency etc. electronic type transmitters shall be provided to convert the output of current and voltage transformers into an impressed direct current in the range 4 - 20 mA. The transmitters shall be housed in the switchgear.

For power measurements precision electricity meters for asymmetrical three-phase networks are to be supplied. Connection of the meters shall generally be to 3 x 1 A current transformers and 3 x 110/√3 V voltage transformers. The meter accuracy class is to be approximate to the respective transformer classes. Instrument transformers with an accuracy class of 0.5 or better shall be used for metering purposes.

For the purpose of billing for electrical energy and for acceptance tests, an instrument transformer of at least class 0.2 (precision) accuracy and high precision electricity meters of class 0.2 have to be provided. Meters for billing purposes shall be of the approved calibrated type (certified by independent testing stations). All meters for billing purposes are to be provided as double 2 x 100% meters.

At all points where power direction reversal is possible, the necessary meters for both directions are to be provided.

The meters in the local switchgear are to be arranged behind the clear plastic fronts of the cubicle doors so that the counter readings can be taken without opening the doors.

B0.6.19.15 Control valves

Control valve spindles and internals shall be made of chromium steel and shall have a high resistance to wear and corrosion. Cones and seats shall be hard faced with materials with a high resistance to wear and corrosion. Housings shall be made of forged or cast steel. A hand wheel, with provision for switching to manual operation and a local position indicator shall also be provided.

All control valves, orifices and nozzles shall comply with the relevant international standards such as DIN, BS or any other which may be agreed to by the Employer/Engineer.

Control valve characteristic shall allow smooth and continuous control of the control parameter.

Valves shall not generate noise in excess of 85 dB(A), measured at a point 1 meter downstream of the valve outlet and 1 meter from the pipe centerline. Where this requirement must be exceeded because of physical limitation, suitable sound attenuators shall be provided in terms of special valve trim, in-line attenuators, isolators and enclosures to satisfy the noise requirement.

Valves shall have trim designed to avoid cavitation damage. If an application cannot avoid cavitation entirely, material selection shall be such as to withstand the effects without damage.

Line strainers shall be provided upstream of control valves where required.

The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. The design pressure drop across the valve should be 15 to 20% of the total available pressure drop at no flow.

Although control valves shall not be used for shut-off service, to provide reasonable shut-off performance, leakage through a closed control valve shall not exceed 1% for single ported valves or 2% for balanced ported valves.

All control valve materials shall be compatible with the fluid handled. Materials shall be in accordance with the piping materials standard and/or as approved by the Employer/ Engineer.

Valve characteristics shall be selected to suit the process and control system dynamics.

All the control valves for boiler feedwater services should be of anti-cavitation type with flash-flow trims and cage type to avoid cavitation problems.

The installation shall include upstream and downstream isolating valves and, for critical control valves, a bypass valve for each control valve on all services. Unless otherwise agreed by the Employer/Engineer the bypass valve shall have a similar characteristic as the control valve but shall provide tight shut-off. Any exceptions or variations to the requirement shall be subject to the approval of the Employer/ Engineer. Where a service is subject to a pressure above 3 bar a 25 mm vent valve shall be provided, between the upstream and downstream isolating valves, in order to relieve the pressure to enable maintenance to be carried out on the control valve.

Control valves shall be adequately supported in all cases and shall be accessible for maintenance. Local pressure gauges shall be provided upstream and downstream of each control valve.

If as per steam turbine OEM‟s proven design, isolating valves or bypass valves are not envisaged for control valves of internal piping, same is also acceptable.

For normal duty globe type valves shall be used.

The use of butterfly valves shall be avoided in the main plant. Where very large sizes are involved (on high flows), or low pressure drops and low static pressure are a determining factor, making globe valves unattractive or impossible, butterfly valves may be used, They shall be of the "balanced torque" type disc usable to the fully open position (90° opening).
The overall shaft rating shall be at least 25 % above the static pressure as differential across the closed valve.

Multi-stage valves (e.g. multi seat or multi cage valves) shall be used on services, e.g. steam and gas, having very high pressure drops which would result in supersonic velocity inside a conventional body and shock waves in the piping, creating unacceptable noise levels.

Angle valves shall be provided:

- for steam pressure reducing de-superheating stations of the "combination" type,
- for erosive services, e.g. slurries,
- on applications where solid contaminants might settle in the valve body,
- on hydrocarbon services with a tendency for “coking”.

Ball valves shall be used for on-off and throttling services under moderate operating conditions.

The control valves must be provided with all data important for their identification, such as flow direction, type, nominal diameter, nominal pressure, seating, CV value.

B0.6.19.16 Actuators

Intelligent drives with integrated power switch unit and further electronics shall be installed. Actuators equipped with integral controls shall be supplied which can be operated via the operation elements on the local controls as soon as power is connected. Only operation commands and feedback signals shall be exchanged between the control system and the actuator. Motor switching shall be performed within the device and virtually without delay.

Unless otherwise specified actuators for modulating valves and dampers shall either be pneumatic or electrically operated. Self contained sealed hydraulic units may be considered where high thrusts or high speeds of operation are required.

Actuators for ON/OFF duty or manually positioned units shall generally be electrical motor and/or pneumatic driven, however the use of solenoid types on small valves shall be allowed dependent on duty.

The various types and sizes of actuators shall be rationalized and as far as possible each type shall be from a common manufacturer to facilitate interchangeability and spares.

In order to prevent the risk of fire or explosion pneumatic actuators shall be used in hazardous areas and associated equipment (e.g. positioners) must be intrinsically safe in accordance with IEC 60079-11.

Pneumatic actuators must be designed in such a way that in the event of air failure the actuator will remain in the position immediately prior to loss of power, or assume a position which is safe for the process.

With either action the failure mode shall be suitably monitored and the Plant operator informed by some form of alarm. The failure response of all actuators in the event of the loss of the prime mover (air pressure, oil pressure, electrical power) shall be indicated on the Piping and Instrumentation (P&I) diagrams, valve schedules, etc.

All pneumatic tubing to control drives or actuators shall, unless otherwise agreed to by the Employer/Engineer, be in copper which shall be sheathed in PVC or alternatively in stainless steel.

For all actuators of control valves and dampers of main systems local indicating pointer and position transmitters for remote indication and closed loop feedback shall be provided in accordance with the most severe operating conditions to be expected. The transmitters shall be designed to withstand conditions such as high temperature, vibrations and leakage of steam and of hot water wherever required. The protection class shall be IP 65 according to IEC 60529.

All actuators shall have a handwheel for direct manual operation. The diameter of the handwheel and geared effort shall be such that they can be reasonably operated by one man. A lockable mechanical clutch mechanism shall be provided to inhibit power control of the actuators when the handwheel is operated.

The speed of response of actuators used for modulating control shall be chosen to suit each particular application. Facilities shall be provided for limiting the actuator movement in each direction.

Special attention must be paid to adequately dimensioned drives and care must be taken to avoid any unintended displacement of the actuator on sudden rises of pressure in the piping.

Actuators shall have fail safe operation and actuator locking device in the event of abnormal conditions. Any abnormality on the valve shall be transmitted to the DCS.

All electrical actuator drives necessary for the safe operation and shut-down of the Plant in the event of 0.4 kV switchgear failure shall be connected to the UPS.

B0.6.19.17 Solenoid valves

In lines with nominal diameters of up to DN 25, as well as for piloting pneumatic actuators, suitable solenoid valves shall be used. Valves with power ratings up to 30 W shall be controlled directly at 24 V DC from the DCS. For powers over 30 W, solenoid valves for 230 V AC shall be employed. Solenoid valves for 110 V, 230 V AC and above shall be secured with blade fuses. Electrical connections are made by means of plug connectors, with the mating connector forming part of the scope of supplies.

B0.6.19.18 Cabling and wiring

The general requirements for cabling are as stated under relevant chapter in **Section B0**.

In particular, wiring within desks and panels shall be supported on trays and shall be segregated according to voltage level. Wiring carrying AC and D.C. voltage shall also be segregated.

All desks, panels, cubicles and racks shall be factory-wired with regard to the internal connections. Where desks or panels will be supplied in more than one Section, electrical connections between the Sections shall be via terminal strips provided for this purpose.

All cables must be provided at both ends, at every 20 m and every bend with identification with identification in the form of numbered labels corresponding to the coding system. The individual cores will be numbered or identified by colour-coding.
Instrumentation cables will be identified by colour codes and band marking, follow VDE 0815. The cables must be laid to ensure that they can be replaced or renewed in a simple manner.
Spare cores shall be terminated at terminal strips in such a way as to give a maximum length of core and shall be ferruled in such a way as to indicate that they are spare cores.

All instrumentation cables including both prefabricated and non-prefabricated type shall be with Fire Retardant Low Smoke (FRLS) type Poly Vinyl Chloride (PVC) overall sheath. For cables that are exposed to ambient temperatures above 60°C, teflon or silicone cables are to be provided. For safety related equipment fire surval cables shall be provided. The cables must be suitable for laying indoors, in the open (direct or indirect sunlight), in ducts, on trays, in the ground and in water. The cables must be resistant to solar radiation, the effect of oil, seawater, bacterial action, insects and rodents. Shields for individual pair and overall shield shall be provided for cables for analogue signals. Cables for binary signals shall have an overall shield. Multipair cables of 0.5 sq. mm, shall be used extensively for I&C cables, wherever required, prefabricated cables may also be used.

For thermocouple measurements compensation cable NiC r-Ni 2x0.5sq. mm or 4x0.5 sq. mm with silicone insulation and pair screen will be used. Fiber optic cables shall be provided for Remote I/O bus, CCTV, Station LAN etc.

The fiber and cable specifications shall comply with ITU-T Recommendation G652 and the relevant IEC standards. Each fiber cable shall be supplied with at least 50% spare cores. A minimum number of four spare cores are required.

Suitable fiber optic cable junction boxes, patch panels and patch leads shall be provided. These shall conform to the following:

- They shall support, organize, and protect the optical fibers and the fiber splices whilst ensuring that the optical fiber minimum-bending radius is not exceeded.
- The splice tray shall not have any sharp edges or protrusions that may damage the optical fiber cable.
- They shall provide entry for all cables.
- Include number tags for tube and fiber identification.
- They shall provide mounting positions for the bulkhead mounted connectors on which the cable will be terminated.
- They shall allow patching of fibers.
- Outdoor mounted boxes shall be rated to IP65 in accordance with IEC 60529.

The junction boxes/ patch panels shall have a fiber capacity equal to the total number of fibers (connected and spares) for all cables to be connected. Patch panels shall be designed for 19-inch rack mounting within a standard equipment cabinet.

All unused couplings shall have protective dust covers. The patch area in patch panels shall be accessible and covered behind a door or removable cover.

Sufficient factory manufactured patch cords with suitable colour coding shall be provided.

Fiber optic connectors shall be standardized for ease of maintenance.

B0.6.19.19 Instrument and measuring impulse piping

Instrument impulse piping shall be supported at intervals as defined in BS 6739. The correct size of tube clips shall be used to suit the tube outside diameter.

The Contractor shall fabricate and erect all mounting brackets for control and monitoring apparatus including all pressure switches and miscellaneous instrumentation. If it is found after commissioning that any mounting frame vibrates excessively under operating conditions, instruments within the frames shall be isolated with vibration dampers by the Contractor or moved to areas of low vibration.

Impulse lines shall have venting, draining and blowdown facilities. Impulse lines between process and sensor shall be as direct as possible and shall include allowance for vibration and vertical and horizontal movement. Joints in impulse lines shall be kept to a minimum.

All pneumatic instrument lines shall be soap tested and any leakage shall be rectified.

While process instrument lines are being pressure tested all instruments shall be completely isolated or disconnected.

B0.7 Inspection and Testing

B0.7.1 General

This Section contains general requirements for inspection of material, parts, equipment and workmanship of the Plant during manufacture, assembling and erection and upon completion to demonstrate compliance with specification, codes and standards and to ensure overall reliability of Plant operation and performance.

Development and implementation of test procedures for the construction inspection, start-up and performance testing and capacity demonstration of the Plant shall be the responsibility of the Contractor.

The Contractor shall be responsible for providing all supplies required for carrying out such tests, except to the high speed diesel and coal used during Reliability Test Run and Performance Tests.

The overall testing program for the Project shall consist of the following:

- workshop inspections and testing
- construction inspections, and testing
- mechanical completion
- pre-commissioning tests
- tests on completion
- reliability test run and performance tests.

The Employer shall have the right to have their representatives present during inspections and tests of Plant equipment and systems in the workshops and during construction. The presence of the Employer˝s representatives during any inspection or test shall in no way relieve the Contractor of its responsibility for supplying the equipment or systems in accordance with the milestone dates.

The Employer will be notified by the Contractor in writing at least ten (10) days prior to such testing and inspection at workshop and two (2) days for test at site.

Three (3) months after effective date of Contract, the Contractor shall submit to the Employer all relevant test documents, which shall include:

- inspection and test program
- test standards
- type of inspection and tests
- tests which are to be witnessed by third parties.

Six (6) months prior to the proposed start of commissioning the Contractor shall submit to the Employer:

- commissioning test program
- commissioning procedures
- tests on completion.

Six (6) months after effective date of Contract the Contractor shall submit to the Employer for the Performance Tests:

- test program
- test standards
- manpower and deployment schedule of the Contractor for performing the tests forms of test records and report
- description of instrumentation to be used, including accuracy, and calibration test results
- method of data recording
- method and equations/correction curves used for adjustment of recorded data to the design conditions.

The results of all tests shall be certified by the manufacturer, Contractor or independent agency as appropriate.

Document files containing material certificates, welding procedures, test report etc. shall be compiled for each item of plant and shall be suitably identified (including equipment classification reference) and bound.

B0.7.2 Testing during manufacturing

B0.7.2.1 Material tests

Major steel forgings
Purchase specifications shall clearly state the quality and inspection requirements and should include:

a. Chemical composition range
b. Heat treatment
c. Mechanical test specimen locations
d. Mechanical properties
e. Magnetic properties (when applicable)
f. Non-destructive testing
   - methods and procedures
   - stage and extent of application
   - recordable indication size
   - allowable indication size
g. Thermal stability test (HP and reheat turbine shafts only).

Each forging shall be suitably marked with an identification number which shall transfer throughout all machining stages. The identification number shall be indicated on all documents relating to the forging.

Repair welding will not be permitted on rotating parts and on other components the proposal will be subject to approval by the Employer‟s Representative.

Rotor forgings
The profile of forgings at the stage of final ultrasonic inspection should be such as to minimize the regions where complete coverage is not possible. Ultrasonic indications should be measured by the equivalent flat bottomed hole or AVG (DGS) method.

The toughness of rim and core (where applicable) material shall be evaluated by testing Charpy V impact specimens over a range of temperatures and thus determining the 50% fibrosity fracture appearance temperature (FATT).

Allowable indication size and material toughness are interdependent design related criteria and the Contractor must be prepared, if requested by the Employer"s Representative, to justify his proposals by reference to fracture mechanics calculations.

Bores, when provided, shall be magnetic particle inspected and a suitable intrascope used for examination.

Residual stress measurement shall be provided for rotor forgings.

Major steel castings
Purchase specifications shall clearly state the quality and inspection requirements and should include:

a. Chemical composition range
b. Heat treatment
c. Mechanical test specimen locations
d. Mechanical properties
e. Non-destructive testing
   - methods and procedures
   - stage and extent of application
   - recordable indication size
   - allowable indication size
f. Other tests
g. Standard weld repair-procedure

Each casting shall be identified by hand stamped or cast-on reference numbers which shall be indicated on all documents relating to the casting.

Non-destructive testing
Minimum requirements are as follows:

a. Crack detection of critical areas of castings which in the case of castings to operate at high temperature or high pressure shall consist of 100% of all accessible areas. Magnetic particle inspection shall be used for ferritic steel castings.
b. Ultrasonic inspection of all surfaces of castings to operate at high temperature or high pressure.
c. Ultrasonic thickness check of critical areas.
d. Radiographic examination adjacent to future butt weld regions (Acceptance Standard Level 1 of ASTM E446 or E186 as appropriate).
e. Radiographic examination shall also be used to assist in defining defects indicated by ultrasonic inspection.
f. Blue matching on the parting plane between upper half and lower of the turbine casing
g. Creep test shall apply for high chrome casting and forging, in particular when used for more than 540^0C.

In addition to being applied as necessary quality control on as cast items, inspections outlined in a) and b) above shall be applied to the finally heat treated casting.

Prior to non-destructive testing all surfaces shall be satisfactorily prepared and visually examined.

Either colour matching of casting by putting two halves together or feeler gauge thickness check from outside to ensure required contact area and joint tightness are acceptable

Repair Welding
Unacceptable defects observed by visual examination or indicated by non-destructive testing shall be excavated by chipping or thermal gauging and grinding and their complete removal proved by crack detection.

In the case of excavations which penetrate more than 25 mm or 50% of the wall thickness or cover more than 10,000 mm^2 area the Employer‟s Representative written approval of the proposed repair must be obtained.

Only welders qualified by performance tests on similar cast materials shall be used.

On completion of repair welded areas shall be ground smooth and carefully blended into the surrounding material. The repaired areas shall be surface crack detected; magnetic particle inspection being used for ferritic steel castings and in addition ultrasonic inspection shall be used on castings to operate at high temperature or high pressure.

After repair weldings hardness shall be checked.

Steel Plates and Sections
The following requirements, which may be supplementary to the applicable material standards, shall be considered when selecting material grades:

- impact testing of plate or Sections over 50 mm thick (impact requirements to be dependent on application).
- ultrasonic testing of plate where the presence of non-metallics may interfere with the interpretation of ultrasonic testing of future welds;
- ultrasonic testing and through thickness ductility measurement, where the application involves the risk of lamellar tearing in the material at regions of high restraint (e. g. at set-on nozzle locations or cruciform joints);
- ultrasonic testing clad materials to detect lack of bonding. (Proposed rectification procedures shall be submitted for the approval of the Employer‟s Representative).

Reinforced Thermosetting Resin Pipes
Checks shall be made on all raw materials to ensure that they comply with the relevant ASTM Standard.

All deliveries of resin shall be checked for consistency by viscosity and reactivity. Any resins deviating from the manufacturer's published figures shall not be used.

Testing of reinforced thermosetting resin pipes:

- Long term hoop strength (type test for pressure pipes only)
- In accordance with ASTM D2992 Procedure B with the exception that the test results shall be extrapolated to determine the stress which the pipe can withstand for a period of 60 years without failure. The lower 95 % confidence limit at 60 years shall also be calculated.
- Hydraulic test
- 100 % of the pipes shall be subjected to an internal hydraulic pressure test at the manufacturer's works prior to delivery. The test shall be applied to a pressure equal to 1.5 times the maximum working pressure stated for each classification of pipe. The test pressure shall be applied for a minimum period of 5 minutes without signs of leakage.
  In addition to the above the first pipe and every thirtieth thereafter of each class and diameter shall be maintained at test pressure for a minimum of 4 hours without signs of leakage.
- Each pipe and fitting shall be subjected to an internal low pressure air test at the manufacturer's works prior to delivery. The test pressure shall be an overpressure of 0.1 bar and this shall be applied for a minimum period of 5 minutes without signs of leakage or distress. Fittings which are of mitred construction shall be manufactured from pipes which have successfully passed the tests defined above.
- Dimensions
  The dimensions and tolerances of all pipes shall be determined in accordance with the relevant standards (e.g. DIN 16965, DIN 16964, DIN16867, DIN 16868, DIN EN 14364)
- Stiffness
  A minimum of one pipe for every 30 pipes manufactured shall be tested for stiffness in accordance with AD 2000 HP110R and N1. A minimum of one pipe of each class and diameter of pipe shall be tested.
- Longitudinal and hoop tensile strength
- The tensile strength properties of a minimum of one pipe for every 100 pipes manufactured shall be measured in accordance with AD 2000 HP110R and N1. A minimum of one pipe of each class and diameter of pipe shall be tested.
- Cure
  Curing, to be tested by the Barcol Hardness test determined in accordance with DIN EN 59: 100% of the produced pieces. Minimum acceptable hardness is 90% of the value recommended by the resin manufacturer of the particular resin used, when non-reinforced.
  The sample pipe shall also withstand a commercial acetone test on the internal portion of the laminate.

- Loss on ignition
  A minimum of one pipe for every 30 pipes manufactured shall be tested in accordance with ASTM-D 2584 "Standard Method of Test for Ignition Loss of Cured Reinforced Resins".
- Joint tests
- A minimum of two pipes in every 100 pipes manufactured shall be jointed and tested in accordance with the requirements of **Section 7.2 of ASTM-D 3262**.
- Visual inspection
- Each pipe and fitting shall be subjected to a complete visual inspection before shipment in accordance with ASTM-D 2563.
- Vacuum test
- Vacuum test for those piping Sections being operated under vacuum shall be carried out for each diameter once at beginning of production. The vacuum to be applied shall be equivalent to the condition which occurs during full vacuum. The corresponding derated vacuum for this test shall be proved by the pipe manufacturer.
- Failure of tests on completed pipes
- In the event of a specimen not fulfilling the minimum requirements for strain corrosion resistance, all pipes of that class and diameter which have been manufactured shall be rejected and shall be replaced entirely.

Any pipe or fitting which fails any of the quality control tests which are to be carried out on each and every pipe or fitting shall be rejected. In the event of any pipe failing any of the remaining tests outlined above that pipe shall be rejected and the relevant test shall be carried out on a further ten pipes of that class and diameter. If any one of these ten pipes fails than the manufacture of pipes of that class and diameter shall cease and the Employer reserves the right to reject all the pipes of that class and diameter.

Thermal insulating materials
Materials shall be tested for bulk density, specific heat, compressive strength, fire resistance under pressure, service temperature limit in accordance with VDI 2055 or equivalent standards.

HP Piping
Ultrasonic inspection of all HP piping shall be performed at manufacturers place and proven by certificates.

B0.7.2.2 Manufacturing tests

RT is not carried out for pulverizer component.

B0.7.2.2.1 Welding tests

Non destructive examination of pressure and vacuum containment welds
Welds shall be non-destructively tested in accordance with the construction

standard applicable to the item of plant. In addition the requirements of the following Table 1 shall be observed. Table 1 shall also apply in cases where the standards used for design and construction of an item of plant does not specify the quality requirements for welds. Fault limitations to be subject of agreement with the Employer"s Representative prior to fabrication. Hardness testing shall determine the hardness for welds and heat affected zone according to all scale i.e Vickers (HV10) , HRC and HB.

Non destructive examinations of steam turbine internal piping will be performed by Radiographic examinations.

The Bidder/Contractor has to fulfil the requirements specified in ASME B31.1 and the stricter requirements of the VGB Guideline R 503.
For turbine internal piping 15% of welds will be checked by radiographic testing. If failures are detected the intensity of testing will be increased which means even more than 15% of the welds will be tested.

Hydraulic tests for steam turbine internal prefabricated pipe systems must not be executed, in case equivalent non destructive examinations of steam turbine internal piping are performed by radiographic examinations. The requirements specified in ASME B31.1 and the stricter requirements of the VGB Guideline R 503 shall be fulfilled.

The test procedure ISO 6507-1 or equivalent shall be used. Minimum 3 hardness locations shall be tested for the weld. On circumferential welds the test locations shall be located at 120° distance. Hardness tests shall be conducted after PWHT.

Following percentages of welds shall be hardness tested.

Carbon steels or low allow steels (<2%Cr)	10%
2.5% Cr steels	50%
9 - 12% Cr steels	100%
Austenitic steels	-

T A B L E 1

Type of Steel	Design factor	Wall thickness	Inside diam	Type and Extent of non destructive testing			Remarks
	(shell)	(mm)	(mm)	Butt	Nozzle	Fillet	
C and C-Mn steels with C content not exceeding 0.25%	≤ 0.85	≤ 10	all	-	-	-	Only applicable to: Atmospheric systems (excluded systems, which handle chemicals, toxics or inflammable media).
		40≤	all	20% R	-	-	
		> 40	all	100% R	10% M	10% M	
	> 0.85	≤ 40	≤ 100	20% R	-	-	
			> 100	100% R	10% M	10% M	
		> 40	all	100% R	100% M	100% M	Test after stress relief
C-Mn steels with C content 0.25 to 0.35%, CrMoVsteels, C 1/2 Mo steels, low alloy steels, and CrMo steels except 12% Cr steels		≤ 30	all	20% R	10% M	10% M	
	all	> 30	all	100% R	100% M	100% M	Test after stress relief
Low alloy steels except CrMoV and 2 CrMo	all	all	all	100% R	100% U**	100% M	Test after stress relief
12% Cr ferritic/martensitic steels	all	all	≤ 100 > 100	100% R 100% R* 100% U	100% M 100% M 100% U	100% M 100% M	Test after stress relief Test after stress relief
				* Radiographic examination may be omitted if done on as-welded joint ** If feasible, otherwise 100% M.			

Type of Steel	Design factor	Wall thickness	Inside diam	Type and Extent of non destructive testing			Remarks
	(shell)	(mm)	(mm)	Butt	Nozzle	Fillet	
Austenitic Stainless Steels	≤ 0.85	≤ 15	all	-	-	-	Not applicable to: Butt welds made from one side only Operating temperatures exceeding 200 °C
		≤ 30	all	20% R	-	-	
		> 30	all	20% R	10% D	10% D	
					-	-	
	> 0.85	≤ 30	≤ 100	20% R			
			> 100	100% R	10% D	10% D	
		> 30	all	100% R	100% D	100% D	

Legend: R = Radiographic examination
U = Ultrasonic examination
M = Magnetic particle examination
D = Dye penetrant examination

Note:

1. Where 10% examinations are shown for pipework under 100 mm diam bore this shall be the circumference of 10% of the welds by each welder selected at random with a minimum of one per welder.
2. Where 10% examinations are shown for vessels or large diameter pipework this shall be 10% of each weld length and must include all intersections of longitudinal and circumferential welds.
3. Where partial examinations reveal rejectable defects, adjacent welds or areas of weld shall be examined. In the event of rejectable defects being found welds shall be subject to 100% examination.
4. Welds in clad materials shall be tested in accordance with the requirements of the base material and the surface of the overlaid welds shall be dye penetrant tested throughout their length.

Non-destructive examination of structural welds
Welds shall be non-destructively tested in accordance with the construction standard applicable to the item of plant. Where appropriate, the following requirements shall also be observed:

- magnetic particle testing of the tension side welds in major fabricated girders and Sections,
- ultrasonic examination of heavily restrained welds (e. g. cruciform joints) where there is a risk of lamellar tearing in the parent material.

Weld Repairs
Unacceptable defects observed by visual examination or indicated by non-destructive testing shall be completely removed by chipping or thermal gouging and grinding. The resulting excavation shall be crack detected prior to rewelding.

Details of the original defects and repair shall be recorded.
Repaired welds shall be subjected as a minimum requirement to the same inspection requirements as the original welds and test records should indicate that a repaired weld is referred to.

B0.7.2.2.2 Pressure testing

All items subjected in service to internal pressure or vacuum shall, unless otherwise agreed, be pressure tested in the manufacturer's works and at site and prior to any internal or external coating.
In case pressure test can‟t be executed at site NDT checking of welding shall be 100%.

Pulverizer assembly shall be excluded from Pressure testing, Required NDT will be carried out during manufacturing stage to ensure quality. (RT will not be carried out for Pulveriser Component)

Hydrostatic testing
Suitable water shall be used as the test media unless otherwise agreed. The test pressures shall be in accordance with ASME.

The test pressure shall be no less than the greater of

- the pressure corresponding to the maximum loading to which the pressure equipment may be subject in service, taking into account its maximum allowable pressure and its maximum allowable temperature, multiplied by the coefficient 1.25

$$p_{test} = 1.25 * PS * f_{test}/f$$

- maximum allowable pressure, multiplied by the coefficient 1.43,

$$p_{test} = 1.43 * PS * f_{test}/f$$

Where:

- p_{test} test pressure (hydrostatic)
- PS design pressure
- f_{test} nominal design stress for design conditions at test temperature
- f nominal design stress for design condition at design temperature

The design pressure shall be in any case not less than 3.5 bar overpressure.

Test pressure of vacuum containment items shall be agreed with the Employer‟s Representative. Any local legal requirement prevails.

The test pressure shall be maintained for sufficient time to permit complete visual examination of all surfaces and joints and in no cases less than specified in the applicable construction standard.

The chloride content of water used for testing austenitic stainless steel items shall not exceed 30 ppm unless immediate flushing with water of this quality is done after the test.

Pneumatic testing
The Contractor shall apply pneumatic testing in cases where hydrostatic testing is impractical or undesirable (e.g. oil pipes). Safety precautions, test pressures/duration and degree of prior non-destructive examination of the subject items shall be agreed with the Employer‟s Representative.

Pneumatic or gas leak testing supplementary to hydraulic testing shall be applied in appropriate cases where specified by the applicable construction standard.

B0.7.2.2.3 Testing of corrosion protection

Surface coatings
Following tests have to be performed before, during and after coating:

- visual inspection of blasted surfaces according to ISO 12944
- test the blast profile with a profile gauge
- checking of coating material
- measurement of air humidity, air temperature and coating substrate temperature and determination of dew point
- visual inspection of coating
- checking of dry film thickness (DFT); All zinc rich paint used for such repairs must contain a minimum of 81% by mass of zinc in the dry film.

- checking of adhesion with a dolly pull adhesion tester in accordance with ASTM D4541-09 type A1

Galvanized zinc coatings
Surfaces shall be visually inspected. Bare patches, lumps blisters or inclusions of foreign matter shall be cause for rejection.

Zinc coating thickness shall be determined non-destructively in accordance with ISO 2178 or coulometrically in accordance with ISO 2177 (or ASTM equivalent). For coatings with a weight exceeding 900 g/m^2 the coulometric test method specified in ISO 2177 shall be used.

Hard rubber linings
Surfaces shall be visually inspected. Uneven surfaces, splits, blisters or inclusion of foreign matter shall be cause for rejection.

The thickness of linings shall be measured in accordance with EN 14879 or equivalent. A tolerance of + 10 % is permitted for rubber coatings of 3 mm nominal thickness.

Hardness tests shall prove compliance with the rubber manufacturer‟s standards.

The absence of pores shall be proved by the induction sparking test method. The potential used shall be 5000 Volts for each mm of thickness plus an additional 5000 Volts (i. e. potential of 20,000 Volts for 3 mm thick lining).

B0.7.2.2.4 Testing of pressure part assembly

Trial assembly shall be checked at the manufacturing place before shipment.

B0.7.2.2.5 Testing of auxiliary and ancillary systems

The Contractor shall provide in his ITPs the specialised checks for various equipments like idlers, pulleys, conveyor belts, coal crusher, stacker reclaimer, coal unloaders, vacuum pumps, air compressors, bottom ash handling equipments, pumps, valves, pipes, EOT & hoists, inert gas system, deluge valves, foam system

The Contractor shall also follow the requirements for testing in the **Sections B1 to B12**.

B0.7.2.2.6 Hangers

Load Test for hangers (in particular spring type) and supports in particular for HP piping shall be executed. All hangers shall be pre-loaded at the manufacturing place.

B0.7.2.3 Mechanical equipment

Rotating units

Balance testing of rotating units
Each rotating unit shall be first statically balanced and then dynamically balanced according to ISO 1940 (in the case of impellers this shall be done before and after mounting of the service rotor shaft). However, Generator rotor will be dynamically balaned according to ISO 11342. A check balance of items that have undergone overspeed test shall also be made.

Vibration testing of rotating units
The vibration characteristics of rotating units shall be measured during performance tests. Locations of measurement and standards to be achieved shall, on request, be subject to agreement by the Employer"s Representative.

Pumps
Running tests and performance tests shall be conducted on all pumps: Performance tests shall be conducted through the full operation range of the pump to closed valve conditions. Graphs indicating flow/head, flow/ power absorbed, flow/ efficiency, flow/NPSH and speed shall be produced. Results for feedpumps shall be assessed with reference to ISO 9906 class 1 (without construction tolerances), and results for other pumps to class II or III as agreed. No negative tolerance on head, capacity and efficiency and no positive tolerance on power are accepted.

The lubricating oil used in the test shall be of the same brand and grade as that recommended by the manufacturer for service use.

Dismantling of the pump for visual examination of parts for damage following test shall be done when required by the inspection standard, when considered necessary by the manufacturer, or when requested by the Employer"s representative witnessing the running or performance tests. Replacement of parts following test shall necessitate repeat testing.

Clearance check of the pumps and balancing test of the impeller (acc. to VDI 20160 or eq.) shall be conducted before pump commissioning.

Pump tests shall be carried out with the motor, as supplied with the pump. In case several pumps of same size and typ are supplied, test can be carried out with the same motor.

Pumps under the scope of auxiliary package/systems shall be tested with calibrated shop motor. The high energy pumps including turbine lube oil and control oil pumps shall be tested with job motor (with the motor, as supplied with the pump).

Full load full speed/back to back locked rotor torque test for one gearbox shall be ensured.

No-load mechanical run test for boiler feed pump drive turbine as per API 612 / ISO 10437 to be ensured.

Steam turbines

The turbines shall be completely assembled with their control; on a suitable erection rig at the manufacturer's works and shall be carefully inspected and measured for manufacture and assembly tolerances.

Deleted: stop and governing valves

Stop and governing valves shall be delivered and installed separately.Therefore stop and governing valves will be inspected and measured for manufacture and assembly tolerance seperately.

Functional tests shall be performed on the safety equipment (running with steam is not requested).

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Important items of turbine control equipment which cannot be adequately tested during the main tests shall be separately bench tested.
Furthermore, testing shall be in accordance with IEC 60953-1 and comprise:

- balancing and overspeed test of the assembled rotor,
- measurement of radial and axial clearances,
- assembling inspection.

Minimum clearances between shaft seal casing and shaft seal ring, radial and axial blade clearances in blading section, axial and radial alignment of rotor in respect of shaft seals, alignment of overspeed governor etc. shall be ensured and verified by Bidder/Contractor.

Testing of free standing blades natural frequency and moment weight shall be performed for IP & LP blades.

All moving blades over 225 mm of active length shall be moment weighed and assembled on shaft in a prescribed sequence to ensure optimum balancing of rotor. Natural frequency of LP turbine blades shall be determined before mounting on rotors to ensure that the same are outside operating frequency range.

No load run test or a rig test at the workshop as per Bidder's/Contractor's/OEM's practice for the two main turbines is acceptable.

Air compressors

Air compressors shall be tested in accordance with the requirements of ISO 1217 or equivalent standards. Any request for deviation from the test conditions shall be accompanied by the manufacturers' proposals for the adjustment of the correction factors contained in the standard.
Tolerances will be allowed according to ISO 5167-1.

Cooling towers
One Cooling Tower per unit shall be tested on site to an appropriate CTI standard. Any request for deviation from the test conditions shall be accompanied by the manufacturers' proposals for the adjustment of the correction factors contained in the standard.

In addition performance testing to be carried out for the whole system (all cells).

Cranes and hoists
Where size permits cranes and hoists shall be completely assembled at the manufacturers works and functional tests without load conducted.

Flue gas (IDF) and air fans (FDF, PAF, SAF)
Axial and radial fans shall be tested in accordance with the requirements of ISO 14694 or equivalent standards for vibration. ISO 12499 shall also apply. Any request for deviation from the test conditions shall be accompanied by the manufacturers' proposals for the adjustment of the correction factors contained in the standard.

Performance tests shall follow VDI 2044, ISO 5801 or equivalent standard.

Before commissioning, the following tests shall be conducted: NDT, trial assembly of casing, blue matching, and clearances.

Dampers and Gates
Large dampers and valves shall be leakage / tightness tested (type test) in the workshop and at site the whole system shall be tested.

Rotary air preheater (RAPH)
Before commissioning, the following tests shall be conducted: NDT, trial assembly of casing, blue matching, and clearances.

Coal Pulverizer
Before commissioning, the following tests shall be conducted: NDT, trial assembly, blue matching, and clearances. The tests will be carried out during manufacturing stage wherever possible.

B0.7.2.4 Electrical equipment

Electrical equipment and material which is not covered by the tests specified elsewhere in this document shall be inspected and tested in accordance with the latest edition of standards listed hereafter. Alternatively, equivalent standards approved by the Employer"s Representative may be used. Type tests shall be carried out if type test certificates certified by an independent test authority are not available.

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Installation Material
IEC 60130 Connectors for frequencies below 3 MHz

IEC 60364	Low voltage electrical installations/ Electrical installations of buildings
IEC 60423	Conduits for electrical purposes

Materials for earthing and lightning protection

IEEE 80	Guide for safety in AC Substation Grounding
IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface potentials for Ground system
NFPA 780	Installation of lightning protection systems

Insulators and Bushings

IEC 60383	Insulators for overhead lines with a nominal voltage above 1000 V
IEC 60507	Artificial pollution tests on high voltage insulators to be used on AC systems
IEC 60137	Insulating bushings for AC voltages above 1000 V

Surge Protection Equipment

The surge protection equipment shall be tested in accordance with IEC 60099.

AC Switchgear for voltages above 1 kV

IEC 62271	High-voltage switchgear and control gear
IEEEC37.013	IEEE standard for AC-High-Voltage generator circuit breakers on a symmetrical current.

At least the following tests shall be performed in the manufacturer's workshop on the individual apparatus and on the complete installation, respectively, all in accordance with IEC Standards:

- Visual inspection
- Power frequency HV tests
- Dielectric tests of the auxiliary circuits
- Measurement of the main contacts resistance with dc
- Temperature rise test on circuit breakers (type test certificate)
- Test of mechanical endurance (type test certificate)
- Measurement of the contact opening period (type test certificate)
- Functional tests of the control circuits
- Check of the operational sequence
- Measurement of the instrument transformer's angle and ratio errors (according to IEC-standards 60044)
- Check of the denominations.

Note 1: All MV switchgear shall be type tested according IEC 62271-1, IEC62271-100 and IEC 62271-200 including internal arc classification IAC

= AFLR. Related type test certificates shall be provided with the Tender. If the test has already been carried out on similar type switchgear, type test certificates may also be accepted.

Note 2: All GIS above 52 kV shall be tested according IEC 62271-1, IEC 62271-203.

Type tests shall be carried out, at the expense of the Contractor and without any impact on the projects overall time schedule, if type test certificates certified by an independent test authority are not available.

Note 3: Generator circuit breakers shall be tested according IEEE Std C37.013.

High voltage fuses
IEC 60282 High voltage fuses
IEC 60644 Specification for high voltage fuse links for motor circuit applications

Oil-immersed power transformers
IEC 60076 Power transformers
IEC 60214 On-load tap-changers
IEC 60404-2 Magnetic materials

a) Tanks

- Inspection of weld preparations, approved crack detection of major strength welds.
- Hydraulic test and vacuum test
- Visual and dimensional checks
- Certification of test results.

b) Cores

- Material
  - Checks on flatness
  - Checks for absence of burrs such as may be caused by slitting, cropping and punching
  - Electrical insulated tests
  - Visual and dimensional checks.
- Assembly
  - Inspection during assembly stage, whilst core is still horizontal
  - Visual and dimensional checks on complete core
  - Checks on straightness of clamps
  - Checks on clamp welding
  - High voltage tests between core packets, clamps and belts in all relevant combinations
  - Check actual weight of core steel in magnetic circuit against design weight
  - Check that all block and sheet insulation and all spacers are in position
  - Check earthing of core packets to clamps.

c) Windings

- Windings
  - Copper checks
  - Fewest possible number of welds
  - Quality of weld and finishing
  - Insulation on copper
  - Check for correct material
  - Check correct application to conductor
  - Visual and dimensional checks
- Winding of turns
  - Checks during winding of different Sections of winding
  - Checks on positions of starts and finishes of Sections
  - Checks on correct directions of windings of turns (Polarity)
  - Visual checks
- Assembly of windings together
  - Check on relative positions and numbers of leads
  - Check that vertical and horizontal coolant ducts are clear and to full design dimensions
  - Visual checks
- Assembly of windings on core
  - Visual and dimensional checks.

d) Leads

- Checks on disposition, insulation and support of tapping leads
- Checks on insulation support and positioning of bushing leads and provision for connection to bushings
- Checks on lead connections (crimping, brazing etc.)
- Checks on interphase connections
- General visual checks.

e) Insulation

- Checks on arrangement of petalling
- Checks on inter-phase and earth barriers
- Checks on shields
- Checks on clearance and creepage distances
- General visual checks.

f) Coolant flow ducts

- Check that vertical and horizontal passages are clear and to full design dimensions
- General visual checks.

g) Current transformers, links and connections

- Check that built-in current transformers are in the correct leads
- Check that the connections and alternative connections are clearly marked and that the marked ratios are correct.

h) Assembly of transformer in Tank

- Check insulation between transformer and tank
- Check security of fixing of transformer in tank and of any packing used
- Check electrical clearances between tank and leads and windings
- Checks for cleanliness and freedom from debris of inside of tank
- General visual check.

i) Valves

- Check action of valves after welding into position (especially butterfly valves)
- Checks for leaks under pressure.

j) Paint work

- Checks for preparation of surfaces
- Checks for use of correct paint system
- Visual checks on general finish.

k) Conservator

- Check for leakage
- Check capacity
- Visual checks.

l) Bushings

- Check against standards
- Check that routine tests have been done
- Checks for leakage when mounted on transformer
- Checks for distortion, flaws and chips.

m) Tap-changers (on-load and off-circuit as appropriate)

- Inspection on completion of manufacture, including a review of manufacturer‟s stage test records and procedures
- Mechanical and electrical checks in the manufacturer‟s works
- Tests in accordance with the appropriate IEC or other standard as applicable
- Check ten complete cycles from end to end of the range
- Check five cycles on full current
- Check five cycles at full voltage
- Check transmitters for correct number of steps and impedance values
- Check interlocks
- Check warning, alarm and trip contacts
- Visual and dimensional checks.

n) Pumps and fans

- Checks for direction of rotation against motor terminal markings

- Visual and dimensional checks.

o) Heat exchangers

- Checks on radiators for leaks
- Checks on radiators for paint finish and inner cleanliness
- Checks on oil-to-water heat exchangers for leaks at manufacturer"s works
- Checks on oil-to-water heat exchangers for cleanliness of oil chambers and passages
- General visual and dimensional checks.

p) Processing

- Checks on pressures and temperatures with manufacturer"s process charts available.

q) Control cubicles, kiosks and terminal boxes

- Checks on functioning of contactors, overloads isolators and general operation of control circuits for cooling gear
- Checks on operation of circuits for thermometers, thermal images, pressure relief valves, oil and gas operated relays, flow detectors, heaters, lights and power output sockets
- Checks on wiring arrangements and terminal boards
- Checks on weather sealing of doors, cable glands and other external features
- Visual and dimensional checks.

r) Workshop tests on complete transformer

The following routine test in accordance with IEC 60076:

- Measurement of winding resistance
- Measurement of voltage ratio and check of voltage vector
- Measurement of impedance voltage, short circuit impedance and
- load loss
- Measurement of no-load loss and current at Ur, 1.05 x Ur and 1.1 x Ur
- Dielectric routine tests in accordance with IEC 60076-3
-
- Test on on-load tap changers
- Insulation resistance
- Separate source voltage withstand test
  - Induced overvoltage test to be carried out on all main transformers (see item 3) acc. to IEC 60076-3, table 1 (ACLD/ACSD).
  - PD test to be carried out for all generator transformers, interconnecting transformers and start-up/standby transformer together with ACLD.
- Frequency response analysis.
- FRA test to be carried out on all main transformers (see item 3).

The above tests shall be carried out on all transformers.

Deleted: Transformers having Ur □ 300 kV wi be tested to Method 1

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The following tests in accordance with IEC to be carried out as type tests (type tests shall not be repeated if type test certificates of an identical/ similar rated transformer issued by a recognized test laboratory are available):

- Temperature rise test including direct measurement of hot-spot temperature
- Measurement of the harmonics of the no-load current
- Dielectric type tests in accordance with IEC 60076-3
- Measurement of zero sequence impedance
- For the above type tests, test certificates may be accepted at the discretion of the Employer/Engineer, in place of tests on the first transformer of each basic type excepting the generator transformer. In the case of generator transformers the type tests must be carried out
- Noise measurements.
- The generator step-up transformer, the 400/230 kV interconnection transformer, the unit auxiliary and the auxiliary transformers shall be dynamic short circuit withstand tested according IEC 60076-1 & -5 either in the manufacturers workshop or in a recognized 3rd party test lab (as special test).

In addition to the above tests, the following tests shall be made as routine tests:

- Tangent delta measurements on the insulation, the method to be agreed with the Employer/Engineer
- Core insulation test on magnetic circuit
- On windings of 30 kV rating or above either:
  - ration influence voltage tests, the method to be agreed with the Employer/Engineer or
  - partial discharge measurements in accordance with IEC
- Transformer oil analysis according to IEC 60296, IEC 60567 and according IEC 62535 for detection of potential corrosive sulphur in mineral oils
- Transformer tanks, conservators, oil pipework and air cooled cooling plant shall withstand without leaking or permanent distortion, the application for 24 hours of a pressure which is such that the test pressure at any point in the equipment is twice theworking pressure at that point or 0.7 kg/cm2 plus the working pressure at the point or 0.3 kg/cm2 plus the pressure exerted at that point when the pressure relief is opened slowly by oil pressure whichever is the greatest.
- Tank vacuum & pressure test
- Pressure test of radiators
- Oil leakage test
- Pressure relief device, Buchholz relay, oil, winding meters, oil level indicator, dry cool breather, dissolved gas analyzer test / check.

Fault withstand (fault versus time) curve for all transformers shall be submitted by the Contractor.

Over-excitation curves shall be provided by the manufacturers for the station transformers.

Separate type and routine tests shall be carried out for all accessories like bushings, bushings CTs, tap changers, cooling fans, control panels, etc.

Dry type transformers
The following routine tests in accordance with IEC 60076 shall be carried out on all transformers:

- Measurement of winding resistance
- Measurement of voltage ratio and phase displacement
- Measurement of short circuit impedance and load loss
- Measurement of no-load loss and current
- Separate source AC withstand test
- Induced AC voltage test
- Lightning Impulse test
- Partial discharge measurement.

The following tests in accordance with IEC 60076 to be carried out as type tests (type tests shall not be repeated if type tests certificates of an identical transformer issued by a recognized test laboratory are available):

- Temperature rise test
- Measurement of sound level
- Short circuit test
- Environmental Test according Class E2
- Climatic test according Class C1
- Fire behaviour test according to Class F1.

Also, Lightning impulse test shall be a type test.

Fault withstand (fault versus time) curve for all transformers shall be submitted by the Contractor.

Separate type and routine tests shall be carried out for all accessories like bushings, bushings CTs, tap changers, etc.

Current and voltage transformers
The current and voltage transformer shall be tested in accordance with IEC 61869

Generators
IEC 60034, IEEE 115, ISO 1680 and ISO 10816.

a) Generator test report

Comprehensive test reports for the generators are to be compiled and submitted by the Contractor, which shall include:

- Description of the test method, equipment used and any limitations of the test plant.
- Copies of the oscillographs recorded with appropriate calibration data
- Open circuit saturation, short circuit and loss curves for the generator
- A performance chart of the generator (being a diagram of constant stator and rotor current curves plotted on rectangular axis of MVAr and MW load) The recommended loading, stator core end heating and stability limits shall be shown on the chart.
- Calculations of full load temperature rise for the stator, rotor and exciter. Any correction factors used to allow for different voltage current and cooling conditions shall be justified by reference to published literature or to previous type tests.
- Calculations of the efficiency of the complete generator at 100%, 75% and 50% load. Any correction factors for losses that could not be measured at routine tests shall be justified by reference to published literature or to previous type tests.
- Calculations of machine parameters (according to IEC 60034-4) such as transient reactance and time constant, sub-transient reactance and time constant, short circuit ratio, synchronous reactance, negative phase sequence reactance, zero sequence reactance, capacitance and also the harmonic analysis of the neutral current.
- Calculation of full load excitation of the machine at rated power factor lagging and at unity power factor, excitation V curves.

b) Routine tests on generator

- Generator stator frame
  - hydrostatic test (if H2 cooling)
  - resistance check of temperature detectors
  - Generator rotor
  - ultrasonic examination
  - mechanical balance
  - over-speed test
  - measurement of 50 Hz rotor impedance (at 3000 RPM).

Deleted: coupled with exciter rotor

Deleted: coupled with exciter

- Stator core laminations
  - Magnetization of stator core lamination layer resistance between the layers of the core

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- Generator H2 cooler (if H2 cooling)
  - hydrostatic test

- Generator assembled:
  - three phase short circuit characteristic test and current balance check
  - dielectric test

- measurement of insulation resistance
- measurement of winding resistance
- open circuit characteristic test and voltage balance, phase sequence check
- segregation of mechanical loss and core loss
- segregation of stray load loss
- efficiency calculation
- unbalanced load test for negative-phase sequence and zero sequence reactance
- shaft voltage measurement
- oscillographing of verified voltage wave form and harmonic analysis
- measurement of vibration
- polarization index
- tan delta measurement of complete winding
- bearing insulation resistance.

c) Type tests on generator (as far as type test certificates are not available)

- Sudden short circuit test at reduced voltage (30%, 50% and 70% of rated voltage), extrapolated to 100% voltage
- Equivalent heat run test consisting of:
  - windage and friction heat run, open circuit heat run at 105% rated voltage, short-circuit heat run at rated line current, open-circuit heat run at rated line voltage
  - measurement of open-circuit direct-axis transient time constant
  - noise measurement
  - moment of inertia
- Measurement of excitation response time*)
  - overall characteristic coupled with generator and AVQC cubicle at no load*)

*) applicable to assembled unit consisting of generator, exciter and voltage regulator, may be carried out on site

Type tests shall be carried out if type test certificates (Not older than 5 years as on date of bid opening) certified by an independent test authority are not available.

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Sudden short circuit test shall be carried out in line with IEC at voltage level to be finalized during detailed engineering.

d) Routine tests on generator exciter

- Resistance of windings
- Insulation resistance
- High voltage tests
- Short-circuit characteristic
- No-load characteristic.

Motors
IEC 60034, ISO 1680, ISO 10816

- Type tests (each motor type) as far as type test certificates are not available
  - measurement of starting (locked rotor) current and torque
  - power factor and efficiency measurement
  - heat run test
  - noise measurement
  - temperature rise measurement
- Routine tests (each motor)
  - measurement of winding resistances
  - measurement of shaft current
  - no-load and current measurement
  - no-load short circuit measurement
  - open circuit secondary induced voltage test at stand still (wound rotor)
  - dielectric test (high voltage test)
  - measurement of insulation resistance
  - overspeed tests (120% for 2 minutes)
  - check of motor vibrations
  - oscillographic measurement of starting current.

Emergency diesel sets
All relevant routine and type tests according to:

ISO	3046	Reciprocating internal combustion engines - Performance
ISO	8528	Generating sets with reciprocrating internal combustion engines

a) Type tests
The diesel generator unit (DGU) and all auxiliary equipment shall be fully type tested. These tests shall include all type tests as defined in the relevant latest IEC and ISO recommendation (as a minimum requirement).

Evidence shall be given that the DGU together with the auxiliary equipment to be provided, under these specifications, have successfully passed all type tests of design, service frequency, impulse, insulation level, dynamic operating range, and electrical and mechanical endurance performance, as appropriate and as specified.

However, if deemed necessary, the Employer shall decide if additional tests are required to be performed by the Tenderer/Contractor.

The Tenderer/Contractor shall supply certified copies of type test certificates covering the proposed DGU of similar capacity or higher, operating range, data features, design and construction.

b) Sample tests
Sample Tests shall be performed, comprising as a minimum the following tests:

- Visual checks and measurements of dimensions
- Functional tests.

c) Routine tests
The Tenderer/ Contractor is required to carry out routine tests on each assembled and finished diesel generator unit and its relevant auxiliary equipment to demonstrate the integrity of the system.

Routine test certificates shall be submitted for the Employer‟s review and approval before shipment of the DGU.

The DGU shall pass all the routine tests as laid down in the relevant latest revisions of IEC & ISO Standards. In addition, the visual Inspection, which shall determine conformity of the DGU & the relevant equipment with the requirement, shall be part of the routine tests.

The acceptance test for the diesel engine at the Manufacturer‟s workshop test bed shall include the measurements, calculations and functional checks stated in ISO 3046-1 (E).
A test report in English shall be issued according to ISO 3046-1 (E) giving evidence of the following data:

- Engine model, order No., rated output, operating speed, number of cylinders, bore, stroke, compression ratio, cylinder displacement, no. of strokes, date of test, the Employer‟s name, inspector‟s name, ambient air temperature, relative humidity, barometric pressure, fuel specific gravity, fuel net calorific value, setting data of injection pump, firing sequence, valve timings, type of fuel oil filter, type of lube oil filter, type of turbocharger and inter-cooler, type of governor, type of injectors.

The Tenderer/Contractor shall submit together with the test report a certificate showing the emission levels of the exhaust gases: NOx, CO and PM (particulate matter).

The diesel engine shall be proven to be capable of operating in steady state condition on all above mentioned loads. If the diesel engine fails to operate in steady state condition on one or more loads, this engine type shall be not accepted for the scope of the diesel generator units.

d) Special tests
The diesel engine shall be at least tested in total for one hour at the following loads:

- Warm-up of the diesel engine as required
- 25 % load operation 10 minutes
- 50 % load operation 10 minutes

- 75 % load operation 10 minutes
- Full load operation 20 minutes
- 110 % load operation 20 minutes
- Cool down of the diesel engine.

During the test run, temperatures, pressures and fuel consumption shall be measured and recorded.

The diesel engine shall be proven to be capable for operation in steady state condition on all above mentioned loads. If the diesel engine fails to operate in steady state condition on one or more loads, this engine type shall not be accepted.

Low voltage switchgear
The following standards and regulations or equivalent shall be used:

IEC	60947	Low-voltage switchgear and control gear
IEC	61439	Low-voltage switchgear and control gear assemblies
IEC	60529	Degrees of protection provided by enclosures (IP Code)
IEC	60898	Specifications for circuit-breakers
IEC	60079	Electrical apparatus for potentially explosive atmospheres
IEC	60947	Regulations for low-voltage switchgear

The “Design Verification” of all low voltage switchgears/ motor control centers shall be carried out by following methods:

- “Testing” for the Pos. No. 1., 2., 3., 4., 5., 9., 10., 11., 12. and 13 of IEC 61439-1/Annex D, Table D.1
- “Assessment” for the Pos. No. 6., 7. and 8 of IEC 61439-1/Annex D, Table D.1

In addition to the above tests for which certificates shall be submitted, at least the following tests shall be performed in the manufacturer's workshop on the individual apparatus and on the complete installation, respectively, all in accordance with IEC Standards:

- Visual inspection
- Power frequency HV tests at main circuit
- Dielectric tests of the auxiliary and control circuits
- Functional test of the control circuits
- Check of the operational sequence.

Capacitors

IEC	60831	Shunt power capacitors
IEC	60871	Shunt capacitors for A.C. power systems
IEC	60931	Shunt power capacitors
IEC	60143	Series capacitors for power systems
IEC	60358	Coupling capacitors and capacitor dividers
IEC	60384	Fixed capacitors for use in electronic equipment

Batteries, charging equipment inverters and DC/DC converters

IEC	60086	Primary batteries
IEC	60119	Recommendations for polycrystalline semiconductor rectifier stacks and equipment
IEC	60146	Semiconductor converters
IEC	60896	Stationary lead-acid batteries
IEC	61204	Low voltage power supply devices DC output

Chargers and batteries shall be tested together in the factory. Testing of chargers and batteries together at site will also be accepted. All factory tests shall be repeated at site.

Chargers
- Visual inspection (to be repeated on site)
- Functional tests (to be repeated on site)
- Heat run (type test)
- Output voltage stability measured for 25% load steps
- Ripple voltage measurement without connected battery
- Ripple measurement (voltage and current) with connected battery (at site will also be accepted.
- Insulation test (to be repeated on site).

Batteries
- Visual inspection (to be repeated on site)
- Insulation test (to be repeated on site)
- Charge test and discharge tests

Fuse Box
- Visual inspection (to be repeated on site)
- Functional tests (on site)
- Insulation test (on site).

Inverters and DC/DC converters
- Visual inspection (to be repeated on site)
- Functional tests (to be repeated on site)
- Heat run (type test)
- Insulation test (to be repeated on site).

Lamps and accessories

IEC	60081	Double-capped fluorescent lamps
IEC	61347	Lamp control gear
IEC	60921	Ballasts for tubular fluorescent lamps
IEC	60155	Glow starters for fluorescent lamps
IEC	60598	Luminaries
IEC	60188	High-pressure mercury vapor lamps
IEC	60400	Lampholders and starter holders for tubular fluorescent lamps
IEC	60901	Single-capped fluorescent lamps
IEC	60662	High pressure sodium vapor lamps
IEC	60192	Low pressure sodium vapor lamps
IEC	60923	Auxiliaries for lamps
IEC	61347	Part 2-13: lamp control gear for LED Modules
IEC	62031	LED modules for general lighting - Safety specifications
IEC	62560	Self-ballasted LED-lamps for general lighting services by voltage > 50 V - Safety specifications
IEC	62612	Self-ballasted LED-lamps for general lighting services by voltage > 50 V - Perforce requirements
IEC	62471	Photobiological safety
IEC	62384	DC or AC supplied electronic control gear for LED modules - Perforce requirements
IEC	60838	Part 2-2: miscellaneous lampholders - Connectors for LED-modules
IEC/PAS	62717	LED Modules for general lighting - Performance requirements
IEC/PAS	62722	Luminares Performance

HV-, MV- and LV-cables
All relevant routine and type tests according to:

IEC	60060	High voltage test techniques
IEC	60071	Insulation co-ordination
IEC	60230	Impulse tests on cables and their accessories
IEC	60811	Common test methods for insulating and sheathing materials of electric cables
IEC	60840	Power cables with extruded insulation and their accessories for rated voltages above 30 kV up 150 kV
IEC	62067	Power cables with extruded insulation and their accessories for rated voltages above 150 kV up 500 kV
IEC	60502	Power cables with extruded insulation and their accessories for rated voltages from 1 kV up to 30 kV

a) LV-cables

LV cables shall be workshop tested as per IEC 60502-1 with the following tests as a minimum:

Type tests:

- electrical type tests acc. to: IEC 60502 - 1 Clause 17
- non electrical type tests acc. to: IEC 60502 - 2 Clause 18.

Also following additional type tests shall be carried by the Contractor at their own cost prior to the first shipment of all offered cable if no type test certificates of identical cables are available:

- Fire Resistant according to IEC 60331, BS 6387
- Flame Retardant according to IEC 60332
- Low Smoke Test according to IEC 61034
- Halogen Content Test according IEC 60754
- Water Tree Test of XLPE Insulation (accelerated)
- Test voltage = 3 x Uo
- Test frequency = 500 Hz
- Core environment = 400C water
- Duration of test = 4 month
- Test after 4 months: Dielectric stress withstand >14kV/mm.

Moreover, test certificates shall be provided, proving that each cable type to be used has successfully passed type tests as required by the applicable standards during the last 12 months before award of contract. Otherwise, these tests have to be repeated on sample Sections.

Routine tests: according IEC 60502 – 1, Clause 15

- measurements of electrical resistance of conductors according to Clause 15.2
- voltage tests according to clause 15.3.

Sample tests: according IEC 60502 – 1, Clause 16

- conductor examination according Clause 16.4
- check of dimensions according Clause 16.5 to 16.8
- hot set test for EPR, HEPR and XLPE insulations and elastomeric sheath according Clause 16.9.

b) MV-cables

MV cables shall be workshop tested as per IEC 60502-2 with the following tests as a minimum:

Type tests:

- electrical type tests acc. to: IEC 60502 - 2 Clause 18
- non electrical type tests acc. to: IEC 60502 - 2 Clause 19.

Also following additional type tests shall be carried by the Contractor at their own cost prior to the first shipment of all offered cable if no type test certificates of identical cables are available:

- Fire Resistant according to IEC 60331, BS 6387
- Flame Retardant according to IEC 60332
- Low Smoke Test according to IEC 61034
- Halogen Content Test according IEC 60754
- Water Tree Test of XLPE Insulation (accelerated)
- Test voltage = 3 x Uo
- Test frequency = 500 Hz
- Core environment = 400C water
- Duration of test = 4 month
- Test after 4 months: Dielectric stress withstand >14kV/mm.

Moreover, test certificates shall be provided, proving that each cable type to be used has successfully passed type tests as required by the applicable Standards during the last 12 months before award of contract. Otherwise, these tests have to be repeated on sample Sections.

Routine tests: according IEC 60502 – 2, Clause 16

- measurements of electrical resistance of conductors according to Clause 16.2
- partial discharge test according to Clause 16.3 on cables having cores with conductor screens and insulation screens in accordance with Clause 7.1 and 7.2
- voltage tests according to clause 16.4.

Sample tests: according IEC 60502-2 Clause 17

- conductor examination according Clause 17.4
- check of dimensions according Clause 17.5 to 17.8
- voltage test for cables of rated voltages above 3.6/6 (7.2) kV according to Clause 17.9
- hot set test for EPR, HEPR and XLPE insulations and elatomeric sheath according Clause 17.10.

c) HV-cables

The 230 kV XLPE-Insulated Single-Core Underground Cables and Accessories shall be tested as per latest IEC 62067 including all subsequent amendments and relative standard. The Employer/Engineer shall witness the required Type and Sample tests.

The approval of the Employer/ Engineer or the passing of any such inspection or test will not however, prejudice the right of the Employer/ Engineer to reject the 230 kV XLPE-Insulated Single-Core Cables and accessories if it does not comply with the Specification.

Defects discovered during the type/routine/sample tests shall entitle the Employer/Engineer to reject the cables/accessories fabricated for this Project.

The Tenderer/ Contractor shall fabricate without additional cost the cable lengths and accessories necessary for the tests, over and above those required to complete the Works at Site.

For the definitions of the Type Tests, Sample Tests, Routine Tests and Tests after installation, reference shall generally be made to the relevant IEC Standards.

HV cables and accessories shall be workshop tested as per IEC 62067 with the following tests as a minimum:

Type tests on cable systems: according clause 12:

- Electrical type test according Clause 12.4
  - Check of insulation thickness acc. to Clause 12.4.1
  - Bending test on the cables acc. to Clause 12.4.4 followed by installation of accessories and a partial discharge test acc. to Clause 12.4.5
  - Tan δ measurement acc. to Clause 12.4.6
  - Heating cycle voltage test acc. Clause 12.4.7
  - Partial discharge test acc. to Clause 12.4.5 (at ambient and at high temperature)
  - Switching impulse voltage test acc. to Clause 12.4.8
  - Lightning impulse voltage test followed by a power frequency voltage test acc. to Clause 12.4.9
  - Test of outer protection for joints
  - Examination of cable system with cable and accessories after completion of tests acc. to Clause 12.4.10.
  - Tesitivity of semi-conducting screen acc. to Clause 12.4.11.

- Non electrical type tests according to Clause 12.5
  - Check of dimensions acc. to Clause 12.5.1
  - Tests for determination the mechanical properties of insulation acc. to Clause 12.5.2
  - Tests for determination the mechanical properties of oversheats acc. to Clause 12.5.3
  - Aging tests acc. to Clause 12.5.4
  - Pressure test at high temperature on oversheets acc. to Clause 12.5.6
  - Other test on oversheets according to the type used.
  - Hot set test for XLPE insulation acc. to Clause 12.5.10
  - Measurement of carbon black of black PE oversheats acc. to Clause 12.5.12
  - Water penetration test acc. to Clause 12.5.14.

Also following additional type tests shall be carried by the Contractor at their own cost prior to the first shipment of all offered cable if no type test certificates of identical cables are available:

- Fire Resistant according to IEC 60331, BS 6387
- Flame Retardant according to IEC 60332
- Low Smoke Test according to IEC 61034
- Halogen Content Test according IEC 60754
- Water Tree Test of XLPE Insulation (accelerated)
  - Test voltage = 3 x Uo
  - Test frequency = 500 Hz
  - Core environment = 400C water
  - Duration of test = 4 month
  - Test after 4 months: Dielectric stress withstand >14kV/mm.

Cables and accessories shall have passed type approval tests in accordance with IEC Specifications and details of the cable designs offered shall be given in the appropriate place in the Technical Schedules. Type test reports shall include cable design details and design drawings of each jointing accessory included in the type test.

The Tenderer/Contractor shall submit certified copies of type test certificates covering the proposed Cables.

Routine tests: according Clause 9
- partial discharge test according to Clause 9.2
- voltage tests according to according to Clause 9.3
- electrical test on oversheath according to Clause 9.4

Sample tests: according to Clause 10
- conductor examination according Clause 10.4
- measurement of electrical resistance of conductor according to Clause 10.5
- measurement of thickness of insulation and oversheath according to Clause 10.6
- measurement of thickness of metallic sheath according to Clause 10.7
- measurement of diameters according to Clause 10.8
- hot set test XLPE insulations and elatomeric sheath according Clause 10.9
- measurement of capacitance according to Clause 10.10
- lightning impulse voltage test follows by a power frequency voltage test according to Clause 10.12
- water penetration test according Clause 12.5.14
- Lead alloy composition and behavior (BS 3908, BS EN 12548).

Type tests of accessories
All accessories shall be tested as per IEC 62067 and all subsequent amendments and relative standards considering Test of Outer protection for buried joints (if applicable).

Routine Tests, Insulation Joints
The insulation flange shall be designed to withstand tests voltages as specified in the Technical Data Sheets and shall be tested accordingly.

Routine Tests, Bonding/Earthing Leads
The Bonding/Earthing Leads shall be designed to withstand tests voltages and currents as specified in the Technical Data Sheets and shall be tested accordingly.

Telecommunication installations
IEC 60215 Safety requirements for radio transmitting equipment

Aerials
IEC 60169 Radio-frequency connectors

Power installations up to 1000 V
IEC 60364 Electrical installations of buildings
IEC 61439-4 Particular requirements for assemblies for construction sites (ACS)

Power installation above 1000 V
IEC 60060 High-voltage test techniques
IEC 62271 HV switchgear and control gear
(incl. Appendix AA "Internal Arc Test")

Protection equipment
Equipment for modular static protection systems (e.g. generator, distance, busbar, protection, etc.) pre-assembled in the relevant standardized boards/ cubicles etc. shall be tested in the manufacturers‟ workshops according to IEC 60255 as far as wiring and proper function is concerned. Simulated inputs (binary signals, current and voltage inputs from test power supplies) shall be used.

Fire alarm system
All relevant routine and type tests according to:
NFPA National Fire Protection Association
DIN VDE 0800 Telecommunications
DIN VDE 0833 Alarm systems for fire, intrusion and hold-up

B0.7.2.5 Control and monitoring equipment

All control and monitoring equipment shall be tested at the manufacturers' works before dispatch to site. Certificates shall be issued for

- synchronizing units
- flow evaluators

On request the correct operation of equipment with specified temperature and humidity limits shall be demonstrated by tests conducted within the limits.

Electrical measuring instruments
All electrical measuring instruments shall be tested in accordance with the following rules and regulations. Alternatively, equivalent standards approved by the Employer"s Representative may be used.

IEC 60051	Recommendations for direct-acting indicating electrical measuring instruments and their accessories
IEC 60258	Direct acting recording electrical measuring instruments and their accessories
IEC 61036	Alternating current static watt-hour meters for active energy
IEC 61010	Safety requirements for electrical equipment for measurement, control and laboratory use

Electrical remote indication
Meters for active power, reactive power and similar remote indication equipment:

VDE 0418	Regulations for electric integrating meters
IEC 60338	Telemetering for consumption and demand

Calibration Tests
The Contractor shall conduct calibration tests of the following instruments and equipment:

- all local indicators over the full range of the indicator
- all transmitters over the full range of the transmitter
- all binary transmitters over the full range including initial setting
- all remote indicators over the full range of the indicator
- all recorders over the full range of the recorder
- one of each type of indication loop with circuit resistance of the loop increased to a value which is equal to the highest value expected, and under worst case operating conditions
- all superheated steam thermocouples
- one of each type of thermocouple or resistance element
- all kinds of analogue transmitters over the full measuring range

- all modules and subassemblies for measuring and control e.g. analogue limit monitors, flow evaluators, function generators
- all quantity meters
- all synchronizing units according to IEC standards
- the actual dimensions of all orifices, nozzles, Venturi nozzles have to be checked as per ISO5167.

Closed-loop control systems
All main closed-loop control systems shall be tested for polarity and function in accordance with the applicable standards. Control valves shall be tested in accordance with mechanical functional tests on control valves and shall be performed with the actuator mounted (open to closed position and vice-versa). Actuators shall be subject to mechanical and electrical function tests.

Sequence logic equipment
All sequence logic equipment shall be tested using simulated inputs.

Alarm annunciator and fault printing system
The alarm annunciator and fault printing system shall be tested using simulated inputs.

DCS system
The system shall be thoroughly tested at the manufacturers' workshops before dispatch to site. Test programs shall be devised and these shall subsequently be made available to the Employer"s Representative. Tests shall be made to ensure that the system operates correctly within the ambient conditions as specified by the manufacturer and that if these conditions are exceeded, i.e. in the case of failure of the air-conditioning system, that the system will automatically fail safe and that neither hardware nor software will be damaged.

Further I&C equipment
Type test reports shall be provided for the following:
- UPS
- 24 V DC battery chargers
- Batteries
- Control valves
- Instrumentation cables
- Flow nozzle orifice plates
- Measuring instruments
- Local instrument enclosures
- Local instrument racks
- PLCs
- Etc.

Type test reports

The minimum type test reports for each of the major I&C systems shall be as follows:

1. Surge Withstand Capability (SWC) for solid state equipment/ systems
   All solid state systems/ equipment shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a Power Plant. All the solid state systems/ equipment shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Hence all front end cards which receive external signals like analogue input & output modules, binary input & output modules, etc. including power supplies, data highway, data links shall be provided with protections that meet the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Complete details of the features incorporated in electronic systems to meet this requirement, the relevant tests carried out, the certificates etc. shall be submitted with the proposal. As an alternative to above, suitable class of EN61000-4-12 which is equivalent to ANSI 37.90.1/ IEEE-472 may also be adopted for SWC test.
2. Dry heat test as per IEC 60068-2-2 or equivalent
3. Damp heat test as per IEC 60068-2-3 or equivalent
4. Vibration test as per IEC 60068-2-6 or equivalent
5. Electrostatic discharge tests as per EN 61000-4-2 or equivalent
6. Radio frequency immunity test as per EN 61000-4-6 or equivalent
7. Electromagnetic field immunity as per EN 61000-4-3 or equivalent

Tests as listed under items number 5 to 7 as applicable for electronic cards only as defined under item 1 above.

B0.7.3 Testing at site

B0.7.3.1 Civil works testing

The Contractor shall carry out all required civil construction tests. Thereby part of the test like concrete and earthwork tests have to be carried out at site, other tests have to be performed in the manufacturer workshops.

The Contractor shall submit all test certificates of materials subject to approval and shall arrange for tests of all materials to be carried out in laboratories on site or elsewhere. The cost of all test equipment, samples, tests and transport to the laboratory shall be borne by the Contractor.

The testing operations shall be performed in accordance with the relevant codes and standards and under the supervision of the Employer.

Where in the specifications materials are specified to be approved samples shall be submitted for approval at the earliest possible date and strictly before any purchasing or delivery to the site is made. The individual tests and inspection for the materials, supply and execution shall be carried out in compliance with the requirements of the individual technical specifications. In the case of rejection, further samples of the rejected materials shall be submitted to SC until they are approved or the material is replaced. The Employer may reject any material which in his opinion is not in accordance with the approved standard. All samples shall be submitted free of charge to the Employer.

The characteristics as determined in the samples which are approved shall indicate the standard to be maintained in the materials used in the execution of the works.

The test samples of materials subject to approval by the Employer shall be kept in a safe place and protected against damage or deterioration until completion of the works.

For materials (e.g. steelwork, pipes, ducts, etc.) to be manufactured in workshops respective manufacturer test certificates including test results shall be submitted to the Employer subject to approval.

After final completion of certain civil structures/ parts to be ready for erection of further equipment individual “Civil Completion Certificates” shall be issued by the Contractor under the following conditions:

- Except for minor items of work that would not affect the safety, all civil works for applicable parts, structures or buildings have been carried out and tested
- All such civil works are in a manner that does not void any subcontractor or vendor warranties or violate any applicable law or applicable permit
- Punch List has been agreed upon by the Employer and the Contractor
- Contractor warrants that all necessary works have been undertaken and all applicable parts, structures or buildings are ready for erection.

If the Employer is satisfied that the pre-conditions for the issuance of the Civil Completion Certificate for the respective civil structures/ parts have been met the Civil Construction Completion Certificate shall be signed off by the Employer.

Further testing requirements for civil works are specified in **Section B9**.

An indicative field quality plan for civil works to be followed by the Contractor at site is required to be submitted with the Tender.

B0.7.3.2 Erection tests

General
During erection all required erection tests as well as final erection checks of the mechanical completion of the systems and part thereof have to be performed.

The Employer shall have the right to witness on request all tests on site and shall be informed of site test 24 hours in advance.

After successful mechanical completion of each system, Individual Erection Completion Certificates will be issued.

The activities necessary for mechanical completion shall include but not be limited to following testing:

- visual inspection after unloading at site
- checking of completion of relevant systems
- completion of buildings and civil works
- test of ventilating and air-conditioning units
- alignment of rotating equipment coupled on site
- safety audit
- testing of site welds (non-destructive examinations)
- pressure testing, leak tests, tightness tests
- checking of pipe hangers, supports, guides, etc.
- pipe line and equipment flushing and cleaning
- chemical protection of piping systems
- checking of coating
- testing of cranes and hoists.

Electrical equipment tests
The following tests or measurements must be made during and after erection but before any item of equipment is put on trial operation:

- design and visual checks
- screwed connections for correct assembly
- terminals and terminal connections for correct assembly
- checking of earthing connections and testing of earthing resistances
- measurement of insulation values (didactic tests)
- verification of earthing conditions
- fire-proof partitioning
- marking, inscription, provision of designation plates
- rotating-field measurement
- phase coincidence with 2 half-busbars
- voltage checks
- polarity checks in the case of DC voltages
- fuses, overcurrent trips, short circuit trips, time settings, relay settings
- oil levels

- status indication, alarm and trip signals
- checks on wiring and cabling for conformity with the constructional circuit drawings and plans
- high voltage tests
- current and voltage transformer circuits
- functional test of all protection relays including winding and oil temperature monitoring as well as Buchholz protection etc.
- interface with the DCS and SCADA.

The tests shall be carried out according to relevant standards.

The Contractor shall submit for each test of all equipment a method statement, with relevant diagrams explaining the procedure of the tests and test criteria supported by relevant standards and test methods.

All major equipment shall have a separate test package.

All high voltage tests shall be carried out at 50 Hz. Equipment for which DC tests is proposed shall be justified and approved by Employer/Engineer. HV tests of switchgears shall be carried out with the relevant circuit breakers in open and closed positions.

Unless otherwise agreed, all erection and civil works related to the equipment shall be completed before starting any site tests.
All switchgears shall be verified by primary injection in addition to secondary injection.

Generators
This Section covers the specific requirements for the site tests and performance tests requirements in the turbine plant.

These tests shall include:

- Routine tests as per IEC 60034 - as far as practicable under site condition comprising of:
  - testing of running behaviour (overspeed)
  - determination of temp. rises of coolants and lubricants for bearing and shaft seals
  - determination of friction losses
  - recording of no-load saturation characteristics and determination of core losses
  - measurement of shaft voltage
  - verification of phase sequence and appropriate terminal marking
  - measurement of excitation current and determination of losses at rated current on short circuit
  - calculation of efficiency from sum of individual losses
  - winding insulation measurement
  - HV test on windings
  - functional test of accessories and attachments

- measurement of excitation response time – GTG: measuring will be carried out at site during commissioning
- overall characteristics coupled with generator and AVR cubicle at no load (applicable for the assembled unit consisting of generator, exciter and voltage regulator) – GTG: measuring will be carried out at site during commissioning.

The Contractor has to provide a detailed test procedure subject to approval by the Employer/Engineer.

Motors
Tests at Site (with motor coupled):

- measurement of insulation resistance
- measurement of shaft current
- measurement of motor vibrations
- at motors rated 47 kW or higher, in addition:
  - oscillographic measurement of starting current (if not performed during workshop testing)
  - measurement of starting period.

Switchgear for Voltages above 1 kV
The complete installation shall be tested at site as follows:

- dielectric test
- visual inspection
- contact resistance/torque test of bus bar joints
- CT‟s, VT‟s ratio, magnetisation characteristic and burden measurement
- HV test
- mechanical functioning test
- test of the functional sequence
- testing of all interlocks
- testing of all protection relays and circuits by primary/secondary injection and functional tests of the arc protection
- testing of high speed transfer systems
- testing of all alarms (local and remote).

LV switchgear (AC and DC)
The complete switchgear and the individual apparatus shall be tested on site as follows:

- visual inspection
- dielectric test
- contact resistance/torque test of bus bar joints
- CT‟s, VT‟s ratio, magnetisation characteristic and burden measurement
- testing of all interlocks
- setting and testing of all protection relays and circuits by primary/ secondary injection. Test kit of adequate rating to be provided

- testing of automatic change over devices
- testing of all alarms (local and remote)
- functional test
- test of the functional sequence.

Setting and functional test of protection devices (primary injection method). However, test plugs and socket facilities for secondary injection tests shall also be made available. Tests kits of adequate ratings shall be made available for the tests.

Batteries and chargers
Chargers and batteries shall be tested together in the factory. All factory tests are to be repeated at site.

Chargers
- visual inspection (to be repeated on site)
- functional tests (to be repeated on site)
- heat run (type test)
- output voltage stability measured for 25% load steps
- ripple voltage measurement without connected battery
- ripple measurement (voltage and current) with connected battery
- insulation test (to be repeated on site).

Batteries
- visual inspection (to be repeated on site)
- insulation test (to be repeated on site)
- charge test and discharge tests (100%).

Fuse Box
- Visual inspection (to be repeated on site)
- Functional tests (on site)
- Insulation test (on site).

Inverters & DC/DC Converters
Following test shall be carried out:

- visual inspection (to be repeated on site)
- functional tests (to be repeated on site)
- insulation test (to be repeated on site).

Earthing and lightning protection
The complete earthing and lightning protection systems shall be tested as follows:

- The earthing system as a whole shall be tested and verified before putting any major equipment into operation.
- visual inspection of exposed elements
- Measurement of the earth electrode potential UE by the voltmeter/ ammeter method, test current 100 300 A or an equivalent, approved method if above will be proved to be not feasible,
- measurement of the touch potential UB,
- measurement of step potential.

Diesel generator units
The diesel generator units (DGU) shall be thoroughly tested at site. The acceptance tests shall be performed according to the Technical Specifications and acc. to ISO 8528 6:1993 (E) and ISO 3046-1:1995 (E) and -3:1989 (E) for the diesel engine. At site the diesel engine shall be measured and documented according to the stipulations made in Clause 7.6.20. The exhaust gas shall be invisible when the Unit is operating at loads between 50 and 110%. The diesel engine‟s filter smoke number shall be measured according to BOSCH Index No. 3 or better within a load range from 60 to 100%. A test report in English language shall be issued according to ISO 8528:1993 (E). Upon full satisfaction of the Employer/Engineer after the successful operation tests, in every respect, and that all components are working properly, the DGU with all ancillaries shall be operated at 100% output for 48 hrs without failure or interruption whatsoever. The performance test measurements of the DGU shall be performed according to ISO 8528 6:1993 (E) for the diesel generator unit, ISO 3046-1:1995 (E) and -3:1989 (E) for the diesel engine and latest issue of IEC 60034-2 for the Generator. All guaranteed values shall be assumed to include all necessary tolerances for accuracy of testing, sampling, instrumentation, notwithstanding the performance test code standard. No further tolerances of any kind shall be permitted.

230 kV XLPE Cables
Test after laying is to be recommended by the manufacturer considering the following minimum requirements and recommendations from CIGRE WG.21.9 (Electra No.173 August „97), IEC 62067 and other applicable standards to Employer/ Engineers approval.

- visual and function test of bonding/earthing system
- phase Identification Test
- conductor and screen/sheath Continuity Test
- primary connection check
- cable connection bolt tightness check
- cable supporting check
- cable fixing check
- insulation resistance test before and after installation
- DC conductor resistance test (IEC 60228)
- contact resistance test of connecting bars in link boxes
- capacitance test
- earthing measurements
- positive/negative and zero sequence impedance measurements
- testing of SVL
- cross bonding check, primary injection Subsequent repeat tests (after guarantee period)
- DC sheath test according Clause 5 of IEC 60229 between metallic sheath/screen/armouring including cross bonding system, etc. and ground.
- AC voltage test according IEC 62067 **Section 14.2**.
- measurements of induced voltages on pilot/telephone cables installed in parallel with the power cables.

Tests accord the Electricity Transmission Code of Bangladesh and Great Britain
Any other tests required to demonstrate compliance with the above indicated Grid Codes.

B0.7.3.3 Pre-commissioning tests

Preconditions for the pre-commissioning are:
- the issue of the individual Erection Completion Certificates;
- the rectification of all relevant erection punch points; and
- the availability of the accepted commissioning test program and commissioning procedures.

The pre-commissioning tests shall cover mainly the functional tests of the individual items of all mechanical, electrical and I&C systems including their alarm and tripping systems. Following tests shall be included, but not limited to:

Mechanical equipment

- Individual pre-commissioning runs of all rotating equipment such as pumps, compressors, dosing equipment etc.
- Functional tests of the mechanical equipment
- Testing and adjustment of safety devices

Electrical equipment

As far as not already covered by the erection tests the pre-commissioning tests shall cover:

- Voltage tests
- Generator and transformer protection system checks
- Automatic voltage and reactive power control (AVQC), governor setting and adjustment and response to grid system signals
- Trip tests
- Functional tests of the equipment e.g.:
  - Motor checks
  - Circuit breakers, LV, MV, HV cabling and switchgears checks for operability
  - Batteries, chargers and UPS checks for operability
- Remaining tests on turbine generator: In addition, a repetition of winding resistance and insulation resistance measurement, as well as dielectric tests shall be carried out in any case on each turbine generator.

Control equipment

- Comprehensive loop tests shall be performed for all measuring loops at least for 0, 50% and 100% value.
- Closed loop control checks up to DCS (for all functions like indication, control, alarms, etc.):
  - Polarity and function test in accordance with the applicable standards.
  - Control valves shall be tested in accordance with mechanical functional tests on control valves and shall be performed with the actuator mounted (open to closed position and vice-versa)
  - Actuators shall be subject to mechanical and electrical function tests.
- All sequence logic equipment shall be tested using simulated inputs.
- The alarm annunciation and sequence of event recording system shall be tested using simulated inputs.
- Binary field contact circuit fault detection.
- Functional tests of control equipment, interlocks, inter-tripping, protection inputs, etc.
- Test of signal exchange with other systems (also with third parties – like LDC, etc.)
- Archiving system (capacity, consistency, redundancy, access times).

- Reports generation
- Emission analyser calibration and emission evaluation tests
- Calibration of metering system (accuracy shall be proven by certificates)

B0.7.3.4 Tests on Completion (Commissioning tests)

Preconditions of the Tests on Completion are:
- the successful completion of the individual erection checks of all items of the whole system;
- the issuing of the Final Erection Completion Certificate; and
- the successful completion of all pre-commissioning test.

Should the Employer decide that the preconditions for the Tests on Completion have not been adequately met, the Employer will advise the Contractor accordingly and withhold the commencement of the the Tests on Completion until the outstanding work is completed.

The Tests on Completion shall prove that the Plant is prepared and adjusted to ensure the correct functioning of the individual components and of the complete Plant.

The Tests on Completion shall cover at least following tests:

- Protection tests
  - Operation of selected turbine train protection devices including the following as a minimum:
    - fire protection
    - boiler protection
    - steam turbine protection
    - generator protection
    - transformer protection.

Method of alarm/ trip condition reset for subsequent starting.

- Operation of auxiliary systems:

Method of changeover of main equipment to stand-by equipment prior to Plant starting (see start-up tests) and during normal operation for fuel oil, coal handling, ash handling, oil lube and cooling systems
- Operation of fire protection systems.

- Isolation procedures
  - Method of isolation of plant equipment for safe shut-down and maintenance procedures including as a minimum:
    - HV station and unit supplies
    - LV supplies
    - fuel oil systems
    - coal handling systems
    - ash handling systems

    - fire protection systems.
- Protection systems/ settings, in accordance with agreed design and the requirements of the transmission system.
- Start-up tests
    - normal semi-automatic start to preset load
    - staged semi-automatic including start to synchronous speed, manual synchronizing (including synchro-check), automatic synchronizing, manual and automatic loading
    - starting with stand-by auxiliaries
    - operation of all auxiliaries.
- Verification of start-up times and loading rates of power unit and steam generator at various downtime conditions.
- Power unit(s)/Plant, to test partial and full load rejection to demonstrate
    - full load rejection tests to measure transient maximum speed and steady state speed at normal governor droop setting
    - method of resynchronism to be demonstrated steam turbine bypass operation capability.
- Power unit(s)/Plant, to verify and check
    - operating stability when operated between 30% and 100% nominal load conditions with load variations by increasing or decreasing the electric load
    - start-up/main fuel change-over:
        - semi-automatic change-over from fuel oil operation to coal operation
        - semi-automatic change-over from coal operation to fuel oil operation.
- Demonstration of the capabilities of the power unit to operate at rated voltage and frequency, at power factors and reactive conditions between 0.85 (lag) and 0.95 (lead).
- Start-up tests of the Plant equipment, facilities and systems including checking of automatic change-over of standby facilities as well as fuel.
- Verification of vibration guarantees.
- Environmental monitoring equipment, water quality monitoring equipment, functioning tests and verification of guarantees.
- Demonstration of the teledispatching and telemetering systems.
- Verification of Active Power Response and Voltage Control Response according to the requirements specified in the Network Connection Conditions.
- Demonstration of proper controlling, monitoring and recording according to the requirements of the Grid Code, including but not limited to the following tests:
    - Reactive Power
    - Fault Detection and Clearing Limits
    - Load Following Capability
    - Black Start (if applicable)
    - Voltage Following Capability (AVQC)
    - Excitation System and Power System Stabiliser
    - Primary, Secondary and High Frequency MW Response

- Unit Start
- Despatch Ramp Rate
- Protection System
- House Load Operation
- Underfrequency Relay
- Loss of AC Power Supply
- Minimum Load
- Site Test for Validation
- Verification of completeness of scope of supply.

B0.7.3.4.1 Additional test in accordance with the PPA

Tests prior to synchronisation of each generating unit of the Plant
According to the requirements of the BPDB which are part of the PPA, the Contractor shall carry out the following additional tests prior to synchronisation of each generating unit of the Plant:

- automatic voltage regulator setting and adjusting in stand-still condition and with the generator running at no load
- turbine governor control checks, including (but not limited to) a steam governor overspeed test (This test may be performed after a specified period of running of the Unit on load as per the manufacturer˝s recommendation)
- open circuit and short circuit tests on the generator
- functional testing and timing of high voltage switchgear in the substation of the Facility
- The Company and BPDB shall verify that the protection level settings for switchyard protection equipment are as agreed by the Joint Coordinating Committee
- Voltage phasing checks will be carried out between the Grid System and the Facility; and

All inter-tripping circuits between the Plant and BPDB equipment shall be proved.
Tests for commissioning of each generating unit of the Plant
In addition to the above specified tests and according to the requirements of the BPDB which are part of the PPA, the following tests shall be carried out by the Contractor for commissioning of each generating unit of the Plant after completing the tests set out before:

a. Dependable Capacity Test
Refer to Section **0.7.4.**

b. Reliability Run
Refer to Section **B.0.7.5**

c. Automatic Voltage Regulator ("AVR") Droop Test
The AVR will be demonstrated to control the steam turbine generator voltage over its entire set range.

d. Steam Turbine Governor Operation Test
The operation of the steam turbine speed governor will be demonstrated.

e. Reactive Capacity Test
This test will demonstrate the capability of the Plant to operate at rated voltage and frequency at power factors and under reactive conditions in accordance with the manufacturer‟s generator rating curves to be provided by the Contractor, insofar as these tests can be accommodated within the grid system.

f. Minimum Load Capability Test
This test will demonstrate the capability of each Unit to be operated at minimum stable load while the steam turbines, and auxiliaries remain in a stable and controlled condition, see also

B0.7.3.4.2 72h Full Load Continuous Test Run

After successful completion of the Tests on Completion and availability of the Commissioning Completion Certificate (CCC), signed by the Employer and the Contractor, the "Authorization to Start the 72 h Full Load Continuous Test" shall be signed.

No trip is admitted during these 72 h. Should the Plant or a Unit, as the case may be, not follow the requested load during the 72 h test, the test shall be restarted.

B0.7.4 Performance Tests

Performance Tests of the Unit(s)
After successful completion of the 72h Full Load Continuous Test Run and after relevant test protocols have been accepted by the Employer for the Unit(s) and Common Facilities, the Contractor shall be allowed to prepare the Unit(s) for the Performance Tests.

For the Unit(s) following guarantees given in the **Technical Schedule B0** shall be tested during the related Performance Test; this includes:

- Performance guarantees of the Unit(s)
- Operating guarantees
- Emission guarantees
- Guarantees of steam generator(s), steam turbine generator(s), flue gas treatment systems etc.

Performance Test of the Plant
After completion of the Performance Tests of the Unit(s), the guarantees of the Plant and the common facilities shall be tested in a separate Performance Test; this includes:

- Performance guarantees of the Plant
- Emission guarantees of the Plant
- Emission guarantees of the auxiliary boiler
- Noise guarantees
- Guarantees of the water and waste water treatment systems
- Effluent and water outfall guarantees.

Dependable Capacity Test according to the PPA
Dependable Capacity means- means at any given time the net amount of capacity at the tariff metering; either for the first generating unit or for the Plant, as the case may be, as determined by the most recent dependable capacity test which shall be comply with ASME standards and shall be carried out as part of the Reliability Run. The Dependable Capacity of the Plant is measured at the Delivery Point. It equals the average Export Power Output, corrected to Reference Site Conditions using correction factors, delivered during twelve continuous thirty (30) minute periods divided by six (6) hours.

Dependable Capacity is the power output/capacity of a unit or the plant which can be reliable evacuated to the grid and which shall be verified by the "Dependable Capacity Test according to PPA". In additon refer to the defnition under B0.2.9.2

The Dependable Capacity Test and the Performance Testing in general will carried out under the the actual prevail conditions. The measued power output and other guaranteed performance data shall be corrected to the reference conditions using the correction curves to be provided by the Bidder/Contractor.

Performance Tests shall be conducted in accordance with following standards:

- the Plant ASME PTC 46
- steam generator ASME PTC 4
- steam turbine ASME PTC 6
- cooling tower ASME PTC 23
- FGD plant ASME PTC 40.

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As for supercritical steam power plants operation without make-up must be possible for a defined time period, the guarantee figures shall not include make-up.

The curves required for the correction of the power output and specific heat rate to the site specified ambient conditions shall be listed in the technical schedules of the Plant performance and steam generator and steam turbine performance, and shall be submitted with the Tender. These curves shall be conclusive and no extra correction shall be given.

The margins required for instrument inaccuracies and for all other reasons shall be deemed to be included in the guarantee figures. The actual figures determined during performance tests shall hence be not corrected with any margins due to instrument inaccuracies prior to comparison with the guarantee figures.

Degradation and fouling during commissioning and other operation prior to Provisional Acceptance shall be deemed to be included in the guarantee figures. The actual figures determined during performance tests shall hence be not corrected for any degradation or fouling effect prior to comparison with the guarantee figures.

Degradation curves for the Plant and Unit(s) performance shall be submitted by the Contractor with bid. The curves shall show the equipment‟s degradation in power output and heat rate versus equivalent operating hours. The curves shall be applicable up to and including final major overhaul.

Test program
In due time prior to the tests a detailed procedure covering the testing to be undertaken and the methods to be employed shall be provided by the Contactor. The test procedure shall also detail areas of responsibility and the items that specifically require preparation and agreement before the tests can be carried out.

The test program shall cover the following documents but not be limited to:

- test procedure and standards (including proposed formulae / curves and standards)
- test schedule
- type of test
- manpower and deployment schedule of the Contractor for performing the tests forms of test records and report
- description of instrumentation to be used, including accuracy, and calibration test results
- method of data recording
- list of all auxiliary loads that will be operating during the tests. The list of auxiliary loads shall be provided with the test program and agreed in the Test Procedure.
- method and equations/correction curves used for adjustment of recorded data to the design conditions.

Test responsibility
All tests shall be prepared and conducted by the Contractor. The Plant shall be operated by Contractor‟s operation personnel.

The Employer and/or an independent third party, awarded by the Employer.shall have the right to witness the tests.

Contractor‟s personnel appointed to carry out the tests shall be adequately skilled and experienced. Information on these personnel shall be provided to the Employer as part of the test program for review.

Test instrumentation
The Contractor shall supply and install all test instrumentation needed to conduct the tests. Temporary instrumentation installed for test purposes only and shall be retained at Site upon the satisfactory conclusion of all tests and shall be then removed.

All instruments to be used for the test shall be strictly dedicated calibrated measurement equipment. Each measuring instrument used shall be according to controlled and provided with a valid calibration certificate.

The calibration of PG Test instrument shall be carried out as per PTC-6 by an independent authorised company, which shall have appropriated quality standards and which shall be to be approved by the Employer, except for instruments which are calibrated and certified at a certified laboratory and holding the authorized traceability certificate. The certificate shall not be older than six (6) months.

Test Duration
The test shall begin after the Plant or a Unit including common facilities, as the case may be, has established stable operation, as judged by the Employer and/or an independent third party, awarded by the Employer.

The test duration shall be in accordance with the standards and codes.

One 60-minute test run shall be conducted for each guaranteed load point, during which the operating conditions shall remain within the defined plant stability criteria.

Test conditions
Performance tests shall be conducted at conditions close to the conditions of the Guarantees. Thereby the boiler and steam turbine cycle shall be adjusted to the conditions of the corresponding heat balance diagram.

Since the accuracy of the test results highly depend on the exact water-steam cycle arrangement respective cycle isolation is required to avoid any unknown cycle leakages. The valve position list has to be provided by the Contractor prior to the performance test. This cycle arrangement shall fully remain during the whole testing period. Any changes of the performance

conditions during the tests are not allowed.

Test evaluation
The Contractor shall submit for the acceptance of the Performance Test all detailed measurements, calculations and individual test results (such as, but not limited to turbine efficiency calculations, generator and transformer details, condenser performance, feedwater heaters and deaerator details, boiler efficiency calculations, pulverizing fineness and other results, air heater temperature traverses and leakage results, coal handling system performance, ash characteristics and ash handling systems performance, ESP and FGD performance and emissions, individual auxiliary power consumption figures, major consumers performance, noise and effluents etc.) and the corrections made based on the correction curves.

The Performance Test report shall be submitted by the Contractor. This report shall include, as a minimum, the following:

- description of the test procedures
- instrumentation details and calibrations (not older than six months)
- full process flow diagrams for fuel, air and flue gas and water and steam with indication of instrument position
- standards that were used
- test logs and summary (arithmetic average) of test readings used for performance calculations
- full set of correction curves
- calculations
- instrument calibration certificates
- list of all auxiliary loads that were operated during the tests
- performance tests results for the "As-run" condition and for the “Corrected as-run conditions”
- conclusions of performance tests: test passed or not.

B0.7.5 Reliability test run

After successful completion of all Performance Tests the Plant or a Unit including common facilities, as the case may be, shall start the 30 (thirty) days Reliability Test Run.

During the Reliability Test Run the Contractor shall demonstrate that the Plant or a Unit including common facilities, as the case may be, is fit for commercial operation.

During the specified periods, the Plant shall be operated continuously and in accordance with the prevailing power requirements of the Transmission System/BPDB or as required by the Employer.

During the Reliability Test Run the Employer‟s operation personnel shall operate the Plant under the full supervision and the responsibility of the

Contractor‟s Personnel and according to the O&M manual as supplied by the Contractor.

For the successful completion of the Reliability Test Run, a maximum of 4 trippings of not more than combined outage of 24 hours are allowed, otherwise the Reliability Test Run will be considered as failed and a new Reliability Test Run will have to be executed until the test has been completed.

At the conclusion of the Reliability Test Run the Contractor shall request from the Employer the issuing of the Provisional Acceptance Certificate (PAC).

A list of minor pending items, which are at the judgment of the Employer do not jeopardize the trouble-free operation of the Plant or a Unit including common facilities, as the case may be, could be attached to that certificate. The envisaged completion date for each item shall be stated in it.

With the issuing of the PAC the Employer takes legal possession of the Plant or a Unit including common facilities, as the case may be, and the Warranty Period will begin.

During the Warranty Period the Contractor has to keep at site at least three Warranty Engineers at Site. Part of their duty shall be inter alia to complete in time the works for the minor punch items mentioned in the PAC. They shall issue, together with the Employer, special reports, should any damages occur to any equipment. Moreover they shall assist the Employer during the daily plant operation and issue additional operational instructions, if requested. They shall assist the Maintenance Superintendent in his work organization and spare part handling procedure.

At the successful conclusion of the Warranty Period, the Contractor shall request the Employer to issue the Final Acceptance Certificate (FAC). .

Additional requirements as per the PPA The Facility shall operate continuously (without interruption) for
Seventy two (72) continuous hours at then demonstrated Dependable Capacity. For ninety six (96) hours the output shall be as requested by BPDB in accordance with the Dispatch provisions as outlined in the PPA.

Abbreviations

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(Please refer also to relevant Sections “**Standards and Codes” and “Units of measurement”**)

AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
AGC	Automatic Grid Control

ASC	Average Site Conditions
ATRS	Automatic Turbine Run-up System
ATT	Automatic Turbine Testing System
AVQR	Automatic Voltage and Reactive Power Control
AVT	All Volatile Treatment
BFP	Boiler Feedwater Pump
BIMS	Building Information Management System
BMCR	Boiler Maximum Continuous Rating
BMS	Burner Management System
BOD	Biological Oxygen Demand
BOP	Balance of Plant
BOQ	Balance of Quantities
BPDB	Bangladesh Power Development Board
BPS	Boiler Protection System
CCR	Central Control Room
CCTV	Closed Circuit Television
CD	Chart Datum
CEMS	Continuous Emission Monitoring System
CHP	Coal Handling Plant
CO	Carbon Monoxide
COD	Commercial Operation Date
COD	Chemical Oxygen Demand
CT	Current Transformer
CW	Cooling Water
DAF	Dry Ash Free
DC	Direct Current
DCDB	DC Distribution Board
DCS	Distributed Control System
DDCMIS	Distributed Digital Control Monitoring & Information System
DCS	Distributed Control System
DOE	Department of the Environment, Bangladesh
DOSH	Department of Safety and Health, Bangladesh
DPC	Damp Proof Course
DWT	Dead Weight Tons
ECP	Electrochlorination Plant
EHG	Turbine Electro Hydraulic Governor Control System
EHSG - TTP	IFC Environmental Health and Safety Guidelines Thermal Power Plants
EHV	Extra High Voltage (500 kV)
EIA	Environmental Impact Assessment
EMC	Electro-Magnetic Compatibility
EPC	Engineering, Procurement, Construction
ESP	Electrostatic Precipitator
ETP	Effluent Treatment Plant
FDF	Forced Draught Fan
FEGT	Furnace Exit Gas Temperature
FGD	Flue Gas Desulphurization Plant
FTU	Field Mounted Termination Unit

Deleted:

GCV	Gross Calorific Value
G-EHSG	IFC General Environmental Health and Safety Guideline
GJ	Gigajoule
GPS	Global Positioning System
GRP	Glass Fiber Reinforced Piping
GWh	Gigawatt hour
GSO	Grid System Operator
HART	Highway Addressable Remote Transducer
HAZOP	Hazard and Operability Study
HCSD	High Concentration Slurry / Solids Disposal
HDPE	High Density Polyurethane
HHV	Higher Heating Value
HMI	Human Machine Interface
HRC	High Ruption Capacity Fuse
HV	High Voltage
HVAC	Heating, Ventilation, Air Conditioning
Hz	Hertz
I&C	Instrumentation and Control
IDF	Induced Draught Fan
IOD	Initial Operation Date
IP	Intermediate Pressure
IPL	Independent Protection Layer
IPP	Independent Power Producer
IR	Infrared
kV	Kilovolt
kW	Kilowatt
LAN	Local Area Network
LCC	Local Control Center
LCV	Lower Calorific Value
HSD	High Speed Diesel
LHV	Lower Heating Value
LIE	Local Instrument Enclosure
LIR	Local Instrument Rack
LP	Low Pressure
LV	Low Voltage
LVS	Large Video Screen
MCC	Motor Control Center
MCL	Maximum Continuous Load
MCR	Maximum Continuous Rating
MCWP	Main Cooling Water Pump
MDBFP	Motor Driven Boiler Feed Pump
MLSD	Land Survey Datum
MNCL	Minimum Continuous Load
MNCR	Minimum Continuous Rating
MOV	Motor Operated Valve
MV	Medium Voltage
MVA	Megavolt Ampere
MVAR	Megavolt Ampere Reactive
MWh	Megawatt hour

MWQCS	Marine Water Quality Criteria and Standards
NCC	Network Control Center
NDE	Non Destructive Examination
NFPA	National Fire Protection Association
NLDC	National Load Dispatch Centre
NO_x	Nitrogen Oxides
NOR	Notice of Readiness
NPSH	Net Positive Suction Head
NRV	Non Return Valve
O&M	Operation and Maintenance
OEM	Original Equipment Manufacturer
OHL	Over head line
P&I	Piping and Instrumentation
P&ID	Piping and Instrumentation Diagram
PA	Public Address
PABX	Private Automatic Branch Telephone Exchange
PA	Primary Air
PADO	Plant Performance Analysis, Diagnosis and Optimization System
PAF	Primary Air Fan
PC	Pulverized Coal
PCDD	Polychlorinated Dibenzodioxins
PCDF	Polychlorinated Dibenzofurans
PF	Performance Fuel
PLC	Programmable Logic Controller
PPA	Power Purchase Agreement
PQR	Procedure Qualification Record
PSS	Power System Stabiliser
PVC	Polyvinyl Chloride
PWD	Public Works Department
PWHT	Post welding heat treatment
QA	Quality Assurance
RAPH	Regenerative Air Preheater
RC	Reinforced Concrete
RSC	Reference Site Conditions
SA	Secondary Air
SAH	Steam Air Heater
SCADA	Supervisory Control and Data Acquisition
SCAPH	Steam Coil Air Heater
SCS	Substation Control System
SER	Sequence of Events Recording
SG	Steam Generator
SI	Soil Investigation
SIL	Safety Integrity Level
SO_2	Sulphur Dioxide
SOE	Sequence of Events
SSC	Summer Site Conditions
ST	Steam Turbine
STG	Steam Turbine Generator

SWAS	Steam and water analyses system
TCS	Technical Comment Sheet
TDS	Total dissolved solids
TEFC	Totally enclosed Fan cooled
TG	Turbine Generator
TIG	Tungsten Inert Gas
TLA	Three-Letter Abbreviation
TMC	Turbine Maximum Capacity
TMCR	Turbine Maximum Continuous Rating
TSCS	Turbine Stress Control System
TSI	Turbine Supervisory Instruments
UHF	Ultra High Frequency
UV	Ultraviolet
VDU	Video Display Unit
VT	Voltage Transformer
VMS	Vibration monitoring system
VWO	Valves Wide Open
WSC	Winter Site Conditions
WPS	Welding procedure specification
WTP	Water Treatment Plant
WWD	Weather Working Days
WWTP	Waste Water Treatment Plant

B0.9 Technical Schedules

The following technical schedules comprise part of this specification. The data and requirements specified in the respective forms are to be adhered to and the missing data of forms are to be completely filled in. The completed technical schedules are to be submitted with the Bid.

B0 Technical Schedule General
B0 Sub-supplier List

TENDER NO: PSER:SITE:KLN-C2019:19

VOLUME -III

PRICE SCHEDULE-REV-0

FOR

Package#10E: CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.

BHARAT HEAVY ELECTRICALS LIMITED

(A GOVT. OF INDIA UNDERTAKING)

General Manager & Construction Manager, 2x660 MW Maitree Super Thermal Power Project, PO-Kalekkharber, Union-Rajnagar, Upajila-Rampal, Dist: Bagerhat-9343, Bangladesh

VOLUME-III	
PRICE SCHEDULE, REV-0	
Package#10E:CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.	
TENDER NO - PSER:SITE:KLN-C2019:19	
PREAMBLE	
01	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.
02	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.
03	Items of work provided in this schedule but not covered in this specification shall be executed strictly as per instruction of the engineer.
04	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, taxes (except service tax), 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.
05	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 thirty percent (± 30%) of the awarded price as per LOI.
06	Prior written approval of BHEL shall be sought by the contractor in case quantity variation of any item crosses +50% (plus fifty percent) limit during execution and approval to be obtained before execution of further quantity for this item.
07	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.
08	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.
09	The rates quoted shall be inclusive of cleaning of site of any vegetation, dressing , clearing of old structures and leveling etc. including fixing of grid pillars, benchmarks etc. required for commencement of site activities. No separate payment will be made towards the same. However, if separate rate for such item is avalable in the rate schedule, the same shall be considered.
10	Rates shall be quoted in figures and in words in clear legible writing. No overwriting is allowed. All scoring and cancellations should be countersigned and in case of illegibility the interpretation of engineer shall be final. All entries shall be in English language.
11	All works item wise shall be measured upon completion and paid for at the rates quoted and accepted as per BHEL approved payment schedule/billing break-up.
12	The tender shall be deemed to have visited site and made himself aware of all the site conditions, studied the specifications and details of work to the done within the time schedule attached and to have acquainted himself of the conditions prevailing at site.
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/BPWD 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 Total price shall be considered for evaluation unless stated otherwise.
22	In case of BOP packages, if Bidder does not quote/indicate the price for freight chagses against indicated rate schedule, the same shall be considered as 2% of basic price and adjusted with the total quoated price against each item keeping the total quoted price unaltered.

VOLUME-III
PRICE SCHEDULE, REV-0

Package#10E:CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.
TENDER NO - PSER:SITE:KLN-C2019:19
SCH-1 : TOTAL PRICE

SL NO	DESCRIPTION	PRICE SCHEDULE REF	TOTAL QUOTED PRICE (IN USD)
1.0	**Package#10E:CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.**	**SCH 2 - BREAK UP OF TOTAL PRICE**	***IN FIGURES:-*** ***IN WORDS:-***
2.0	**NON-SCHEDULE ITEM** **Quote % above or % below or at par for items not covered SCH 3 & 4 of Price Schedule. The rate shall be derived from Schedule of Rates 2014, PWD, Govt. of Bangladesh**		
1a)	Rate of complete item	_____% above/_____% below/ at par of BPWD Rate Schedule 2014	
1b)	Rate of supply of material at site only	_____% above/_____% below/ at par of BPWD Rate Schedule 2014	
1c)	Rate for execution complete excluding supply of materials.	_____% above/_____% below/ at par of BPWD Rate Schedule 2014	

NOTE

1.0	Bidder shall quote total price for total price of 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 1.0 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 to note that SCH-2 is Break-up of Total Price.
3.1	Bidder to note that SCH-3 covers SERVICE of respective items, unless specified otherwise in the description of items.
3.2	Bidder to note that SCH-4 is Break-up of SUPPLY unless specified otherwise in the description of items.

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SCH-1 : TOTAL PRICE

4.0	Bidder's quoted total priceat Sl. no 1 above respectively 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.
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 after roundeding off .
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.7below.
7.0	Unit rates of each item of works of respective schedules/ parts will be derived by dividing derived amount by corresponding quantities. In deriving the unit rates of each item in this manner, figures only upto **2** decimal places will be taken into account. Any adjustment, if required, due to such methodology, will be effected in final bill.
8.0	Successful bidder shall draw a schedule of quantities of various items of work of SCH-5 and obtain BHEL's approval/ clearance in writing before procurement, supply, etc.
9.0	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.
10.0	Price format shall not be changed by bidder in any case and it may lead to cancellation of their offer.
11.0	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.
12.0	For payment of non schedule items, the rate shall be derived from Schedule of Rates 2014, PWD, Govt. of Bangladesh.

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SCH-2 : BREAK UP OF TOTAL PRICE SCHEDULE

SL NO	DESCRIPTION	PRICE SCHEDULE REF	WEIGHTAGE
1.0	SERVICE	SCH 3 -SERVICE	**0.9866365**
2.0	SUPPLY	SCH 4-SUPPLY	**0.01336351**
	TOTAL		**1.00000000**

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
	100 EARTH WORK			
	Earth work In excavation, backfilling and disposal including necessary men/women, materials, equipment, loading, transportation, unloading, dewatering etc as per specification, drawing, relevent laws of Bangladesh, relevant BS (or equivalent international standard) Standards approved by BIFPCL/BHEL and as directed by engineer- in-charge for the following.			
A101	Earth work in excavation in all types of soil including ash which can be excavated by any means including setting out, levelling, dewatering (but excluding special type of dewatering viz. well point method), shoring & strutting (wherever required), 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.**This item is only applicable for excavation by using of Sheet Pile . Payment for Sheet Pile shall be paid as per Item No. 2516. [Measurement of excavation shall be paid as per clause 5.2.0 of Technical Specification, Section D, Sub-Section D1 sheet 20 0f 22]**			
a	Depth from ground level but not exceeding 2 m	CUM	4050	0.00284681
b	Depth exceeding 2 m but not exceeding 4 m	CUM	3400	0.00298386
c	Depth exceeding 4 m but not exceeding 6 m	CUM	3000	0.00328166
d	Depth exceeding 6 m but not exceeding 8 m	CUM	1250	0.00171050
e	Depth exceeding 8 m but not exceeding 10 m	CUM	750	0.00123218
f	Depth exceeding 10 m but not exceeding 15 m	CUM	500	0.00094415
B101	Earth work in excavation in all types of soil including ash which can be excavated by any means including setting out, levelling, dewatering (but excluding special type of dewatering viz. well point method), shoring & strutting (wherever required), 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.**This item is applicable in all the excavation areas except excavation by using of Sheet Pile . [Measurement of excavation shall be paid as per clause 5.2.0 of Technical Specification, Section D, Sub-Section D1 sheet 20 0f 22]**			
a	Depth from ground level but not exceeding 2 m	CUM	4050	0.00795085
b	Depth exceeding 2 m but not exceeding 4 m	CUM	3400	0.00878188
c	Depth exceeding 4 m but not exceeding 6 m	CUM	3000	0.01262753
d	Depth exceeding 6 m but not exceeding 8 m	CUM	1250	0.00711235
e	Depth exceeding 8 m but not exceeding 10 m	CUM	750	0.00557758

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
f	Depth exceeding 10 m but not exceeding 15 m	CUM	500	0.00427614
A108	Earthwork in Back filling upto any depth below ground level around foundations, plinths, trenches, drains etc to proper grade and level in layers not exceeding 250 mm thickness using/with selected earth directly from excavation within a lead upto 1 Km and compacted as specified including watering, ramming/ compaction by manual/mechanical means, dressing etc all complete for the following.			
e	Each layer compacted so as to achieve at least 85% relative density as per ASTMD-4253 & ASTMD-4254	CUM	7600	0.00287655
A109	Extra over ST No. 101 and 103 to 108 for carriage of material/earth for every 500 m or part thereof beyond an initial lead of 1 Km.	CUM	400	0.00002828
C 200	**CONCRETE WORKS**			
	Placing of concrete work including cost of labour, materials (unless otherwise specified in BOQ/ contract specification) and equipment for handling, transportation, placing, vibrating and curing, cleaning and rendering the exposed surface with cement sand mortar to give a smooth and even surface (excluding cost of centering, shuttering and reinforcement) with mechanised equipments like transit mixer, concrete pump etc, preparation of scheme for concreting, getting it approved by engineer, maintaining and submitting records of concreting. complete as per drawing, specifications, relevant laws of Bangladesh, manufacturer's recommendation, relavant BS standards/equivalent international standards and as approved by BIFPCL/ BHEL and as per direction of engineer in charge for the following. (RMC SHALL BE PROVIDED BY BHEL AT BATCHING PLANT IN PROJECT PREMISES. TRANSPORTATION FROM THE BATCHING PLANT UP TO THE POURING POINT SHALL BE UNDER THE SCOPE OF CONTRACTOR)			
C203	**Concrete of grade C12/15 as per BS EN-206 and BS 8500 or equivalent international standard (with 40 mm graded aggregate)** as **lean concrete, leveling course, mud mat, under and around foundation/floors** at any depth below finished floor level etc.	CUM	201	0.00213100

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SCH: SERVICE

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
C205	Design Mix cement concrete conforming to BS EN-206 and BS 8500 or equivalent international standard for reinforced concrete works with coarse sand and graded hard stone aggregate of 20mm nominal size **in foundations/substructure**, **grade slab, paving, drains, under floors** etc at any level below finished floor level, any shape, position or thickness etc complete including use of plasticizer/ superplasticizer conforming to BS EN 934 (latest) or equivalent international standard to achieve required slump in concrete all complete **as per specification & drawing for the following.**			
c	Grade C30/37	CUM	5040	0.06475379
C206	Design Mix cement concrete conforming to BS EN-206 and BS 8500 or equivalent international standard for reinforced concrete works with coarse sand and graded hard stone aggregate of 20mm nominal size **in superstructure** at all level above finished floor level, any shape, position or thickness etc complete including use of plasticizer/ superplasticizer conforming to BS EN 934 (latest) or equivalent international standard to achieve required slump in concrete all complete **as per specification & drawing for the following.**			
c	Grade C30/37	CUM	1310	0.01689623
C212	**Screed concrete** conforming to relevant BS code or equivalent international code with coarse sand and graded hard stone aggregate 12.5mm/6 mm nominal size on the roof at any level or thickness, drains etc complete as per following.			
a	1:2:4 (1 part cement, 2 part sand, 4 parts of aggregate by volume)	CUM	60	0.00063612
C213	Providing and laying Design Mix cement concrete as per BS 8500 and BS EN 206 or equvalent International code for reinforced concrete works using graded aggregate for Concrete **in precast works** like roof slabs/trench covers, fins, lintels, chajas, beams, columns, wall panels, facias etc.at all levels in all kinds of work including formwork/moulds, curing, rendering the top exposed surface with cement sand mortar (1:3), handling, storing, transporting, all leads, erection without damage, setting in position with cement sand mortar (1:3), filling the gaps between adjacent preacast units with concrete or cement sand mortar (1:3) and including making of holes for bolts for fixing, welding etc.complete with graded aggregate and as per specification and drawing for following grades.			
c	C 40/50 grade	CUM	100	0.00166995

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
215	Dismantling concrete work for all types of structures at all levels including stacking of servicable material to a lead of 500 m and disposal of unservicable material upto a lead of 2 km, cutting of reinforcement, labour, equipment, safety precautions etc all complete as per drawings, specification and instructions of engineer in charge.			
a	PKG-11B	CUM	140	0.00108948
b	PKG-11B	CUM	140	0.00165955
216	Chipping of concrete in reinforced concrete work, cutting pockets, making openings at all levels and according to shapes, disposal of waste materials upto a lead of 2 km as directed by engineer including equipment, safety precautions, making good the broken surface etc all complete as per specification, drawing, instructions of engineer in charge but excluding cutting of reinforcement .	CUDM	760	0.00033191
217	Extra over and above St No 216 for cutting of reinforcement, all sizes and types including labour, equipment, return of cut reinforcement to store etc all complete as per specification, drawings and instructions of engineer in charge. Measurement shall be on the cross sectional area of reinforcement cut.	SQCM	220	0.00000732
218	Cutting Reinforced concrete with mechanised tools like Core drilling machine etc. for cutting pockets, holes, cores in slab, beam, column or foundation as per direction of engineer in charge.	CUDM	220	0.00045569
	300 FORM WORKS			
	Providing, fixing and removing formwork at any elevations for all structures, as per specifications and including all labour, material, scaffoldings and centereing complete including pockets, rubbing the fairfaced concrete with carborundum stone to make smooth finish etc. complete as per drawing, specifications, relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL and as per direction of engineer in charge for the following.			
A301	**Fairface form work** with good quality water proof ply wood (Plywood lining for form shall be of timber, which is resin bonded and water repellant) of minimum 12 mm thickness and smooth surface **below finished ground floor level** for foundations, footings, base of columns, walls, columns, pilasters, beams, mass concrete, trenches etc including providing 25mmx25mm chamfer at all exterior corners.	SQM	9358	0.04016793

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
A302	**Fairface form work** with good quality water proof ply wood (Plywood lining for form shall be of timber, which is resin bonded and water repellant) of minimum 12 mm thickness and smooth surface **above finished ground** floor level for columns, beams, suspended floors, roofs, lintels, cantilevers, staircases, landings, balconies etc. for all heights including providing 25mmx25mm chamfer at all exterior corners.	SQM	7000	0.03330741
A304	Providing, fixing and removing **formwork in block-outs**/pockets and openings (below 0.1 sqm plan area) at all elevations including cutting, formation of all shapes and all other operations required for making the required shape and size all complete as per specification, drawing and instruction of engineer in charge.			
c	Pockets of depths more than 300mm and upto 600 mm depth	Each	100	0.00076364
d	Pockets of depths more than 600mm and upto 1000 mm depth	Each	80	0.00071074
305	Extra over item no. 301 and 302 for curved formwork for foundations, footings, beams, walls, trenches, domes, arches etc as per specification			
a	Extra for curve shuttering for item no. A301	SQM	200	0.00014557
	400 REINFORCEMENT			
	Reinforcement work including all labour, material (unless otherwise specified in BOQ/contract specification), equipment, transportation, handling etc at all level as per specification, relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL drawings and as directed by engineer - in - charge for the following			
402	Straightening, cutting, bending, placing in position at any level, binding in position of **steel reinforcements of grade B500B** confirming to **BS 4449:2005+A:2009** including cost of reinforcement steel, binding wire, labour, scaffolding, transportation to & from stores etc complete all as per specifications, drawings and as directed by Engineer. **(REINFORCEMENT STEEL SHALL BE PROVIDED BY BHEL AS PER TCC)**	MT	977	0.06227066
	600 JOINTS AND FILLERS			
	Joints & fillers including all labour, material, equipment, transportation, handling etc at any level as per specification, drawings, relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL and as directed by engineer - in - charge.			
601	Supplying & installation of **bitumen impregnated fibre board** confirming to relevant BS code or equivalent international code as joint filler at joints in concrete including nailing, coating of both faces with coal tar pitch/bitumin etc. all complete.			

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SCH: SERVICE

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
c	25 mm wide joints	SQM	2950	0.02801204
602	Providing and applying **polysulphide based sealant** conforming to relevant BS code or equivalent international code in expansion joints in concrete including cleaning of joints, raking out groove, application of primer, scaffolding etc. all complete (The sealant should have VOC content limited to 250 grams per litre) for following size grooves:			0.00000000
c	25mmX25mm	RM	88	0.00048753
606	Providing and fixing **PVC water stops** in joints conforming to relevant BS code or equivalent international code all complete for the following:			
b	230 mm wide and 8 mm thick	RM	1110	0.00364726
	700 MS EMBEDMENTS			
	Embedments including all labour, material (unless otherwise specified in BOQ/specification), equipment, transportation, handling etc. at any level as per specification, drawings, relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL and as directed by engineer - in - charge.			
701	Fabricating and fixing of mild steel embedments, inserts, pipe sleeves, angle pieces, rungs of various diameters, plates of dimensions as required etc. including welding, bolting, cutting, drilling, scaffolding, setting etc. all complete.	MT	22	0.00469168
704	Fabricating, erecting and installing following items in concrete/brickwall for all kind of works, including setting material in concrete, layout, scaffoling, cutting, forming, grinding, drilling, bolting, welding, jointing, testing etc. all complete.			
a	MS pipes of all diameters	Quintal	1	0.00001130
b	PVC pipes / conduits of all diameters	Quintal	1	0.00005851
c	UPVC pipes / conduits of all diameters	Quintal	1	0.00005665
	800 GROUTING			
	Grouting including all labour, material (unless otherwise specified in BOQ/specification), equipment, roughening surface, cleaning, ramming, curing etc. at any level unless otherwise specified as per specification, drawings, relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL and as directed by engineer - in - charge.			

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ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
801	Providing & grouting with **cement slurry mix** of approved ratio using **pressure pump** for water retaining concrete structures as per approved procedure including cost of nipples/ nozzles, cement, admixture, curing, pressure pumps, slurry agitator etc. all complete. Cost shall include fixing of nipples at maximum 500 mm centre to centre spacing, cutting of nipples after completing of grouting, making good of the nipple hole with appropriate non-shrink cement paste, water tightness test etc. all complete wherever specified in the drawing.	SQM	210	0.00117042
802	Providing & grouting of pocket holes, pipe sleeves under base plates, machinery, pipe supporting structures etc. with **mix 1:1 (1 cement :1 sand)** using non shrink admixture etc. all Complete.	CUM	10	0.00233472
803	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	2	0.00043813
804	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 **ConbextraGP-1 or equivalent**. (Cost of all material and cleaning of the pockets by compressed air shall be in the scope of the contractor).	CUM	2	0.00124067
805	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-2 or equivalent.** (Cost of all material and cleaning of the pockets by compressed air shall be in the scope of the contractor).	CUM	2	0.00124067
	900 DOORS, WINDOWS, VENTILATORS, LOUVERS			
	Doors (including master key system), windows, ventilators, louvers, roof ventilators, rolling shutters, partitions including all labour, material (unless otherwise specified in BOQ/specification), equipments, transportation, handling, preparation of working drawings etc. at any level as per specification, drawings, relevant laws of Bangladesh, relavant BS Standards or Bangladesh National building code or Equivalent International standards approved by BIFPCL/BHEL and as directed by engineer - in - charge.			

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SCH: SERVICE

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
901	Providing and fixing **wooden frame** conforming to relevant BS standard or Bangladesh National Building Code or equivalent International standard made of best quality seasoned CP teakwood free from large or loose knots, cracks or other defects including sand paper smoothening, hold fasts, beading, primer and finish painting / polishing etc. all complete with proper wood joinery, accurately set to required lines or levels and rigidly secured in place. (finish painting/polishing paid seperately)	CUM	4	0.00573278
903A	Providing, fitting and fixing **solid core flush door shutter** as per relevant BS standard or Bangladesh National Building Code or equivalent International standard, 35mm thick pre-laminated homogenous particle board bonded with BWP type phenolformaldihyde synthetic resin, partical board core conforming to relevant BS standard or Bangladesh National Building Code or equivalent International standard, 35x12 mm thick teakwood beading all around including preparation of working drawings. godrej or equivalent make mortice lock with handels on both sides,approved anodised fittings like door stopper,300mm long tower bolts,16x300mm long aldrops ,125mm long handles on both sides etc. butt hinges, sliding bolt, knobs, (all fittings shall be anoidised aluminium color dyed), finish synthetic paint over primer, screws etc. all complete as per drawing, specification and instruction of engineer in charge. with prelaminated faces and teak wood edges.	SQM	20	0.00038365
904	Fixing **single or double steel door shutters** with **45mm thk flush design shutter** comprising of two outer sheets of 18 gauge steel sheets rigidly connected and reinforced inside with continuous vertical 20 gauge stiffeners, spot welded in position at not more than 150mm on centres including void filled with mineral wool (density as per specification), all fittings, Godrej or equivalent make mortice lock with handle on both sides, shop and final painting etc all complete as per specification.	SQM	10	0.00005137

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
A909	Providing and fixing **anodised aluminium work** of Jindal, Hindalco or other equivalent approved make for door frames,doors, windows, ventillators, partitions, railing, skylight frames etc with extruded standard tubular and other sections including all fittings & fixtures and accessories of approved make conforming to relevant BS standard or equivalent international standard anodised and electro color dyed to required shade according to relevant BS standard or equivalent international standard (minimum anodic coating of grade AC15), fixed with rawl plugs, expansion fasteners, SS screws or with fixing clips, including necessary filling of gaps at junctions, at top, bottom and sides with required PVC/neoprene felt for bi-mettalic protection etc.including preperation of working drawings, aluminium cleat angle, aluminium snap-on-beading for glazing/panelling, stair case tread nosing, with all fittings and fixtures (like tower bolts, handles, door stopper with rubber shoes, 'L' drops, stays, floor springs, hydraulic door closures etc.), CP brass/stailess steel screws, providing and fixing hinges/pivots, and making provision for fixing of fitting wherever required including cost of PVC/neoprene gasket, all complete as per drawing, specification and instructions of engineer in charge (Glazing and panelling shall be paid seperately).Weight of aluminium section only shall be measure.	Kg	1800	0.01169419
911	Providing and fixing of door closers as per relevant BS code or equivalent international code of approved make & quality all complete of following type :			
a	Over head hydraulic door closures	Each	11	0.00007682
A912	Fixing **pressed steel frames** fabricated from **16 gauge M.S sheet** mortised, reinforced drilled and tapped for hinges and locks bolts strikes, hold fasts adjustable floor anchors, floor tiles/weather bars, paintings etc all complete as per specifications.	Kg	100	0.00002496
913	Fixing **in position rolling shutter of hot rolled double dipped galvanised steel** double walled hollow sections interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation including wire springs, top cover, primer & shop coats of approved enamel paint etc, all complete as per relevant BS code or equivalent international code and specification of approved make of following types: The bottom lath shall be coupled to a lock plate fabricated from 3mm thick galvanised steel plate and securely rivetted with stiffening angles.			
a	**Hand Operated**	SQM	40	0.00043206

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
b	**Mechanically Operated**	SQM	10	0.00012944
915	Providing, fixing and fitting of **glazing of first grade class** in steel/aluminium/wooden frames, where ever required, cleaning after fixing including hardware, gaskets, clips, beadings etc. all complete.			
c	5.5 mm thick clear float glass	SQM	10	0.00013576
f	4 mm thick ground glass	SQM	10	0.00012590
i	Two nos. 6 mm thick clear toughened glass hermetically sealed and separated by 12 mm thick air gap for thermal insulation (only single elevation area to be measured)	SQM	119	0.00399724
	1000 BRICKWORK			
	Brickwork masonry including all labour, material (unless otherwise specified in BOQ/specification), equipment, transportation, handling, scaffolding etc. at all levels as per relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL, specification, drawings and as directed by engineer - in - charge.			
1001AA	Providing masonary work with Autoclaved Aerated Concrete (AAC) block (600 mm x 200 mm, thickness ranging from 201 mm to 400 mm and conforming to Category I of BS EN 771-4) in cement mortar 1:6 (1 part cement, 6 part sand of fineness 1.1) in walls, chambers etc. at all depths, places and positions **below plinth** including raking out joints, curing, scaffolding etc complete (excluding plastering and painting) complete as per relevant BS or equivalent international standards, drawings, specifications, manufacturer's recommendations.	CUM	400	0.03390800
1002A	Providing masonary work with Autoclaved Aerated Concrete (AAC) block [600 mm x 200 mm, thickness ranging from 100 mm to 200 mm, maximum thermal conductivity of 0.18 W/(mK) and conforming to Category I of BS EN 771-4] in cement mortar 1:6 (1 part cement, 6 part sand of fineness 1.1) in walls, chambers etc. at all depths, places and positions **above plinth** including raking out joints, curing, scaffolding etc complete (excluding plastering and painting) complete as per relevant BS or equivalent international standards, drawings, specifications, manufacturer's recommendations.	CUM	3160	0.28009648
	1100 DAMP PROOF COURSE			
	Damp proof course including all labour, material (unless otherwise specified in BOQ/specification), equipment, transportation, handling, shuttering, centering, curing etc at any level as per relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL, specification, drawings and as directed by engineer - in - charge.			

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
1101A	**Providing Damp Proof Course 40mm thick** 1:1.5:3 concrete (10mm and down graded aggregate) with 2% of approved admixture of water proofing compound all complete. Two layers of hot bitumen coating conforming to BS 6398 or equivalent international code shall be applied one before & one after the DPC.	SQM	150	0.00071685
	1200 CEMENT MORTAR PLASTER			
	Cement mortar plaster including making grooves whereever required including all labour, material (unless otherwise specified in BOQ/specification), scaffolding, curing etc at any level as per relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL, specification, drawings and as directed by engineer - in - charge.			
1201	Providing **18mm thick plaster** in two layers **outside** the building/boundary wall in cement **mortar 1:6** on walls, finished to a smooth finish including providing 3mmx3mm size grooves at junctions of two dissimilar materials all complete.	SQM	4300	0.00847742
1202	Providing **12mm thick plaster inside** the building/boundary wall in cement **mortar 1:6** on walls finished to a smooth finish as per specification all complete.	SQM	3950	0.00545446
1204	Providing **6mm thick plaster on ceiling in** cement **mortar 1:4** finished to a smooth all complete.	SQM	1770	0.00213495
1208	Providing **drip coarse** on plastered surface at all elevations for all type of work such as chajjas, parapet, projections etc. including scaffolding, finishing etc. complete with all labour, tools and plants as per specification, drawing and instructions of engineer in charge.	RM	230	0.00004974
	1400 FLOORING AND SKIRTING			
	Flooring and skirting at any level including base layer, labour, material (unless otherwise specified in BOQ/specification), equipments, transportation, handling, curing, polishing etc. at any level as per relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL, specification, drawings and as directed by engineer - in - charge.			
1416	Providing and laying **vitrified ceramic tiles of polished variety** from reputed / approved manufacturer, complete including epoxy grout, underbed of cement mortar 1:3 minimum 20mm thick underbed for flooring and 12mm thick underbed for dado/skirting with neat cement slurry @3.3Kg/sqm etc. all complete for following			
a	600x600x10 mm thick tiles In flooring	SQM	2425	0.04371368

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
b	600x600x10mm thick tiles In skirting and dado upto specific height	SQM	500	0.00898402
	1500 ROOFING / SIDE CLADDING			
	Roofing / side cladding work including all labour, material (unless otherwise specified in BOQ/specification), equipment, transportation, handling, scaffolding, laps, hooks, washers, corner pieces etc. at any level as per relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL, specification, drawings and as directed by engineer - in - charge.			
1508	Providing and installing **under deck insulation** using minimum 0.05 mm thick aluminium foil on exposed surface followed by 0.56 mm dia and 25 mm mesh GI wire netting, fixed at various elevations with rawl plugs including clips but excluding cost of insulation.	SQM	220	0.00139909
1510	Providing and fixing 1 mm thick corrugated/semicorrugated **G.I. sheet in roofs, cladding** of minimum galvanisation of 275 gsm total on both sides with minimum 150mm overlapping, 8 dia G.I. hook bolts or 'J' Bolts and nuts @305 mm c/c along with G.I. and bitumen washers including cutting of sheets for opening etc. all complete.	SQM	220	0.00143753
	1700 RAIN WATER DOWN TAKE PIPES			
	Rain water down take pipes including all labour, material (unless otherwise specified in BOQ/specification), transportation, 2 coats of approved paint over one primary coat, fixtures, accessories etc at any level as per relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL, specification, drawings and as directed by engineer - in - charge.			
1706	**Providing and fixing UPVC down take** pipes of **160mm** diameter-Class C as per BS 3505:1986 or equivalent international code all complete.	RM	320	0.00171162
	1800 MISCELLANEOUS WORKS			
	Miscellaneous works including all labour, material (unless otherwise specified in BOQ/specification), equipment etc. at any level unless otherwise specified as per relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL, specification, drawings and as directed by engineer - in - charge.			

VOLUME-III
PRICE SCHEDULE, REV-0

Package#10E:CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.

TENDER NO - PSER:SITE:KLN-C2019:19

SCH: SERVICE

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
1801	**Providing and Filling in trenches, plinths, area paving and other underground structures with graded stone aggregate of size range 63 mm to 45 mm** in layers not exceeding 230 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	250	0.00744717
1819	Design, supply, fabrication, erection of **stoplog gates, sluice gates etc in CW/RW/etc Pumps** with embedments required, lifting beams, special tools & plants, spare parts for three years, machining, casting, all materials such as structural steel, cast steel, stainless steel, brass used for seals, rubber seals, gears, ball and roller bearing, branch bushings, greasing, bolts, nuts, lugs, threaded fastners etc., cleaning, sand blasting, hot double dip galvanised with minimum coating of zinc 750 gms/sqm., following by an application of etching primer and dipping in black bitumen as per B.S. 3416 or equivalent international code, erection along with a second stage concreting to true plumb and levels, submission of drawings / fabrication drawings for engineers approval etc all complete. The leakage through rubber seal shall not be more than 5 lit/min/metre length of seal under maximum head.(only weight of structural steel including embedments shall be considered for payment purpose) (SS component shall be measured separately for payment) (supply of structural steel is in the scope of contractor only)	MT	15	0.01485622
A1819	Design, supply, fabrication, erection of **stoplog gates, sluice gates etc in CW/RW/etc Pumps** with embedments required, lifting beams, special tools & plants, spare parts for three years, machining, casting, all materials such as structural steel, cast steel, stainless steel, brass used for seals, rubber seals, gears, ball and roller bearing, branch bushings, greasing, bolts, nuts, lugs, threaded fastners, balance valves etc., cleaning, sand blasting, hot double dip galvanised with minimum coating of zinc 900 gms/sqm., following by an application of epoxy primer and epoxy paint as per DIN 12944 or equivalent international code, erection along with a second stage concreting to true plumb and levels, submission of drawings / fabrication drawings for engineers approval etc all complete. The leakage through rubber seal shall not be more than 5 lit/min/metre length of seal under maximum head.(only weight of structural steel including embedments shall be considered for payment purpose) (SS component shall be measured separately for payment) (supply of structural steel is in the scope of contractor only)	MT	1	0.00113897
1820	SS component mentioned under ST No. 1819.	MT	6	0.01535306

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TENDER NO - PSER:SITE:KLN-C2019:19

SCH: SERVICE

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
A1821	Supplying, fabricating, erecting in position and testing / examining bolted and / or welded stainless steel (AISI type Grade 316 Ti) work for **stationary/travelling screens** made out of rolled sections and / or plates including cutting, straightening if required, edge preparation, bolting / welding of joints, cleaning, sand blasting, hot double dip galvanised with minimum coating of zinc as 750 gms./sqm. followed by application of an etching primer and dipping in black bitumen as per BS 3416 or equivalent international code, submission of drawings / fabrication drawings for engineers approval etc all complete. (supply of stainless steel is in the scope of contractor only)	MT	25	0.02622085
A1822	Mud removal from the excavated Area	CUM	400	0.00099939
A1823	Pulling out tilted sheet pile by making temporary platfrom	MT	200	0.01406664
	2100 WATER SUPPLY			
	Water supply work including men, material (unless otherwise specified in BOQ/specification), equipment etc. at any level as per relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL, specification, drawings and as directed by engineer - in - charge.			
2101	Providing and fixing in position tested heavy duty type **chromium plated (CP) brass long neck bib cocks** including sockets, union, nuts etc all complete **- Nominal size 1/2**	EACH	16	0.00015479
2114	Providing & fixing in position UV resitant **glass-fibre reinforced polyethylene water tank** conforming to relevant BS or equivalent international code including making all necessary inlet & outlet pipes, fixture, ball cocks, valves, visible outside water level gauge etc all complete as per specification for following capacities . Pipes shall be paid separately under ST No. 2105A.			
b	2000 litres capacity	EACH	7	0.00154387
c	5000 litres capacity	EACH	3	0.00165418
	2200 SANITARY WORKS			
	Sanitary work including all labour, material (unless otherwise specified in BOQ/specification), equipment etc. at any level as per relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL, specification, drawings and as directed by engineer - in - charge.			

VOLUME-III
PRICE SCHEDULE, REV-0

Package#10E:CiviL, structural & architectural works for Raw water Pump House ,Desilting Chamber,RW Elect Annexe & RW Chlorination for 2X660 MW Maitree Rampal Project, Bangladesh.

TENDER NO - PSER:SITE:KLN-C2019:19

SCH: SERVICE

ST. NO	DESCRIPTION OF ITEM	UNIT	QTY	Weightage
2201	Supply and fixing **glazed vitreous china Wash Basin (minimum size 580x450 mm)** conforming to relevant BS code or equivalent international code of approved shape with R.S. or C.I. brackets painted white, nominal size 1/2 chromium plated brass hot & cold mixing faucets with nylon washers, chromium plated brass chain with rubber plug, nominal size 1 1/4 chromium plated brass bottle trap and waste of standard pattern, nominal size 1 1/4 dia chromium plated brass trap unions, plastic connection pipe with chromium plated nuts, fittings, cutting and making good the walls where required etc all complete.			
a	White	EACH	14	0.00066440
2207	Supply, laying and jointing UPVC pipes conforming to BS EN 13476 or equivalent international code including bends, branches and all other necessary fittings, M.S holder bats/clamps, cutting and making good the walls and floors, jointing, testing etc all complete for following.			
c	160mm dia pipes	RM	280	0.00136840
2211	Providing and fixing **C.I Manhole heavy duty cover of size 600mmx450mm** including frame from reputed manufacture etc. all complete.	EACH	4	0.00011192
2500	**PILING WORK: Piling works including all labour, material (unless otherwise specified in BOQ/contract specification), equipment etc. as per specification, drawings and as directed by engineer - in - charge.**			
2516	Design, supplying, installing of sheet pile for earth protection around foundation as per accepted scheme including material, labour, equipment, consumable etc. all complete complying all safety norms and removal of sheet pile after completion of foundation work. this item to be executed after approval of execution scheme by BHEL Engineer. **[mode of measurement : Area shall be calculated on the basis of exposed sheet pile area above founding level inside excavated pit].** **Payment shall be made 70% after installation and 30% after removal of sheet pile.**	SQM	1700	0.15757173
Total				**0.98663649**

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TENDER NO - PSER:SITE:KLN-C2019:19

SCH: SUPPLY

ST. NO	DESCRIPTION OF ITEM	UNIT	TOTAL QUANTITY	Weightage
	700 MS EMBEDMENTS			
	Embedments including all labour, material (unless otherwise specified in BOQ/specification), equipment, transportation, handling etc. at any level as per specification, drawings, relevant laws of Bangladesh, relavant BS Standards or Equivalent International standards approved by BIFPCL/BHEL and as directed by engineer - in - charge.			
S701	Supply of mild steel embedments, inserts, pipe sleeves, angle pieces, rungs of various diameters, plates of dimensions as required etc. including welding, bolting, cutting, drilling, scaffolding, setting etc. all complete.	MT	22	0.01094697
S704	Supplying of following items in concrete/brickwall for all kind of works, including setting material in concrete, layout, scaffoling, cutting, forming, grinding, drilling, bolting, welding, jointing, testing etc. all complete.			
a	MS pipes of all diameters	Quintal	1	0.00006407
b	PVC pipes / conduits of all diameters	Quintal	1	0.00033156
c	UPVC pipes / conduits of all diameters	Quintal	1	0.00032099
	S900 DOORS, WINDOWS, VENTILATORS, LOUVERS			
	Doors (including master key system), windows, ventilators, louvers, roof ventilators, rolling shutters, partitions including all labour, material (unless otherwise specified in BOQ/specification), equipments, transportation, handling, preparation of working drawings etc. at any level as per specification, drawings, relevant laws of Bangladesh, relavant BS Standards or Bangladesh National building code or Equivalent International standards approved by BIFPCL/BHEL and as directed by engineer - in - charge.			

VOLUME-III
PRICE SCHEDULE, REV-0

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TENDER NO - PSER:SITE:KLN-C2019:19

SCH: SUPPLY

ST. NO	DESCRIPTION OF ITEM	UNIT	TOTAL QUANTITY	Weightage
S904	Providing of **single or double steel door shutters** with **45mm thk flush design shutter** comprising of two outer sheets of 18 gauge steel sheets rigidly connected and reinforced inside with continuous vertical 20 gauge stiffeners, spot welded in position at not more than 150mm on centres including void filled with mineral wool (density as per specification), all fittings, Godrej or equivalent make mortice lock with handle on both sides, shop and final painting etc all complete as per specification	SQM	10	0.00029102
SA912	Providing of **pressed steel frames** fabricated from **16 gauge M.S sheet** mortised, reinforced drilled and tapped for hinges and locks bolts strikes, hold fasts adjustable floor anchors, floor tiles/weather bars, paintings etc all complete as per specifications.	Kg	100	0.00009857
S913	Providing of **rolling shutter of hot rolled double dipped galvanised steel** double walled hollow sections interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation including wire springs, top cover, primer & shop coats of approved enamel paint etc, all complete as per relevant BS code or equivalent international code and specification of approved make of following types: The bottom lath shall be coupled to a lock plate fabricated from 3mm thick galvanised steel plate and securely rivetted with stiffening angles			
a	**Hand Operated**	SQM	40	0.00100837
b	**Mechanically Operated**	SQM	10	0.00030196
Total				**0.01336351**