TENDER SPECIFICATION
BHEL: PSSR: SCT: 1894

FOR

Structural steel works (i.e. transporting from BHEL store, fabrication, erection, alignment including blast cleaning & painting and other allied works) of Ash Handling Plant, Lime Handling Plant and Gypsum Handling Plant at 5x800 MW Yadadri Power project, Veerlapalem village, Dameracherla Mandal, Nalgonda District., Telangana state.

TECHNOCOMMERCIAL BID - Consists of Book- I & Book- II

Book- I Consists of

- **Notice Inviting Tender**
- **Volume-IA: Technical Conditions of Contract**

Book-II consists of

- **Volume-IB: Special conditions of Contract,**
  Rev 01 dated 1st June 2012
  Amendment 01 dated 1st October, 2015
- **Volume-IC: General conditions of Contract**
  Rev 01 dated 1st June 2012,
  Amendment 03 dated 1st October, 2015
- **Volume-ID: Forms & Procedures**
  Rev 01 dated 1st June 2012
  Amendment 01 dt 1st October, 2015

VOLUME –I BOOK – I

BHARAT HEAVY ELECTRICALS LIMITED
(A Government of India Undertaking)
Power Sector – Southern Region
690, Anna Salai, Nandanam, Chennai – 600 035.

TENDER SPECIFICATION CONSISTS OF

Tender Specification

- **Volume - I**
  - **Book-I**
    - **Notice Inviting Tender**
    - **Volume-IA: Technical Conditions of Contract**
      - **Part I**
      - **Part II**
  - **Book-II**
    - **Volume-IB: Special conditions of Contract**
      Rev 01 dated 1st June 2012
      Amendment 01 dated 1st October 2015
    - **Volume-IC: General conditions of Contract**
      Rev 01 dated 1st June 2012,
      Amendment 03 dated 1st October, 2015
    - **Volume-ID: Forms & Procedures**
      Rev 01 dated 1st October, 2015
      Amendment 01 dt 1st October, 2015
- **Volume – II: Price Bid**

NOTICE INVITING TENDER

Bharat Heavy Electricals Limited

Ref: BHEL: PSSR: SCT: 1894 **Date: 12 March 2020**

NOTICE INVITING TENDER (NIT)

Submission only through E-Procurement Portal

https://bhel.abcprocure.com

Note: Bidder may download Tender Document from web sites

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To
Dear Sir/Madam

Sub: NOTICE INVITING TENDER

Online Sealed offers in two part bid system (National competitive bidding (NCB)) are invited from reputed & experienced bidders (meeting PRE QUALIFICATION CRITERIA as mentioned in Annexure-I) **through E-Procurement Portal** https://bhel.abcprocure.com only, for the subject job by the undersigned on the behalf of BHARAT HEAVY ELECTRICALS LIMITED as per the tender document. 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**	**BHEL: PSSR: SCT: 1894**	
ii)	**Broad Scope of job**	Structural steel works (i.e. transporting from BHEL store, fabrication, erection, alignment including blast cleaning & painting and other allied works) of Ash Handling Plant, Lime Handling Plant, and Gypsum Handling Plant at 5x800 MW Yadadri Power project, Veerlapalem village, Dameracherla Mandal, Nalgonda District., Telangana state.	
iii)	**DETAILS OF TENDER DOCUMENT**		
A	Volume-IA	Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc.,	Applicable
B	Volume-IB	Special conditions of Contract, Rev 01 dated 1st June 2012, Amendment 01 dated October 01, 2015	Applicable
C	Volume-IC	General conditions of Contract Rev 01 dated 1st June 2012, Amendment 03 dated October 01, 2015	Applicable

D	Volume-ID	Forms & Procedures Rev 01 dated 1st June 2012 Amendment 01 dated October 01,2015	Applicable
E	Volume-II	Price Schedule (Absolute value).	Applicable
iv)	Issue of Tender Documents	**1. This is an E-tender floated online through our E-Procurement Portal** https://bhel.abcprocure.com **2. Sale** **Start: 12.03.2020** **Close:** Tender documents can be downloaded till closing time for offer submission. **3. From**: BHEL website (www.bhel.com -> Tender Notifications). Tender documents for bidder's reference can be downloaded from this website till due date of submission.	Applicable
v)	Due Date & Time of Offer Submission	**Date:26.03.2020, Time :15.00 Hrs** The bidder should submit their offer online in e-Procurement portal at https://bhel.abcprocure.com. ***Bidders are requested to upload their offer well in advance in order to avoid last minute congestion at this website.*** **Hard copy bid or bids through E-mail / fax shall not be accepted.**	Applicable
vi)	Opening of Tender	**Date: 26.03.2020, Time :15.30 Hrs** 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 record their presence online, during tender opening. However, this being an e-tender it shall be opened online.	Applicable
vii)	EMD Amount	**Rs.51,00,000/-** (Rupees Fifty-One Lakhs only). - Refer Vol-1A Part-II Chapter-1 of Technical Conditions of Contract (Volume-I, Book-I) for mode of payment of EMD. - Exemption of EMD for MSEs is not applicable for this tender. - One time EMD is not applicable for this tender.	Applicable

viii)	Cost of Tender	**Rs. 2,000/-** (Rupees Two Thousand Only) - Cost of tender shall be remitted through, Electronic Fund Transfer credited in BHEL account or Banker's cheque or Pay order or Demand draft, in favour of BHEL. - Exemption of Cost of Tender for MSEs is not applicable for this tender. - Originals shall be sent to "BHEL-PSSR, EVR Periyar Building, 690, Anna Salai, Nandanam, Chennai – 600035'.	Applicable
ix)	Last Date For Seeking Clarification	Bidders may submit their queries in https://bhel.abcprocure.com at least 7 days before the due date of offer submission or two days before the scheduled date of pre-bid meeting whichever is earlier along with soft version also, addressing to undersigned & to others as per contact address given above.	Applicable
x)	Schedule of Pre Bid Discussion (PBD)	Date**:18.03.2020** Time **11.00AM** at BHEL:PSSR:Chennai-35	Applicable
xi)	Integrity Pact & Details of Independent External Monitor (IEM)	a. Integrity Pact (IP) is a tool to ensure that activities and transactions between the company and its Bidders / Contractors are handled in a fair, transparent and corruption free manner. Following Independent External Monitors (IEMs) on the present panel have been appointed by BHEL with the approval of CVC to oversee implementation of IP in BHEL.: 1. Shri. Arun Chandra Verma, IPS(Retd.) E Mail: acverma1@gmail.com 2. Shri. Virendra Bahadur Singh, IPS (Retd.), E Mail: vbsinghips@gmail.com b. The IP as per format given at Volume IA Part II of this tender is to be submitted (duly signed by the authorized signatory) along with Techno Commercial Bid (Part-1, 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.	**Applicable**

		c. Please refer section- 8 of the IP (refer the format given at Volume IA Part II of this tender) 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 IEMs. All correspondence with the IEMs shall be done through E-mail only. Note: No routine correspondence shall be addressed to the IEM (Phone / Post / E mail) 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 department's officials whose contact details are provided below:	
	Contact Details	For all clarifications /issues related to the tender, please contact: 1. Ms. Asha Alex, SDGM/ SCT BHEL-PSSR 690 Anna Salai, Nandanam, Chennai-35 044-28286714 ashaalex@bhel.in 2. Mr. Sandipan Biswas, AGM/ SCT & Purchase BHEL-PSSR 690 Anna Salai, Nandanam, Chennai-35 044-28286757/ 044-24348943 bsandipan@bhel.in	
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 → Tender Notifications), CPP Portal (https://eprocure.gov.in) & portal **https://bhel.abcprocure.com.** Bidders to keep themselves updated with all such information. This also form part of tender hence the same shall be enclosed with their offer.	

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 & stamped on each page, as part of offer**. **Rates / Price including discounts / rebates, if any, mentioned anywhere / in any form in the techno-commercial offer other than the Price Bid, shall not be entertained.**

3.0 Unless specifically stated otherwise, Bidder shall remit cost of tender through, Electronic Fund Transfer credited in BHEL account or Banker's cheque or Pay order or Demand draft, in favour of BHEL.

4.0 Unless specifically stated otherwise, bidder shall deposit **Earnest Money Deposit (EMD) as mentioned in Volume IA, Part-II, Chapter-1** of Technical Conditions of Contract (Volume-I Book-I) under the heading 'Modes of Deposit of EMD'. Please note that 'One Time EMD' shall not be considered. **It is to be noted that proof of remittance for EMD shall be made available at BHEL PSSR Office prior to tender opening.**

5.0 **Procedure for Submission of Tenders**: This is an E-tender floated online through our E-Procurement portal https://bhel.abcprocure.com . The bidder should respond by submitting their offer online only in our e-Procurement portal at https://bhel.abcprocure.com . Hard copy bid or bids through email/ fax shall not be accepted.

I. Pre-requisite for Offer Submission: -

Digital Certificate: To participate in an e-Tender, you need to have a Class-II/III Digital Signature Certificate (DSC) for Signing & Encryption (Required both digital signature certificate: Signing & Encryption) of bids issued by any of the valid Certifying Authorities (approved by Controller of Certifying Authorities) in India. Valid Digital Signature Certificate (DSC) must be installed in a computer system from where you want to access the website.

MINIMUM REQUIREMENT: (Mandatory)

- Computer with good Internet Connection.
- Operating System should be Windows Vista / Windows 7 and above.
- Web Browsers: Internet Explorer 9.0 (32-bit Browser only) & above.
- System Access with Administrator Rights.

At first time login, to verity and approve your login profile & DSC, you are requested to contact e-Procurement Service Provider.
Also please Refer "Bidder Manual for BHEL Bidders" and "Minimum System Requirements and Settings Document for BHEL user & Bidders" available at https://bhel.abcprocure.com .

II. Digital Signing of e-Tender

Tenders shall be uploaded with all relevant documents in PDF/zip format. The relevant tender documents should be uploaded by an authorized person having Class-II/III Digital Signature Certificate (DSC) for Signing & Encryption.

i) The Requirement:

a. A PC with Internet connectivity &
b. DSC (Digital Signature Certificate) Class-II/III Digital Signature Certificate (DSC) for Signing & Encryption)

Vendors are also requested to go through bidder manual available on https://bhel.abcprocure.com

III. E-procurement service Provider-:

Address:

e-Procurement Technologies Limited (abcProcure),

Head Office: B-704/705, Wall Street - II, Opp. Orient Club,

Nr. Gujarat College, Ellis Bridge, Ahmedabad - 380 006, Gujarat (India)

Timing:

Indian Standard Time (+5:30 GMT): 10:00 AM - 07:00 PM (Monday to Friday)

Indian Standard Time (+5:30 GMT): 10:00 AM - 04:00 PM (Saturday)

The contact details of the service provider are given below:

Contact: +91-79-68136819/809/862/867/823/872/842

E-Mail: Bhel.Support@abcProcure.com

Further contact details can be obtained by visiting the following webpage:

https://bhel.abcprocure.com/EPROC/contactus

IV. Documents Comprising the e-Tender

The tender shall be submitted online – only except tender fee & EMD (in physical form) as mentioned below:

i) Technical Tender (UN priced Tender)

Bidders shall furnish the following information along with technical tender (preferably in pdf format):

i). Tender Cost and Earnest Money Deposit (EMD) furnished in accordance with **NIT Clause 3.0 & 4.0.**

ii). All Technical details (eg. Eligibility Criteria requested, Technical Conditions of Contract) should be attached in e-tendering module **(As detailed in Clause 6.0 below),** failing which the tender stands invalid & may be REJECTED.

ii) Price Bid:

a. Prices are to be quoted as per the Price Bid Form available on e-tender portal.
b. The price should be quoted for the accounting unit indicated in the e-tender document.
c. The item description, Quantity and Unit of measurement, as mentioned in Price bid uploaded by BHEL and subsequent revisions issued by BHEL, shall be binding on the bidder.

Note:

i). It is the responsibility of tenderer to go through the Tender document to ensure furnishing all required documents in addition to above, if any. Any deviation would result in REJECTION of tender and would not be considered at a later stage at any cost by BHEL.
ii). A person signing (manually or digitally) the tender form or any documents forming part of the contract on behalf of another shall be deemed to warrantee that he has authority to bind such other persons and if, on enquiry, it appears that the persons so signing had no authority to do so, the purchaser may, without prejudice to other civil and criminal remedies, cancel the contract and hold the signatory liable for all cost and damages.
iii). A tender, which does not fulfil any of the above requirements and/or gives evasive information/reply against any such requirement, shall be liable to be ignored and rejected.
iv). In case offer is sent through hard copy/fax/telex/cable/electronically in place of e-tender, same shall not be considered.

V. DO NOT'S

Bidders are requested NOT to submit the hard copy of the Bid. In case offer is sent through hard copy/fax/telex/cable/electronically in place of e-tender, the same shall not be considered.

Vendors are also requested to go through bidder manual available on https://bhel.abcprocure.com

6.0 DOCUMENTS TO BE UPLOADED & MODALITY OF UPLOADING in E-PROCUREMENT PORTAL https://bhel.abcprocure.com SHALL BE AS DETAILED BELOW

Sl No	Description	Remarks
	Techno-Commercial Bid CONTAINING THE FOLLOWING:-	
i.	Covering letter / Offer forwarding letter of Tenderer.	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
ii.	Duly filled-in `No Deviation Certificate' as per prescribed format to be placed after document under sl no (i) above. **Note:** 1. In case of any deviation, the same should be submitted separately for technical & commercial parts, indicating respective clauses of tender against which deviation is taken by bidder. The list of such deviation shall be attached along with document under sl no (i) above. It shall be specifically noted that deviation recorded elsewhere shall not be entertained. 2. 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.	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
iii.	Supporting documents / annexure / schedules / drawing etc as required in line with Pre-Qualification criteria. (Technical & Financial) As detailed in Clause No. 25 of NIT, it shall be specifically noted that all documents as	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com

	per above shall be indexed properly and credential certificates issued by clients shall distinctly bear the name of organization, contact phone no, FAX no, E-mail ID, etc.	
iv.	All Amendments / Correspondences / Corrigenda / Clarifications / Changes / Errata etc pertinent to this NIT.	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
v.	Integrity Pact Agreement (Duly signed by the authorized signatory)	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
vi.	Duly filled-in annexures, formats etc as required under this Tender Specification / NIT	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
vii.	Notice inviting Tender (NIT)	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
viii.	Volume – I A : Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc	
ix.	Volume – I B : Special Conditions of Contract (SCC)	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
x.	Volume – I C : General Conditions of Contract (GCC)	
xi.	Volume – I D : Forms & Procedures	
xii.	Volume – II (UNPRICED – without disclosing rates/price, but mentioning only 'QUOTED' or 'UNQUOTED' against each item	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
xiii.	Any other details preferred by bidder with proper indexing.	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com

Caution to Bidders: -

The duly signed & stamped copies of Volume – 1 Book I & Volume 1 Book II are to be attached as a part of your offer, under the form Techno-commercial Bid. Also for any further queries, please refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com

	PRICE BID consisting of the following shall be attached as mentioned below	
i	**Price/ Total Amount corresponding to the total works as specified in "Part C: Bill of Quantities" available in "Volume II – PRICE BID (latest Revision) shall be quoted in the Price Bid Form available in e-Procurement portal.** **Bidders to note that total amount quoted by the bidder in Price Bid - "Bidding Forms" of e-Procurement Portal shall be considered for evaluation of offer.**	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com

SPECIAL NOTE:

i. All documents / annexures submitted with the **offer shall be properly attached / entered / uploaded in the respective sections**. BHEL shall not be responsible for any missing documents.

ii. **Your offer & documents submitted along with offer shall be signed & stamped in each page by your authorized representative**.

7.0 Deviation with respect to tender clauses and additional clauses / suggestions / in Techno-commercial bid / Price bid shall NOT be considered by BHEL. Bidders are requested to positively comply with the same.

8.0 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).

9.0 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 of 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 'six 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 = $\mathbf{P_T}$ (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 '$\mathbf{T_T}$' for total similar Packages '$\mathbf{P_T}$' for all Regions (i.e. $\mathbf{T_T} = T_1 + T_2 + T_3 + T_4 + ..T_N$)

c) Sum 'S_1 'of 'Monthly Performance Evaluation' Scores (S_{1-1}, S_{1-2}, S_{1-3}, S_{1-4}, S_{1-5}…. S_{1-T1}) for similar package P1, for the 'period of assessment' 'T_1' (i.e. $S_1 = S_{1-1} + S_{1-2} + S_{1-3} + S_{1-4} + S_{1-5} + \ldots S_{1-T1}$). 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 ie Sum (Σ) of columns (iii) to (ix)

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

ii.) <u>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'.</u>

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. '$\mathbf{R_{BHEL}}$' 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. six 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, '$\mathbf{R_{BHEL}}$' 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 PMax 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 & CI	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). CI iii). Others (Elec & CI)	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.

10.0 Performance evaluation in Clause 9 above is applicable to Prime bidder and consortium partner (or Technical tie up partner) for their respective scope of work.

11.0 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.

12.0 For any clarification on the tender document, the bidder may seek the same in clarification provision available in procurement portal https://bhel.abcprocure.com or writing or 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 postal delay or any other delays. Any clarification / query received after last date for seeking clarification may not be normally entertained by BHEL and no time extension will be given.

13.0 BHEL may decide holding 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.

14.0 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.

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

16.0 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 Integrity pact is to be submitted by Prime Bidder & Consortium / Technical Tie up partner jointly in case Consortium bidding is permitted, otherwise by the sole bidder. The names and other details of Independent External Monitor (IEM) for the subject tender is as given at point (1) above.**

17.0 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.

18.0 In case BHEL decides on a 'Public Opening', the date & time of opening of the sealed PRICE BID shall be intimated to the qualified bidders and in such a case, bidder may depute one authorized representative to witness the price bid opening. BHEL reserves the right to open 'in-camera' the 'PRICE BID' of any or all Unsuccessful / Disqualified bidders under intimation to the respective bidders.

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

20.0 Void

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

22.0 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.

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

24.0 Void

25.0 The bidder shall submit documents in support of possession of 'Qualifying Requirements' duly self-certified and stamped 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.

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

27.0 The offers of the bidders who are under suspension 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 web site "www.bhel.com → tender notification".

28.0 It may be noted that guidelines / rules in respect of 'Suspension of Business dealings' available on BHEL web site "www.bhel.com → **Supplier**

Registration", 'Vendor evaluation format', Quality, Safety & HSE guidelines', etc may undergo change from time to time and the latest one shall be followed.

29.0 The Bidder along with its associate/ collaborators/ sub-contractors/ sub-vendors/ consultants/ service providers shall strictly adhere to BHEL Fraud Prevention Policy displayed on BHEL website **http://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.

30.0 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.

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

31.1 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.

31.2 Commitment by Bidder / Supplier / Contractor:

31.2.1 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, 1894 or any other law in force in India.

31.2.2 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.

31.2.3 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.

31.3 If any bidder / supplier / contractor during pre-tendering / tendering / post tendering / award / execution / post-execution stage indulges 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, 1894 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.

32.0 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.

33.0 In the course of evaluation, if more than one bidder happens to occupy L-1 status, effective L-1 will be decided by soliciting discounts from the respective L-1 bidders.
In case more than one bidder happens to occupy the L-1 status even after soliciting discounts, the L-1 bidder shall be decided by a toss/ draw of lots, in the presence of the respective L-1 bidder(s) or their representative(s).
Ranking will be done accordingly. BHEL's decision in such situations shall be final and binding.

34.0 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
d. Technical Conditions of Contract (TCC)—Volume-1A
e. Special Conditions of Contract (SCC) —Volume-1B
   Rev. 01 Dt. 01 Jun 2012; Amendment: 01 Dt. 1st October 2015
f. General Conditions of Contract (GCC) —Volume-1C
   Rev. 01 Dt. 01 Jun 2012; Amendment: 03 Dt. 1st October 2015
g. Forms and Procedures —Volume-1D
   Rev. 01 Dt. 01 Jun 2012; Amendment: 01 Dt. 1st October 2015

For and on behalf of BHARAT HEAVY ELECTRICALS LTD

Additional General Manager / SCT & Purchase

Enclosure

1. Annexure-1: Pre Qualifying criteria.
2. Annexure-2: Check List.

3. Annexure-3 Technical Pre qualifying criteria.
4. Annexure-4 Annexure to Pre-Qualifying Criteria.
5. Annexure-5 Tender Schedule.
6. Other documents as per this NIT.

ANNEXURE - 1
PRE QUALIFYING CRITERIA

JOB	Structural steel works (i.e. transporting from BHEL store, fabrication, erection, alignment including blast cleaning & painting and other allied works) of Ash Handling Plant, Lime Handling Plant and Gypsum Handling Plant at 5x800 MW Yadadri Power project, Veerlapalem village, Dameracherla Mandal, Nalgonda District., Telangana state		
Tender No.	**BHEL: PSSR: SCT: 1894**		
Sl. No.	**PRE QUALIFICATION CRITERIA**	**Bidders claim in respect of fulfilling the PQR Criteria**	
		Name and Description of qualifying criteria	**Page no of supporting document. Bidder must fill up this column as per applicability**
A	**Submission of Integrity Pact duly signed (if applicable)** (**Note**: To be submitted by Prime Bidder & Consortium / Technical Tie up partner jointly in case Consortium bidding is permitted, otherwise by the sole bidder)	Applicable	
B	**Technical**		
	Refer Annexure 3	Applicable	To be filled in Annexure-4
C C-1	**FINANCIAL** **Turnover** Bidders must have achieved an average annual financial turnover (Audited) of Rs. 12,30,00,000/- (Rupees Twelve Crores Thirty Lakhs only) or more over last three Financial Years (FY) i.e., 2016-17, 2017-18 and 2018-19.	Applicable	To be filled in Annexure-4
C-2	**Net worth** (only in case of Companies) Net worth of the Bidder based on the latest Audited Accounts as furnished for 'C-1' above should be positive	Applicable	To be filled in Annexure-4
C-3	**Profit** Bidder must have earned profit in any one of the three Financial Years as applicable	Applicable	To be filled in Annexure-4

	in the last three Financial Years as furnished for 'C-1 above.		
C-4	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.	Applicable	To be filled in Annexure-4
D	Assessment of Capacity of Bidder to execute the work as per Sl. No 9 of NIT (if applicable)	Applicable	By BHEL
E	**Approval of Customer (if applicable)** **Note:** Names of bidders who stand qualified after compliance of criteria A to D shall be forwarded to customer for their approval.	Applicable	
F	**Price Bid Opening** **Note:** Price Bids of only those bidders shall be opened who stand qualified after compliance of criteria A to E	Applicable	BY BHEL
G	**Consortium criteria (if applicable)**	Not Applicable	
	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 against C-1 above along with all annexures. 2. In case audited financial statements have not been submitted for all the three years as indicated against C-1 above, then the applicable audited statements submitted by the bidders against the requisite three years, will be averaged for three years. 3. 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. 4. C-2:-NETWORTH: Shall be calculated based on the latest Audited Accounts as furnished for C-1 above. Net worth =Paid up share capital* + reserves (* Share capital OR Partnership Capital OR Proprietor Capital as the case may be) (Net worth is required to be evaluated in case of companies). 5. C-3:- PROFIT : shall be PBT earned during any one year of the three financial years as in C-1 above 6. For Evaluation of PQR, the credential of the Bidder alone, and not that of the Group Company shall be considered.		

	7. Completion date for achievement of the technical criteria specified in the Common QR should be in the last 7 years ending on the 'latest date of Bid Submission' of Tender irrespective of date of the start of work. 8. Boiler means HRSG or WHRB or any other types of Steam Generator 9. Power Cycle piping means Main Steam, Hot Reheat, Cold Reheat, HP Bypass. 10. 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. 11. 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. 12. Scope for capital overhaul of STG shall cover Bearing Inspection work and overhauling of all cylinders of the Turbine. 13. In case the tendered scope is not a Pulverized Fuel Bidder, experience of Oil/Gas Fired Boilers can be considered unless otherwise specifically indicated in the PQR. 14. No consortium bid is allowed for this Tender. However, for the purpose of qualification, after successful execution of one similar work with a consortium partner under direct orders from 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.

Note:

(i) BIDDER SHALL SUBMIT PRE-QUALIFICATION CRITERIA FORMAT (Refer Annexure-4), DULY FILLED-IN, SPECIFYING RESPECTIVE ANNEXURE NUMBER AGAINST EACH CRITERIA AND FURNISH RELEVANT DOCUMENT INCLUSIVE OF WORK ORDER AND WORK COMPLETION CERTIFICATE ETC. IN THE RESPECTIVE ANNEXURES IN THEIR OFFER.

(ii) Authenticity of Credentials submitted by the Bidder against 'Pre-Qualifying Criteria' shall be verified from the Issuing Authority, by BHEL. In case, any credential(s) is/are found to be unauthentic, offer of the bidder is liable to be rejected. BHEL reserves the Right to Initiate any further action as per the "Guidelines for Suspension of Business Dealings with Suppliers/Contractors" (Published in http://www.bhel.com/vender_registration/vender.php) and "Fraud Prevention Policy" (Published in http://www.bhel.com/home.php) as applicable.

ANNEXURE - 2

CHECK LIST

NOTE: - Tenderers are required to either fill in or submit separately the following details. No column should be left blank.

1	Name of the Tenderer			
	Address of the Tenderer			
2	Details about type of the Firm / Company			
3a	Details of Contact person for this Tender: Name : Mr. / Ms. Designation: Telephone No/ Mobile No: E-mail ID:			
3b	Details of alternate Contact person for this Tender: Name: Mr. / Ms. Designation: Telephone No/ Mobile No: E-mail ID:			
4	EMD DETAILS *(Remittance of EMD should be in line with Mode of Deposit as detailed in Vol 1A, Part-2, Chapter-1)* a. Cash portion of EMD – online payment/ DD/ Cheque (Minimum Rs 2 Lakhs) b. Balance portion of EMD (Over and above Rs. 2 Lakhs) (Applicable only for BG/FD)	a. Mode of Remittance: Ref No: Date : Amount: b. Mode of Remittance: Ref No : Date :		
5	Validity of Offer	To be valid for six months from due date		
			Applicability (By BHEL)	**Bidder Reply**
6	Whether the format for compliance with **PRE QUALIFICATION CRITERIA (ANNEXURE-I & ANNEXURE-IV)** is understood and filled with proper supporting documents referenced in the specified format		Applicable	Yes/ No
7	Submission of Copy of Balance sheet and Profit and Loss Account for the last three years (Refer "Explanatory Note for the PQR" in Annexure 1 of NIT)		Applicable	Yes/ No
8	Submission of Copy of PAN Card		Applicable	Yes/ No

9	Whether all pages of the Offer Documents are signed by the person authorized to sign this offer	Applicable	Yes/ No
10	Whether all pages of the Tender documents including annexures, appendices etc are read understood and signed	Applicable	Yes/ No
11	Submission of Integrity Pact	Applicable	Yes/ No
12	Submission of Declaration by Authorized Signatory	Applicable	Yes/ No
13	Submission of No Deviation Certificate	Applicable	Yes/ No
14	Submission of Declaration confirming knowledge about Site Conditions	Applicable	Yes/ No
15	Submission of Declaration for relation in BHEL	Applicable	Yes/ No
16	Submission of Non-Disclosure Certificate	Applicable	Yes/ No
17	Submission of Copy Bank Account Details for E-Payment	Applicable	Yes/ No
18	Submission of Capacity Evaluation of Bidder for current Tender	Applicable	Yes/ No
19	Submission of Tie Ups / Consortium Agreement as per format	Not Applicable	
20	Submission of Power of Attorney for Submission of Tender / Signing Contract Agreement	Applicable	Yes/ No
21	Submission of Analysis of Unit rates	Applicable	Yes/ No
22	Submission of Unquoted Price Bid	Applicable	Yes/ No
23	Tabular column showing Category- wise, month wise, man power deployment sub package wise planned for the execution of the scope of works.	Applicable	Yes/ No
24	Declaration by bidder for price opening through Reverse Auction	Not Applicable	
25	Copy of Organization Chart	Applicable	Yes/ No
26	Copy of Registration / Incorporation certificate, Partnership Deed (Certified by Notary Public) as applicable for firm.	Applicable	Yes/ No
27	Undertaking as per Financial C 4 Criteria of Annexure 1 of NIT regarding Bankruptcy Code Proceedings (IBC)	Applicable	Yes/ No

NOTE:

1. STRIKE OFF 'YES' OR 'NO', AS APPLICABLE.
2. TENDER NOT ACCOMPANIED BY THE PRESCRIBED **ABOVE APPLICABLE DOCUMENTS** ARE LIABLE TO BE SUMMARILY REJECTED.
3. For Sl. No.12, 14 to 21 above, the formats are available in "Volume ID of Volume I Book-II – Forms and Procedures" of this tender specification.

DATE:

AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

Annexure-3

B Technical Pre-Qualification Criteria

B.1. Technical Qualification Criteria

Bidder should have executed "Similar works" for any one of the following in the last seven years preceding the latest due date of bid submission

B.1.1 One (1) work of value not less than **Rs. 32.79 Crores**

(OR)

B.1.2 Two (2) works each of value not less than **Rs. 20.50 Crores**

(OR)

B.1.3 Three (3) works each of value not less than **Rs. 16.40 Crores**

(AND)

B.2. Bidder should have executed the following in the last seven years preceding the latest due date of bid submission.

B.2.1 Structural works:

Executed the Structure work for

(A) At least 2,700 MT of Structure Fabrication work within a common period of twelve consecutive months in cumulative of two running/completed contracts.

AND

At least 2,700 MT of Structure Erection work within a common period of twelve consecutive months in cumulative of two running/completed contracts.

(OR)

(B) At least 1,800 MT of Structure Fabrication work, completed within a period of twelve consecutive months in one running/completed contract.

AND

At least 1,800 MT of Structure Erection work, completed within a period of twelve consecutive months in one running/completed contract.

Note: -

I. 'Similar Works' in the QR B.1 means 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.

II. Value of work in 'B.1' 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-

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

Where

P = Updated value of work

R = Value of executed work

X_N = All India Avg. Consumer Price index for industrial workers for the month, three months prior to the month of latest due date of bid submission (e.g. If latest bid submission date is 03-Apr-17, then bid submission month shall be reckoned as April'17 and index for Jan'17 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 the month, three months prior to the month of latest due date of bid submission (e.g. If latest bid submission date is 03-Apr-17, then bid submission month shall be reckoned as April'17 and index for Jan'17 shall be considered).

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

III. The term 'Executed' in the above QR (B.1 & B.2) means; the bidder should have achieved the criteria specified even if the contract has not been completed or closed.

IV. In case the bidder is a subsidiary but does not meet the requirement of Clause B.1 & B.2 above, then, the credentials of their parent / holding company shall be considered for satisfying the PQR subject to the following:

i. The parent / holding company shall have a controlling stake of 50% or more in the bidder organization /company.

ii. The parent / holding company provides an undertaking that they are jointly and severally responsible for successful performance of the contract.

V. Completion date of achievement of the technical criteria (B.1 & B.2) should be in last 7 years ending on the 'latest date of bid submission' of tender irrespective of date of start of work.

ANNEXURE - 4

Additional Format to be submitted by Bidders in an additional separate cover superscribed "Annexure to Pre-Qualifying Criteria".

Name of the Bidder: M/s……...

Sl. No.	PQR Ref	PQR (Reproduced from Annexure – 1)	Qualifying Experience	Work order Ref with page no in Offer for supporting documents	Completion certificate ref for the referred Work with page no in Offer for supporting documents	Details of work with Project, Unit, Quantity / rating & Period	Rem-arks
1	**Technical B:**	**B.1. Technical Qualification Criteria** Bidder should have executed "Similar works" for any one of the following in the last seven years preceding the latest due date of bid submission B.1.1 One (1) work of value not less than **Rs. 32.79 Crores** (OR) B.1.2 Two (2) works each of value not less than **Rs.20.50 Crores** (OR) B.1.3 Three (3) works each of value not less than **Rs.16.40 Crores** (AND)					

		B.2. Bidder should have executed the following in the last seven years preceding the latest due date of bid submission. B.2.1 Structural works: Executed the Structure work for (A) At least 2,700 MT of Structure Fabrication work within a common period of twelve consecutive months in cumulative of two running/completed contracts. AND At least 2,700 MT of Structure Erection work within a common period of twelve consecutive months in cumulative of two running/completed contracts. (OR) (B) At least 1,800 MT of Structure Fabrication work, completed within a period of twelve consecutive months in one running/completed contract. AND At least 1,800 MT of Structure Erection work, completed within a period of twelve consecutive months in one running/completed contract.					

2	**Financial C1**	**TURNOVER** Bidders must have achieved an average annual financial turnover (Audited) of Rs.12,30,00,000/- (Rupees Twelve Crores Thirty Lakhs only) or more over last three Financial Years (FY) i.e. 2016-17, 2017-18 and 2018-19.					
3	**Financial C2**	**NET WORTH** (only in case of Companies) Net worth of the Bidder based on the latest Audited Accounts as furnished for 'C-1' above should be positive					
4	**Financial C3**	**PROFIT** Bidder must have earned profit in any one of the three Financial Years as applicable in the last three Financial Years as furnished for 'C-1 above.					
5	**Financial C4**	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.					

Note: Indicate the page nos in the respective columns for the enclosed PQR supporting documents in the offer

ANNEXURE-5

Tender Schedule

Description	Schedule	Remarks
Technical Bid Opening	As mentioned in Notice Inviting Tender.	
Communication from BHEL for Clarifications, if any, required by BHEL	Within Three days from tender opening date	
Last date for Bidders to submit the clarifications/ documents required	Within Six days from tender opening date	Bidders to note that their competent representative to be readily available in this week for offering clarifications/ submitting the further documents, if any, required.

Note:

1. Bidders to note that the above schedule should be adhered to and no further extension will be given. To adhere to the schedule indicated below, Bidders should ensure the adequacy of the documents submitted in their offer, with proper validation.

VOLUME – IA
Part I & II

TECHNICAL CONDITIONS OF CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED

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VOLUME - IA PART – I CHAPTER – I

PROJECT INFORMATION

INTRODUCTION

5 x 800 MW Yadadri Thermal power station is being set up by **TELANGANA STATE GENERATION CORPORATION** at a site in Veerlapalem village, Dameracherla Mandal, NALGONDA DISTRICT, TELANGANA STATE, India. The Bidder shall acquaint himself by a visit to the site, if felt necessary, 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 BHEL/Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

A. PROJECT INFORMATION

1	Name of the Project	YADADRI Thermal Power Station
2	Station Capacity	5X800 MW (Coal based)
3	Owner	Telangana State Power Generation Corporation Limited (TSGENCO)
4	Site Location	Site is located 7 km from the SH 2 Miryalaguda - Vadapalle Highway.
5	Latitude	*16° 42'*20.40 N
6	Longitude	79° 34'41.56 E
7	Nearest Town	30 Km Miryalaguda
8	Nearest Railway Station	6.5 Km Damercherla
9	Nearest Airport	130 Kms (Vijayawada)
10	Site Conditions	
	Ambient Temperature	
	Daily minimum (average)	10°C
	Daily maximum (average)	47°C

	Design Ambient Temperature	50°C
	Ambient temperature (performance)	38°C
	Relative Humidity for design / efficiency	48-84 %
	Annual rainfall, mm	600 mm
	Plant Elevation above MSL	85 m above MSL
	Mean Wind Speed	8 km/h
	Wind Pressure	As per the latest revision of IS 875/1987
	Seismic co-efficient	Zone-II as per IS- 1893 (Part-IV)

VOLUME-IA PART-I CHAPTER – II

SCOPE OF WORKS

1.2.1 The scope of works covers Structural steel works (i.e. transporting from BHEL store, fabrication, erection, alignment including blast cleaning & painting and other allied works) of Ash Handling System (AHP), Lime Handling system (LHP) & Gypsum handling system (GHP) of all units (i.e., Unit 1 to 5) of 5 x 800MW Yadadri TPS as mentioned below, including supply of all materials (excluding Free issue Materials by BHEL for incorporation in the permanent works i.e. Structural steel for structural works (as specified in BOQ)), labour, tools and plants. The scope of work is indicative but not limited to the given below.

The list of structures and buildings are mentioned below.

AREAS OF WORK

1. Ash Handling Plant Pipe Rack
2. Silo Buildings
3. Cable Rack
4. Lime Stone Shed
5. Lime Stone Hopper
6. Lime Stone Conveyor - 1AB
7. Pent House for Lime Stone - 1AB
8. Lime Stone Crusher House
9. Belt Feeder (BF) Conveyor
10. Bucket Elevator
11. Belt Weigh Feeder (BWF) Conveyor
12. Gypsum Conveyor 1A/B (GHS 1A/B)
13. Gypsum Storage Shed
14. Gypsum Drive House
15. Miscellaneous AHP, LHP & GHP structures

The following Structures falling outside plant boundary are also included in the scope of works under this tender:

a. Pipe rack up to silo area

b. Silo cum HCSD complex (Silo, silo utility cum HCSD pump houses, MCC room, Weighbridge, Drain water sump with pumps, Seal water pump with sumps, Ash conditioner water tank, etc.)

c. Ash water recovery system in dyke area (Ash water recovery cum recycle pump house, Clarifiers, sludge pump with tank, MCC room, etc.)

Note: The above provided list is indicative only for the bidder's guideline. Any other structure not mentioned above, but required for completion of the package in total, deemed to have been included in the bidder's scope under this contract. Such work will be executed under this contract by bidder as per the direction of Engineer in charge. If any item of work not available in the rate schedule of this contract, the rate will be fixed in line with clause 2.15.7 of GCC.

1.2.2 Bidder to note that steel materials required for Embedment's, inserts, MS Grating, Galvanized Grating, Stainless Steel Stop Log Gates, Sluice gates, Stainless Steel Stationery Screens, fasteners like MS/HT/HSFG bolts/nuts, lock nuts, washers and foundation bolts other than those supplied by BHEL, shall be supplied by the bidder

1.2.3 The works to be performed under this contract consist of providing all labour, supervision, material, scaffolding, construction equipment's, tools and plants, temporary works, supplies including POL (Petroleum, oil & lubricants), 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, preparation of fabrication drawings etc. are included on the rates of items of work. Works shall be carried out only with approved structural fabrication drawings.

1.2.4 The area of work shall be cleared of all vegetation, rubbish and other objectionable matter and materials removed shall be burnt or otherwise disposed of as directed by the Engineer-in-Charge (Wherever applicable). 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.

1.2.5 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.

1.2.6 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.

1.2.7 The unit rates for various items of B.O.Q shall include all the stipulations mentioned in technical specifications and nothing extra over B.O.Q rates shall be payable.

1.2.8 Drawings showing enough details for the construction as per the specification shall be furnished to the contractor in a phased manner. Further, preparation of detailed fabrication drawing is in the scope of contractor. The detailing drawing of structures to be prepared and submitted by the bidder for approval by BHEL.

1.2.9 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.

VOLUME-IA PART – I CHAPTER – III

FACILITIES & CONSUMABLES IN THE SCOPE OF CONTRACTOR / BHEL

(SCOPE MATRIX)

Sl. No	Description	Scope to be taken care by		Remarks
1.3.1.0	**PART I**	**BHEL**	**Bidder**	
1.3.1.1.0	**ESTABLISHMENT**			
1.3.1.1.1	FOR CONSTRUCTION PURPOSE:			
A	Open space for office	Yes		Free of charges as provided by TSGENCO
B	Open space for Fabrication Yard & Storage	Yes		Free of charges as provided by TSGENCO
C	Construction of bidder's office, canteen and storage building, fabrication yard (including Shot / Grit blasting shed) including supply of materials and other services		Yes	At bidder's own cost
D	Bidder's all office equipment's, office / store / canteen consumables		Yes	At bidder's own cost
E	Canteen facilities for the bidder's staff, supervisors and engineers etc.		Yes	At bidder's own cost
F	Firefighting equipment's like buckets, extinguishers etc.		Yes	At bidder's own cost
G	Fencing of storage area, office, canteen etc. of the bidder		Yes	At bidder's own cost

Sl. No	Description	Scope to be taken care by		Remarks
1.3.1.0	**PART I**	**BHEL**	**Bidder**	
1.3.1.1.2	FOR LIVING PURPOSES OF THE SUCCESSFUL BIDDER'S PERSONNEL			
A	Open space	Yes		Free of charges as provided by TSGENCO
B	Living accommodation		Yes	At bidder's own cost
1.3.1.2.0	**ELECTRICITY**			
1.3.1.2.1	Electricity for construction purposes	Yes		Free of charges as provided by TSGENCO
1.3.1.2.1.1	Single point source (In general) For detail, refer clause no. 1.3.4.1	Yes		
1.3.1.2.1.2	Further distribution for the work to be done which include supply of materials and execution		Yes	At bidder's own cost
1.3.1.2.2	Electricity for the office, stores, canteen, labour colony, etc. of the bidder which include:		Yes	At bidder's own cost
1.3.1.2.2.1	Distribution from single point including supply of materials and service		Yes	At bidder's own cost
1.3.1.2.2.2	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	At bidder's own cost
1.3.1.2.2.3	Duties and deposits including statutory clearances for the above		Yes	At bidder's own cost
1.3.1.2.2.4	Demobilization of the facilities after completion of works		Yes	At bidder's own cost

Sl. No	Description	Scope to be taken care by		Remarks
1.3.1.0	**PART I**	**BHEL**	**Bidder**	
1.3.1.2.3	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc. on the above lines. (in case BHEL provides this facility, the scope should be given without ambiguity)		Yes	At their own cost
1.3.1.3.0	**WATER SUPPLY**			
1.3.1.3.1	For construction purposes:	Yes		Free of charges as provided by TSGENCO
1.3.1.3.1.1	Making the water available at single point	Yes		As provided by TSGENCO
1.3.1.3.1.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	At bidder's own cost
1.3.1.3.2	Water supply for bidder's office, stores, canteen, labour colony, etc.		Yes	At bidder's own cost
1.3.1.3.2.1	Making the water available at single point		Yes	At bidder's own cost
1.3.1.3.2.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	At bidder's own cost
1.3.1.4.0	**LIGHTING**			
1.3.1.4.1	For construction work (supply of all the necessary materials) At office storage area At the preassembly area At the construction site / area		Yes	At bidder's own cost

Sl. No	Description	Scope to be taken care by		Remarks
1.3.1.0	PART I	BHEL	Bidder	
1.3.1.4.2	For construction work (Execution of the lighting work / arrangements) At office storage area At the preassembly area At the construction site /area At the labour hutment		Yes	At bidder's own cost
1.3.1.5.0	**COMMUNICATION FACILITIES for site operations of the bidder**	**-**		
1.3.1.5.1	Telephone, Fax, internet, intranet, email etc		Yes	At bidder's own cost

Sl.No	Description	Scope to be taken care by		Remarks
	PART II	BHEL	Bidder	
1.3.2.0	**CONSTRUCTION FACILITIES**			
1.3.2.1.0	**Engineering works for construction**			
1.3.2.1.1	Providing the construction drawings for all the equipment covered under this scope	Yes		Progressive ly
1.3.2.1.2	Detailed drawings (for fabrication) for construction & methodology		Yes	Necessary approval from BHEL/ TSGENCO required
1.3.2.1.3	As-built drawings – wherever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes	Yes	Yes	In consultation with BHEL
1.3.2.1.4	Shipping lists etc for reference and planning the activities	Yes	Yes	”

Sl.No	Description PART II	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.2.1.5	Preparation of site construction schedules and other input requirements		Yes	In consultation with BHEL, As per requirement of BHEL targets
1.3.2.1.6	Review of performance (Form-14) and revision of site construction schedules in order to achieve the end dates and other commitments		Yes	
1.3.2.1.7	Weekly construction schedules based on Sl No 1.3.2.1.5		Yes	
1.3.2.1.8	Daily construction / work plan based on Sl No 1.3. 2.1.7		Yes	For daily monitoring meeting at site
1.3.2.1.9	Periodic visit of the senior official of the bidder to site to review the progress so that works are completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two months.		Yes	At bidder's own cost
1.3.2.1.10	Preparation of preassembly bay, if any required		Yes	At bidder's own cost
1.3.2.1.11	Laying of racks for gantry crane if provided by BHEL or brought by the contractor / bidder himself		Yes	At bidder's own cost

1.3.3 OPEN SPACE:

Open space, as provided by TSGENCO, will be provided to the bidder free of cost. Availability of land within plant boundary is very limited and the contractor has to plan and use the existing land considering the use of land by other Civil /mechanical/ electrical contractors and the storage of plant machineries and materials. The existing land shall be shared by all erections agencies. Land will be allocated with certain time frame and to the extent available/ considered necessary, and will be reviewed by BHEL depending upon the area availability. Area within plant premises for office, fabrication

yard, storage area etc. for construction purpose shall be provided as per availability free of cost. The contractor will be responsible for handing back all lands, as handed over to him by BHEL.

Land for labour colony shall be provided by BHEL nearer to site (outside plant premises) free of cost as provided by TSGENCO. The contractor has to construct labour colony as per the technical specification No.PSSR/PMX/CVL/Labour colony/01, latest revision enclosed along with this tender at his own cost. The contractor shall provide adequate water arrangement for drinking/washing/bathing with required toilets, drainage system, and electrification etc. in labour colony at his own cost. Suitable paved area to be provided in the labour colony at the cost of contractor.

1.3.4 ELECTRICITY:

1.3.4.1 In general, Construction power will be provided to the contractor free of cost at one single point within the plant area by BHEL as provided by TSGENCO. However, based on request of Contractor and requirement of project, BHEL Site in charge, at his discretion, may provide construction power at multiple point (as close to work area as possible), free of cost, for smooth execution of the work at site. If, BHEL provides electricity at more than one point (it will be responsibility of the contractor to provide the necessary support (Manpower support, Minor excavation & transporting of construction power cables) for enabling BHEL for extending such provision to contractor. The contractor has to provide necessary meter for measuring the power consumption. The contractor shall make his own arrangement for further distribution with necessary isolator/LCB etc.

1.3.4.2 Necessary “Capacitor Banks” to improve the Power factor to a minimum of 0.9 shall be provided by the contractor at his cost. Penalty if any levied by customer on this account will be recovered from contractor’s bills.

1.3.4.3 Any duty, deposit involved in getting the Electricity shall be borne by the bidder. As regards contractor’s office shed also all such expenditure shall be borne by the contractor.

1.3.4.4 Provision for distribution of electrical power from the given single central common point to the required places with proper distribution boards, approved cables and cable laying including supply of all materials like cables, switch boards, pipes etc., observing the safety rules laid down by electrical authority of the State / BHEL / their customer with appropriate

statutory requirements shall be the responsibility of the tenderer / contractor.

1.3.4.5 BHEL is not responsible for any loss or damage to the contractor's equipment as a result of variations in voltage / frequency or interruptions in power supply.

1.3.4.6 Contractor has to make their own arrangements for electricity requirement for labour colony at his own cost.

1.3.4.7 As there are bound to be interruptions in regular power supply, power cut/ load shedding in any construction sites, contractor should make his own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown / failure to get urgent and important work to go on without interruptions. No separate payment shall be made for this contingency.

1.3.5 WATER:

1.3.5.1 Water (Raw water) required for construction purposes will be provided at one single point within the plant area free of cost as provided by TSGENCO. The required pumps & accessories, pipes for drawing water from the given point and further distribution will be arranged by the contractor at their cost to go on without interruptions.

1.3.5.2 In case of non-availability of water, the contractor shall make his own arrangements of **water suitable for construction purpose** to have uninterrupted work. No separate payment shall be made for any contingency arrangement made by contractor.

1.3.6 MATERIAL SUPPLY:

1.3.6.1 Supply / providing of all materials required (excluding Free issue Materials by BHEL for incorporation in the permanent works i.e. Structural steel for structural works (as specified in BOQ)) for the work are in the scope of the contractor.

- The steel material will be issued from BHEL stores, within the plant premises. Collection and transporting to the place of work is in contractor's scope without any extra cost to BHEL. The steel will be issued to the agency in standard lengths.
- If any matching sections of steel are not available with BHEL, contractor may arrange these sections on certification of BHEL and the landing cost of sections to site will be reimbursed based on the

prevailing rate at SAIL at the time of procurement at the nearest SAIL outlet with the freight charges against supporting document.

- Bidder to note that steel materials required for embedments, inserts, MS grating, galvanized grating, stainless steel stop lock gates, sluice gates, stainless steel stationery screens, fasteners like MS/ HT/ HSFG bolts/ nuts, lock nuts, washers and foundation bolts other than those supplied by BHEL, shall be supplied by the bidder.

1.3.7 CONSUMABLE

All consumables, like gas, electrodes (low hydrogen electrodes should be used for welding of steel (for all thickness), Note: For MIG welding approval is to be obtained from BHEL/ TSGENCO / TSGENCO's consultant), chemicals, lubricants etc. required for the scope of work, shall be arranged by the contractor at his own cost unless otherwise specifically mentioned in the contract. Prior approval from Engineer In-Charge shall be obtained for all the consumable to be used in permanent work.

In the event of failure of contractor to bring necessary and sufficient consumables, BHEL may arrange for the same at the risk and cost of the contractor. The entire cost towards this along-with overhead shall be paid by the contractor or deducted from the contractor's bills.

1.3.8 WELDING

A detailed methodology for structural steel works shall be submitted by the contractor for approval by BHEL/TSGENCO. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

Welding Procedure Specification (WPS) to be provided by Bidder in line with the BOQ / Technical speciation / Quality Assurance & Inspection manual provided in this Tender for approval of BHEL/TSGENCO. After approval of WPS, bidder shall conduct & submit the records of Procedure Qualification Records and welder qualification test results to BHEL/TSGENCO for approval at his own cost including expenditure against all required Chemical, Mechanical, Destructive testing, Non Destructive testing, etc. However, where required by BHEL/TSGENCO, the tests shall be conducted in presence of BHEL/TSGENCO authorized representative.

Heat treatment procedures & Non Destructive testing procedures will be provided by BHEL. In case of any additional requirement vendor has to

submit the procedures for approval by BHEL/TSGENCO before use.

In addition to the tests mentioned in Technical specification / Quality Assurance & Inspection manual, Bidder has to perform additional quality checks for structures like Conical Hopper, Feeder Floor, Tipper Floor, etc. (as directed by engineer - in - charge) at his own cost including expenditure against all required Chemical, Mechanical, Destructive testing, Non Destructive testing, etc.

1.3.9 LIGHTING FACILITY:

Adequate lighting facilities such as flood lamps, hand lamps and area lighting shall be arranged by the contractor at the site of construction, and contractor's material storage area etc. at his own cost.

1.3.10 CONTRACTOR'S OBLIGATION ON COMPLETION:

On completion of work, all the temporary buildings, structures, pipe lines, cables etc. shall be dismantled and leveled and debris shall be removed as per instructions of BHEL by the contractor at his own cost. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

1.3.11 DEWATERING

Contractor shall ensure at all times that his work area & approach/ access roads are free from accumulation of water, so that the materials are safe and the erection/ progress schedule are not affected. No separate claim in this regard shall be admitted by BHEL. No separate payments for dewatering of subsoil, surface water or catchments water, if required, at any time during execution of the work including monsoon period shall be considered by BHEL. Dewatering by well point method is not included in this scope of work.

1.3.12 BID DRAWINGS

Bid drawings enclosed is only tentative & for information purpose and this may get revised during execution.

VOLUME-IA PART – I CHAPTER – IV

T&Ps TO BE DEPLOYED BY CONTRACTOR

1.4.1 All the tools and plants required for satisfactory completion of the work, except those T&P provided by BHEL, have to be arranged by the contractor within the quoted rates.

1.4.2 The contractor is required to arrange the following tentative Major T&Ps and other T&Ps for the satisfactory completion of the work

A: <u>STRUCTURAL WORKS</u>

Sr No	Major T&Ps	Mobilizing time from the date of start of work
A1	1 No. 150MT capacity crawler crane for erection.	As per work requirement at site.
A2	**For Erection:** 3 Nos. 75MT/ 100MT capacity crawler crane (depends up on erection requirement)	As per work requirement at site.
A3	**For Fabrication**: 1 No. 40MT Capacity gantry crane with 150m length rails for movement + 1 No. 75MT/100MT capacity crawler crane (or) 3 Nos. 75MT/100MT capacity crawler crane.	As per work requirement at site.
A4	1 No. 45MT capacity Tyre mounted crane	As per work requirement at site.

Sr No	Other T&Ps	Mobilizing time from the date of start of work
A5	4 Nos. pick & carry cranes (10/ 12 T cap) (hydra)	2 Nos. – Within 30 days. Balance progressively as per site requirement
A6	2 Nos. Radial drill machine	As per work requirement at site.
A7	4 Nos. magnetic base drill machine	As per work requirement at site.

Sr No	Other T&Ps	Mobilizing time from the date of start of work
A8	5 Nos. submerged arch welding machine	As per work requirement at site.
A9	9 Nos. MIG machine	As per work requirement at site.
A10	45 Nos. welding rectifier	10 Nos. within 75 days, 15 nos. within 100 days and balance as per site requirement.
A11	2 Nos. trailor – 15T	1 No. within 100 days. Balance as per site requirement.
A12	3 Nos. power driven HSFG bolt tightening m/c	As per work requirement at site.
A13	3 Nos. torque tightening m/c. (2 Nos. Capacity up to 30mm dia HSFG bolt tightening)	As per work requirement at site.
A14	Sufficient quantity of steel ladders for approach up to the top of each erected column to be required during erection of columns.	As per work requirement at site.
A15	Power winch – 3T - 4 Nos. for structural erection	As per work requirement at site.
A16	Power winch – 5T - 2 Nos. for structural erection	As per work requirement at site.
A17	1 No. ultra-sonography testing machine for structural work.	As per work requirement at site.
A18	2 Nos. Painting equipment sets complete with compressor, hopper, screen, blasting hose pipe, nozzle airless/conventional spray (within CGI temporary cover shed)	As per work requirement at site.
A19	3 Nos. drinking water tank – 5000 lit.	1 No. within 30 days. Balance as per site requirement.
A20	3 Nos. mobile toilet blocks for labour use.	1 No. within 30 days. Balance within 75 days.
A21	1 No. truck mounted 125 KVA DG set	As per work requirement at site
A22	Electrode baking oven (1 No.), Electrode holding oven (2 Nos) &	As per work requirement at site

Sr No	Other T&Ps	Mobilizing time from the date of start of work
	Electrode holding Flask (12 Nos.)	
A23	Construction power cable	As per requirement
A24	Construction water Pipeline	As per requirement
A25	Portable fire extinguishers as below: Soda acid – 15 sets. Dry chemical powder – 15 sets CO2 – 10 sets. Water & sand bucket (4 buckets in one stand) – 7 sets. Fire hose with nozzle (50 M length) – 3 sets	25% within 30 days and balance progressively within 90 days.

Note:

1. T&P shown in the above mentioned list is tentative requirement considering parallel working in all areas mentioned in scope of work. However, mobilization schedule & quantity/ numbers as mutually agreed at site for major T&Ps, have to be adhered to. Numbers of T&Ps / time of requirement will be reviewed time to time at site and contractor will provide required T&P/ equipment's to ensure completion of entire work within schedule/target date of completion without any additional financial implication to BHEL. Vendor will give advance intimation & certification regarding capacity etc. prior to dispatch of heavy equipment's. Also on completion of the respective activity, demobilization of T&P in total or in part can be done with the due approval of engineer in charge. Retaining of the T&P's during the contract period will be mutually agreed in line with construction requirement.
2. 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.
3. In the event of non-mobilisation of Tools, Plants, Machinery, Equipment, Material or non-availability of the same owing to breakdown and as a result progress of work suffered, BHEL reserves the right to make alternative arrangement (available or higher capacity) in line with SCC clause no. 4.2.1. 7 and hire charges shall be applicable as under:
   A: BHEL provides its own Capital T&P: If BHEL provides owned T&P then BHEL, hire charges (as per BHEL norms) will be recovered from the contractor as per the prevailing BHEL Corporate hire charges applicable as per following cases:

- In case the T&P is specifically listed in "T&Ps to be deployed by Contractor", 'Rates of hire charges applicable to outside agencies other than contractors working for BHEL' will apply.
- In case the T&P is not specifically listed in "T&Ps to be deployed by Contractor", 'Rates of hire charges applicable to contractors working for BHEL' will apply.

The hire charges of Capital Tools & Plants are exclusive of operating expenses e.g., Operator, fuel & Consumables and the same shall be arranged by the contractor at his cost.

B: BHEL provides hired T&P: In all cases other than that specified in "A" above, actual expenses incurred by BHEL for arranging T&P along with applicable overheads will be back-charged to the contractor.

4. In the event of need of change of type of any of major T&Ps, approval shall be taken from BHEL Engineer in-charge prior to mobilization. The decision of Number of T&P required due to replacing the enlisted T&P as per above table, shall be taken after analyzing the production capacity and suitability of both the T&Ps.

5. Clause no. 1.6.1. of this specification (i.e. TCC) shall be referred for date of start of work.

1.4.3 In addition to the above, any other tools and plants required for execution of the above work are in contractor's scope.

1.4.4 The Bidder shall establish and maintain a field laboratory on the site and this laboratory shall be available at all time for testing. Successful bidder shall submit scheme for lab arrangement within 7 days from date of commencement of work at site for approval of BHEL engineer in-charge.

1.4.5 The laboratory must have qualified technicians to carry out all tests and must be adequately equipped to ensure that all necessary testing work can be carried out in compliance with the standards.

1.4.6 Contractor shall have at all times experienced operators and technicians for routine and breakdown maintenance of the equipment. Any delay in rectification of defects will warrant BHEL rectifying the defect and charging the cost to the contractor.

1.4.7 The area and infrastructure development of the work area are 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

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.

1.4.8 In general, any crane (Upto 150 MT capacity) for the tendered scope of work will not be provided by BHEL.

1.4.9 The age of the contractor deployed cranes up to 150 T should be within 15 years as on date of deployment. Contractor has to provide documentary proof for the age of the crane at the time of deployment to the BHEL Engineer.

VOLUME-IA PART – I CHAPTER – V

T&Ps PROVIDED BY BHEL

1.5.1 BHEL will provide suitable higher capacity cranes above 150T capacity to the contractors as per the requirement at the discretion of BHEL on free of hire charges on shareable basis.

1.5.2 Besides the T & P mentioned above, which is being made available to the contractor on free of hire charges, any additional crane and other T & P which may be required for successful and timely execution of the work covered within the scope of this tender shall be arranged and provided at site by the contractor at his cost. In case if the contractor fails to provide such equipment, BHEL will arrange for the same and the cost will be recovered from the contractor's bill with BHEL overheads, as applicable from time to time which may vary even during contract period.

1.5.3 BHEL's Crane is only for erection purpose and shall not be available for material handling or transportation purpose. Contractor shall make their own arrangements for material transportation to erection site.

1.5.4 BHEL may provide either BHEL owned cranes or hired cranes at the discretion of BHEL. Operator for the BHEL supplied cranes will be provided by BHEL on free of charges.

1.5.5 Fuel has to be arranged by the contractor at his cost, for both BHEL owned cranes as well as Hired cranes.

1.5.6 For all BHEL's cranes, BHEL shall provide crane operators free of charges,

1.5.7 All consumables for BHEL crane maintenance shall be provided by the contractor within the quoted rates. Tentative List of consumables required to be provided by contractor is as below:

a. Engine Oil 15 W 40
b. Fuel Filters
c. Air Filters
d. Hydraulic Filters
e. Hydraulic Oil –Servo 68
f. Gear Oil- Servo 90
g. Engine oil Filter

h. Oil Separator Filter

i. Rope- CRG 100 Grease

j. Grease- Servo Multi-Purpose Grease

1.5.8 Maintenance for the BHEL crane shall be carried out by BHEL. Bidder shall extend support (if required) for routine maintenance works.

VOLUME-IA PART – I CHAPTER – VI

TIME SCHEDULE

1.6.1 The date of commencement of work at site shall be mutually agreed between successful bidder and BHEL site in-charge.

1.6.2 The entire structural works as detailed in the Tender Specification shall be completed within **24 (Twenty-four) months** from the date of commencement of work.

1.6.3 Fronts & drawings (as applicable) will be provided by BHEL to contractor in a phased manner as per the project requirement.

1.6.4 During the total period of contract, the contractor has to carry out the activities in a phased manner as required by BHEL and the program of milestone events.

1.6.5 The contractor is required to refer Form 15 (in Volume 1- PART-II) for all the instructions to be taken immediately after receipt of LOI.

1.6.6 **MOBILISATION**

The Contractor has to subsequently augment his resources in a prudent manner to achieve the COMPLETION SCHEDULES:

The above time allowed for completion of work including Sundays and Holidays is from the date of commencement of work. Detailed program to be prepared by the tenderer taking in to consideration of the COMPLETION SCHEDULES /site decision on drawings flow (latest) and submitted for BHEL's approval.

1.6.7 In order to meet above schedule in general, and any other intermediate targets set, to meet customer / project schedule requirements, contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL.

1.6.8 In case the project is to be advanced, the structural works in the scope of the contractor is to be advanced to meet the project requirement. No extra payment whatsoever shall be paid on this account.

1.6.9 CONSTRUCTION SCHEDULE

Overall completion period for the completion of works and submission of final bill is 24 months.

Tentative construction schedule for structural works is as mentioned below.

Sl. No.	Area	Completion from the date of commencement of work
1	Start of submission of Fabrication Drawings and Readiness of fabrication yard	45 days Note: Date will be counted from the date of issue of 1st RFC drawing to bidder for detailing purpose.
2	Ash Handling Plant Cable Rack	Progressively by 12th month
3	Ash Handling Plant Pipe Rack & Silo Buildings	Progressively by 16th month
4	Limestone Shed	Progressively by 16th month
5	Gypsum Storage Shed & Limestone Crusher House	Progressively by 17th month
6	Limestone Hopper, Limestone Conveyor- 1AB, Pent House for Lime Stone - 1AB, Belt Feeder (BF) Conveyor, Bucket Elevator, Belt Weigh Feeder (BWF) Conveyor, Gypsum Conveyor 1A/B (GHS 1A/B), Gypsum Drive House & Other miscellaneous AHP, LHP & GHP structures	Progressively by 22nd month
7	Material Reconciliation, balance finishing works and final bill submission	Progressively by 24th month

The above schedule is for entire completion and handing over the structure/ Building to BHEL. Date of commencement of work shall be as mutually agreed at site between BHEL & contractor.

The left out minor finishing works shall also be completed and handed over to BHEL within the contract period.

1.6.10 The above schedule is tentative. In case the project is to be advanced, the structural works in the scope of the contractor is to be advanced to meet the project requirement. No extra payment whatsoever shall be paid on this account.

1.6.11 The above time allowed for completion of work including Sundays and Holidays is from the date of commencement of work. Detailed program to be prepared by the bidder taking in to consideration of the COMPLETION SCHEDULES / site decision on drawings flow (latest) and submitted for BHEL's approval.

1.6.12 In order to meet the above schedule in general, and any other intermediate targets set, to meet customer/ project schedule requirements, Contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL Engineer.

1.6.13 The bidder must submit area wise detailed schedule (the major activities as mentioned against the work schedule in clause 1.6.9 are to be indicated in detailed schedule) for completion of work to meet the work schedule given in Clause 1.6.9 within 15 days from the date of issue of LOI.

1.6.14 SUBMISSION OF L3 SCHEDULE

The contractor shall submit a detailed area/structure wise L3 schedule within 15 days from date of issue of LOI, in consultation with BHEL based on the tentative schedule provided as per the clause 1.6.9. The detailed L3 schedule shall be approved by BHEL and same shall be implemented. Contractor shall submit L3 schedule in MS Projects (or any suitable format as agreed between contractor and BHEL engineer in-charge) to meet the agreed project schedule covering various mile stone activities and their split up details such as construction, procurement of materials, fabrication & erection activities, etc. This schedule shall also clearly indicate the interface facilities/inputs to be provided by BHEL/Customer and the dates by which such facilities/inputs are required. The schedule shall be acceptable to BHEL for meeting their milestone targets/schedule.

1.6.15 MAJOR INTERMEDIATE MILESTONES

The following Intermediate Milestones shall be applicable for this work.

S. No	Description	Completion month from the	Intermediate Milestone

		date of start of the work at site	
1	Ash Handling Plant Cable Rack	12th Month	M1
2	Ash Handling Plant Pipe Rack & Silo Buildings	16th month	M2

Note: Please refer Sl. No:7, Part-II, Chapter-1 of Technical Conditions of Contract (Volume 1A of Volume I Book I) for Penalty for Intermediate Milestones.

1.6.16 GUARANTEE PERIOD FOR THE PACKAGE

Guarantee period of 12 months shall commence from the date of completion of the whole work and certified by the BHEL Engineer.

1.6.17 RECORDS TO BE MAINTAINED AT SITE :

Record of Quantity of FREE/Chargeable items issued by BHEL must be maintained during contract execution. Also reconciliation statement to be prepared at regular intervals.

The under mentioned Records/ Log-books/ Registers applicable to be maintained.

- Hindrance Register.
- Site Order Book.
- Test Check of measurements.
- Steel & Cement Supply and Consumption Daily Register
- Records of Test reports of Field tests.
- Records of manufacture's test certificates.
- Records of disposal of scraps generated during and after the work completion.

VOLUME-IA PART – I CHAPTER – VII

TERMS OF PAYMENT

1.7.1 Secured Advance

Not applicable

1.7.2 Advance for Mobilization

1.7.2.1 Interest bearing advance for Mobilization, limited to 5% of the contract value will be paid against submission of bank guarantee of at least 110% of the advance valid for the contract period, which will be recovered from the first running bill onwards. The advance for mobilization shall be paid as under.

1.7.2.2 2% of contract value after receipt of initial Security Deposit and additional security deposit as applicable if any, as per relevant clauses in the GCC/TCC along with unqualified acceptance of detailed letter of intent.

1.7.2.3 1.5% of contract value on completion of site Mobilization of Machinery & T&P as given below and on certification by site in-charge for compliance provided clause no. 1.7.2.2 as mentioned above is also complied with.

- 75MT/100MT crawler crane - 2 Nos.
- Pick & carry crane of minimum (10/12MT capacity)(Hydra) - 2 Nos.

1.7.2.4 1.5% of contract value on completion of site Mobilization of Machinery & T&P as given below in addition to the above, and on certification by site in-charge for compliance.

- 75MT/100 T crawler crane - 1 No.
- Pick & carry crane of minimum (10/12MT capacity)(Hydra) - 2 Nos.
- Tyre mounted crane of 45 T capacity - 1 No.

1.7.2.5 Payment of the advance as specified herein and recovery of the advance will be as per clause 2.13 of GCC and as per Sl No. 9 of Vol-1A Part II Chapter1. Option of availing the interest bearing mobilization advance is left with the bidder.

1.7.3 Interim Payment

1.7.3.1 Interim bills in the form of monthly running bills prepared by the contractor in soft as well as Hard copies shall be based on the quantities executed and measured.

1.7.3.2 95% item rate shall be released after completion of works certification by Engineer in charge.

1.7.3.3 5% of the item rate shall be released after submission of the quality check formats as per the quality plan for the quantum of work billed and duly certified by engineer.

1.7.3.4 **For Performance Security Deposit**, please refer Sl. No.16 of Vol-1A Part II Chapter-1.

1.7.4 BHEL Site Engineer, at discretion, may operate the part rate of the items in line with GCC clause no. 2.23.1 (v). Payment for supply portion (subject to approval of Engineer In-Charge) shall be made only after receipt of material at site.

1.7.5 METHOD OF MEASUREMENT

Mode of measurement shall be as per relevant IS 1200 in conjunction of IS code 3385. In case the same is also not available, the standard procedure adopted in CPWD shall be adopted. In case, the same is also not available in CPWD, the measurement of the work done will be based on the mutual agreement between BHEL and contractor. In all the above cases, the interpretation of BHEL will be final and binding to the contractor. Measurement guidelines as a ready reference is also available in the technical specification.

1.7.6 NO CLAIM WHAT SO EVER MAY BE, WILL BE ENTERTAINED UNDER THIS CONTRACT, AFTER DULY SIGNING THE FINAL BILL ALONG WITH MEASURMENT BOOKS AND ACCEPTED BY BHEL.

VOLUME-IA PART – I CHAPTER – VIII

TAXES & DUTIES

1.8.1 Goods and service Tax (GST) & Cess

1.8.1.1 The successful bidder shall furnish proof of GST registration with GSTN Portal in the State in which the Project is being executed, covering the services under this contract. Registration should also bear endorsement for the premises from where the billing shall be done by the successful bidder on BHEL for this project/ work.

1.8.1.2 Contractor's price/rates shall be exclusive of GST & Cess (if applicable) (herein after termed as GST). Contractor shall submit to BHEL the GST compliant tax invoice/debit note/revised tax invoice on the basis of which BHEL will claim the input tax credit in its return. Since this is a works contract, the applicable rate shall be @ 18% GST, as applicable presently

1.8.1.3 Bidder shall note that the GST Tax Invoice complying with GST Invoice Rules wherein the 'Bill To' details will as below:

BHEL GSTN	- 36AAACB4146P1ZG
NAME	- BHARAT HEAVY ELECTRICALS LIMITED
ADDRESS	- Yadadri Thermal Power Station, 5X800 MW (Coal based), Veerlapalem village, Dameracherla Mandal, Nalgonda District, Telangana State.

1.8.1.4 GST charged in the tax invoice/debit note/revised tax invoice by the contractor shall be released separately to the contractor only after contractor files the outward supply details in GSTR-1 on GSTN portal and input tax credit of such invoice is matched with corresponding details of outward supply of the contractor and has paid the GST at the time of filing the monthly return.

1.8.1.5 In case BHEL has to incur any liability (like interest / penalty etc.) due to denial/reversal / delay of input tax credit in respect of the invoice submitted by the contractor, for the reasons attributable to the contractor, the same shall be recovered from the contractor.

1.8.1.6 Further, in case BHEL is deprived of the Input tax credit due to any reason attributable to contractor, the same shall not be paid or Recovered if already paid to the contractor.

1.8.1.7 Tax invoice/debit Note/revised tax invoice shall contain all such particulars as prescribed in GST law and comply to the timelines for issue of the same. Invoices shall be submitted on time to the concerned BHEL Engineer In Charge.

1.8.1.8 TDS under GST (if/ as & when applicable) shall be deducted at prevailing rates on gross invoice value from the running bills.

1.8.1.9 E-way bills / Transit passes / Road Permits, if required for materials / T&P etc., bought into the project site is to be arranged by the Contractor only.

1.8.1.10 BHEL shall not reimburse any amounts towards any interest / penalty etc., incurred by contractor. Any additional claim at a later date due to issues such as wrong rates / wrong classification by contractor shall not be paid by BHEL.

1.8.2 All taxes and duty other than GST & Cess

The contractor shall pay all (except the specific exclusion viz GST & Cess) taxes, fees, license charges, deposits, duties, tools, royalty, commissions, Stamp Duties, or other charges / levies, which may be levied on the input goods & services consumed and output goods & services delivered in course of his operations in executing the contract and the same shall not be reimbursed by BHEL. In case BHEL is forced to pay any of such taxes, BHEL shall have the right to recover the same from his bills or otherwise as deemed fit.

1.8.3 Statutory Variations

Statutory variations are applicable under the GST Acts, against production of proof. The changes implemented by the Central / State Government during the tenure of the contract viz. increase / decrease in the rate of taxes, applicability, etc. and its impact on upward revision / downward revision are to be suitably paid/ adjusted from the date of respective variation. The bidder shall give the benefit of downward revision in favour of BHEL. No other variations shall be allowed during the tenure of the contract.

1.8.4 New Taxes/Levies

In case Government imposes any new levy / tax after submission of bid during the tenure of the contract, BHEL shall reimburse the same at actual on submission of documentary proof of payment subject to the satisfaction of BHEL that such new levy / tax is applicable to this contract.

1.8.5 Direct Tax

BHEL shall not be liable towards Income Tax of whatever nature including variations thereof arising out of this contract as well as tax liability of the bidder and their personnel. Deduction of tax at source at the prevailing rates shall be effected by BHEL before release of payment as a statutory obligation, unless exemption certificate is produced by the bidder. TDS certificate will be issued by BHEL as per the provisions of Income Tax Act.

VOLUME-IA PART – I CHAPTER – IX

BILL OF QUANTITY

As mentioned in the Volume II, Price Bid, Part-C

NOTE TO BOQ:

A) The Price bid contains the consolidated list of BOQ with brief description of items. The quantity indicated in the BOQ / Price bid is approximate only and is liable for variation. Payment will be as per actual quantity executed as certified by BHEL Engineer.

B) Before filling the Rates in the Price bid, the bidder shall go through the detailed specification of all items of BOQ as well as Scope of Work as specified in relevant Clause of this document

C) Tenderers are requested to affix their company seal and authorized signature in all pages.

D) Bidders shall refer Volume II, Price Bid, Part –A for Instructions.

VOLUME-IA PART-I CHAPTER -X

GENERAL

1.10.0 In addition to the clause 2.8 of General Conditions of Contract (Volume-1C of Book-II) the contractor shall comply with the following:

1.10.1 Payment Bidders are requested to furnish the following at PSSR-HQ, Chennai immediately after release of Letter of Intent (LOI)

I. Security Deposit and Additional Security Deposit (As applicable).
II. Unqualified Acceptance for Detailed LOI/ Work Order.
III. Rs.100/- Stamp Paper for preparation of Contract Agreement.
IV. Option (whether a or b of said clause) exercised towards Performance Security Deposit for the subject contract as per Sl. No. 16 of Volume IA Part II Chapter 1 of TCC.

1.10.2 Bidders are requested to furnish the proof of documents for the following at PSSR- Site.

I. PF Regn No.
II. Labour License No.
III. Workmen Insurance Policy No.

1.10.3 In addition to the clause 2.8 of General Conditions of Contract (Volume-1C of Book-II) the contractor shall comply with the following.

1.10.4 BOCW Act & BOCW Welfare Cess Act

1.10.4.1 The Contractor Should Register their Establishment under BOCW Act 1996 read with rules 1998 by submitting Form I (Application for Registration of Establishment) and Form IV (Notice of Commencement /Completion of Building Other Construction Work) to the respective Labour Authorities i.e.,

a) Assistant Labour Commissioner (Central) in respect of the project premises which is under the purview of Central Govt.–NTPC, NTPL etc.

b) Appropriate State authorities in respect of the project premises which is under the purview of State Govt.

1.10.4.2 The Contractor should comply with the provisions of BOCW Welfare Cess Act 1996 in respect of the work awarded to them by BHEL

1.10.4.3 The contractor should ensure compliance regarding Registration of Building Workers as Beneficiaries, Hours of work, welfare measures and other conditions of service with particular reference to Safety and Health

measures like Safety Officers, safety committee, issue of Personal protective equipments, canteen, rest room, drinking water, Toilets, ambulance, first aid centre etc.,

1.10.4.4 The contractor irrespective of their nature of work and manpower (Civil, Mechanical, Electrical works etc) should register their establishment under BOCW Act 1996 and comply with BOCW Welfare Cess Act 1996.

1.10.4.5 Contractor shall make remittance of the BOCW cess as per Act in consultation with BHEL as per the rates in force (presently 1%). BHEL shall reimburse the same upon production of documentary evidence. However, BHEL shall not reimburse the Fee paid towards the registration of establishment, fess paid towards registration of beneficiaries and contribution of beneficiaries remitted.

1.10.4.6 Non-compliance to provisions of the BOCW act and BOCW welfare Cess act is not acceptable. In case of any non-compliance, BHEL reserves the right to withhold any sum it deems fit. Only upon total compliance to the BOCW act and also discharge of total payment of Cess under the BOCW Cess act by the contractor, BHEL shall consider refund of the amounts.

1.10.5 PROVIDENT FUND

1.10.5.1 The contractor is required to extend the benefit of Provident Fund to the labour employed by the contractor in connection with this contract as per the Employees Provident Fund and Miscellaneous Provisions Act 1952. For due implementation of the same, the contractor is hereby required to get themselves registered with the Provident Fund authorities for the purpose of reconciliation of PF dues and furnish to us the code number allotted to them by the Provident Fund authorities within one month from the date of issue of this letter of intent. In case the contractor is exempted from such remittance an attested copy of authority for such exemption is to be furnished. Please note that in the event of contractor's failure to comply with the provisions of said Act, if recoveries therefore are enforced from payments due to BHEL by the customer or paid to statutory authorities by BHEL, such amount will be recovered from payments due to the contractor.

1.10.5.2 The final bill amount would be released only on production of clearance certificate from PF / ESI and labour authorities as applicable.

1.10.6 OTHER STATUTORY REQUIREMENTS

1.10.6.1 The Contractor shall submit a copy of Labour License obtained from the Licensing Officer (Form VI) u/r25 read with u/s 12 of Contract Labour (R&A) Act 1970 & rules and Valid WC Insurance copy or ESI Code (if applicable) and PF code no along with the first running bill.

1.10.6.2 The contactor shall submit monthly running bills along with the copies of monthly wages (of the preceding month) u/r78(1)(a)(1) of Contract Labour Rules, copies of monthly return of PF contribution with remittance Challans under Employees Provident Fund Act 1952 and copy of renewed WC Insurance policy or copies of monthly return of ESI contribution with Challans under ESI Act 1948 (if applicable) in respect of the workmen engaged by them.

1.10.6.3 The Contractor should ensure compliance of Sec 21 of Contract Labour (R&A) Act 1970 regarding responsibility for payment of Wages. In case of "Non-compliance of Sec 21 or non-payment of wages" to the workmen before the expiry of wage period by the contactor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.

1.10.6.4 The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workman under I D Act 1948, copies of Form 6-A (Annual Return of PF Contribution) along with Copies of PF Contribution Card of each member under PF Act and copies of monthly return on ESI Contribution – Form 6 under ESI Act1948 (If applicable) to BHEL along with the Final Bill.

1.10.6.5 In case of any dispute pending before the appropriate authority under I D act 1948, WC Act 1923 or ESI Act 1948 and PF Act 1952, BHEL reserve the right to hold such amounts from the final bills of the Contractor which will be released on submission of proof of settlement of issues from the appropriate authority under the act.

1.10.6.6 In case of any dispute prolonged/pending before the authority for the reasons not attributable to the contractor, BHEL reserves the right to release the final bill of the contractor on submission of Indemnity bond by the contractor indemnifying BHEL against any claims that may arise at a later date without prejudice to the rights of BHEL.

1.10.7 DEPLOYMENT OF SKILLED / SEMI-SKILLED TRADESMEN

The following clause is applicable in case the contract value / contract price is Rs. Five crores and above.

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.

1.10.8 RECOVERY OF COMPENSATION PAID TO VICTIM(S) BY BHEL IN CASES OF DEATH/ PERMANENT INCAPACITATION OF PERSON DUE TO AN ACCIDENT DURING THE WORKS

BHEL shall recover the amount of compensation paid to victim(s) by BHEL towards loss of life / permanent disability due to an accident which is attributable to the negligence of contractor, agency or firm or any of its employees as detailed below.

1.10.8.1 Victim: Any person who suffers permanent disablement or dies in an accident as defined below.

1.10.8.2 Accident: Any death or permanent disability resulting solely and directly from any unintended and unforeseen injurious occurrence caused during the manufacturing / operation and works incidental thereto at BHEL factories/ offices and precincts thereof, project execution, erection and commissioning, services, repairs and maintenance, trouble shooting, serving, overhaul, renovation and retrofitting, trial operation, performance guarantee testing undertaken by the company or during any works /during working at BHEL Units/ Offices/ townships and premises/ Project Sites.

1.10.8.3 Compensation in respect of each of the victims:

(i) In the event of death or permanent disability resulting from Loss of both limbs: Rs. 10,00,000/- (Rs. Ten Lakh)

(ii) In the event of other permanent disability: Rs. 7,00,000/- (Rs. Seven Lakh)

1.10.8.4 Permanent Disablement: A disablement that is classified as a permanent total disablement under the proviso to Section 2 (I) of the Employee's Compensation Act, 1923.

1.10.9 GENERAL

1.10.9.1 Site Visit by the Bidder

Prior to submitting his tender for the work, the bidder shall visit, examine and

acquire full knowledge & information of necessary conditions prevailing at the site and its surroundings of the plant premises together with all statutory, obligatory, mandatory requirements of various authorities about the site of works at his own expense, and obtain and ascertain for himself on his own responsibility that may be for preparing his tender and entering into a contract, and take the same into account in the quoted contract price for the work.

1.10.9.2 The bidder shall satisfy themselves about the following factors:

i) Site conditions including access to the site, existing and required roads and other means of transport/communication for use by him in connection with the work including diverting and re-routing of services.
ii) Requirement and availability of land and other facilities of his enabling works, establishment of his nursery, office, stores etc.
iii) Ground conditions including those bearing upon transportation, disposal, handling and storage of materials required for the work or obtained there-from.
iv) Source and extent of availability of suitable materials, including water etc., and labour (skilled and unskilled) required for work, and laws and regulations governing their use and employment.
v) Geological, meteorological, topographical and other general features of the site and its surroundings as are pertaining to and needed for the performance of the work.
vi) The limit and extent of surface and subsurface water to be encountered during the performance of the work, and the requirement of drainage and pumping.
vii) The type of equipment and facilities needed, for and in the performance of the work;
viii) The extent of lead and lift required for the work in complete form over the entire duration of the contract, and
ix) All other information pertaining to and needed for the work including information as to the risks, contingencies and other circumstances which may influence or affect the work or the cost thereof under this contract.

1.10.9.3 The bidder should note that information, if any, in regard to the local conditions, as contained in these tender documents, has been given to tenderer merely for guidance and is not warranted to be complete.

1.10.9.4 A bidder shall be deemed to have full knowledge of the site, whether he

inspects it or not, and no extra charges consequent on any misunderstanding or otherwise shall be allowed.

1.10.9.5 The bidder and any of his personnel or agents will be granted permission by the Site-In-Charge or his authorized nominee, on receipt of formal application in respect thereof a week in advance of the proposed date of inspection of site, to enter upon his premises and lands for purpose of such inspection, but only on the express condition that the tenderer (and his personnel and agents) will relieve and indemnify the Employer (and his personnel and agents) from and against all liability in respect thereof and will be responsible for personal injury (whether fatal or otherwise), loss of or damage to property and any other loss, damage, costs and expenses however caused which, but for the exercise of such permission, would not have arisen.

1.10.9.6 Scope of work covered under this specification requires quality workmanship, engineering and green belt management along with the supply of all consumables, tools and tackles and testing instruments. The contractor shall ensure timely completion of work. The contractor shall have adequate tools, measuring instruments etc. in his possession. He shall also have adequate trained, qualified and experienced engineers, supervisory staff and skilled personnel. The manpower deployment identified by contractor shall match with above scope of works.

1.10.9.7 It is not the intent to specify herein all details of all material. Any item related this work not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.

1.10.9.8 All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there at no extra cost.

1.10.9.9 Site testing wherever required shall be carried out for all items / materials installed by the contractor to ensure proper installation and functioning in accordance with drawings, specifications and manufacturer's recommendations.

1.10.9.10 The contractor shall carryout additional tests, if any, which the Engineer feels necessary because of site conditions and also to meet system specification.

1.10.9.11 The work shall be executed under the usual conditions without affecting power plant construction / operation and in conjunction with other operations and contracting agencies at site. The contractor and his personnel shall co-operate with the personnel of other agencies, co-ordinate his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.

1.10.9.12 All the work shall be carried out as per instructions of BHEL engineer. BHEL engineer's decision regarding the correctness of the work and method of

working shall be final and binding on the contractor.

1.10.9.13 Wherever Construction sequences are furnished by BHEL, the contractor shall follow the same sequence.

1.10.9.14 Contractor shall execute the supply and works as per sequence prescribed by BHEL at site engineer. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of execution of similar job in any other site or for any reasons whatsoever.

1.10.9.15 If required by BHEL, the contractor shall change the sequence of his operation so that work on priority sectors can be completed within the projects schedule. The contractor shall afford maximum assistance to BHEL in this connection without causing delay to agreed completion date.

1.10.9.16 Contractor shall, transport all materials to site and unload at site / working area for inspection and checking. All material handling equipment required shall be arranged by the contractor.

1.10.9.17 Contractor shall retain all T&P / Testing instrument / Material handling equipment's etc. at site as per advice of BHEL engineer and same shall be taken out from site only after getting the clearances from engineer in charge.

1.10.9.18 The contractor at his cost shall arrange necessary security measures for adequate protection of his machinery, equipment, tools, materials etc. BHEL shall not be responsible for any loss or damage to the contractor's construction equipment and materials. The contractor may consult the Engineer-in-Charge on the arrangements made for general site security for protection of his machinery equipment tools etc.

1.10.9.19 The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. However, completion time for construction, agreed will be subject to the condition that contractor's work is not hampered by the agencies.

1.10.9.20 Contractor has to work in close co-ordination with other agency at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less / more at a particular given time. Activities and Construction program have to be planned in such a way that the milestones are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.

1.10.9.21 The contractor must obtain the signature and permission of the security personnel of the customer / BHEL for bringing any of their materials inside the site premises. Without the Entry Gate Pass these materials will not be allowed to be taken outside.

1.10.9.22 Contractor shall remove all scrap materials periodically generated from his working area and collect the same at one place earmarked for the same.

Load of scraps is to be shifted to a place earmarked by BHEL. Failure to collect the scrap is likely to lead to accidents and as such BHEL reserves the right to collect and remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect.

1.10.9.23 The contractor shall ensure that his premises are always kept clean and tidy to the extent possible. Any untidiness noted on the part of the contractor shall be brought to the attention of the contractor's site representative who shall take immediate action to clean the surroundings to the satisfaction of the Engineer-in-Charge.

1.10.9.24 The contractor is strictly prohibited from using BHEL's regular components like angles, channels, beams, plates, pipe / tubes, and handrails etc. for any temporary supporting or scaffolding works. Contractor shall arrange himself all such materials. In case of such misuse of BHEL materials, a sum as determined by BHEL engineer will be recovered from the contractor's bill. The decision of BHEL engineer is final and binding on the contractor.

1.10.9.25 No member of the already erected structure / buildings, other component and auxiliaries should be removed / modified without specific approval of BHEL engineer.

1.10.9.26 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on latest ISO 9001 Standards.

1.10.9.27 Some time it may be required to re-schedule the activities to enable other agencies to commence / continue the work so as to keep the overall project schedule.

1.10.9.28 The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.

1.10.9.29 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.

1.10.9.30 On Completion of work, all the temporary buildings, structures, pipe lines, cable etc. shall be dismantled and leveled and debris shall be removed as per instruction of BHEL by the contractor at his cost. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

1.10.9.31 It is the responsibility of the contractor to do the checking, testing etc. if necessary, repeatedly to satisfy BHEL Engineer with all the necessary tools and tackles, manpower etc. without any extra cost. The testing will be completed only when jointly certified so, by the BHEL Engineer.

1.10.9.32 If any item not covered but requires being executed, same shall be carried

out by the contractor. Equivalent or proportional unit rate shall be considered wherever possible from the BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.

1.10.9.33 The contractor's work shall not hinder other work, either underground or over ground, such as electrical, phone lines, water or sewage lines, etc. In areas of overlap, the contractor shall work in coordination with other related contractors. Any damage by the landscape contractor's team to such utilities will be penalized and contractor shall be responsible for cost for such damages.

1.10.9.34 SITE INSPECTION

1.10.9.34.1 BHEL or his authorized agents may inspect various stages of work during the currency of the contract awarded to him. The contractor shall make necessary arrangements for such inspection and carry out the rectification pointed out by the owner / employer without any extra cost to the owner / employer. No cost whatsoever such duplication of inspection of work be entertained.

1.10.9.34.2 BHEL / Customer will have full power and authority to inspect the works at any time, either on the site or at the contractor's premises. The contractor shall arrange every facility and assistance to carry out such inspection. On no account will the contractor be allowed to proceed with work of any type unless such work has been inspected and entries are made in the site inspection register by customer / BHEL.

1.10.9.34.3 Wherever the performance of work by the contractor is not satisfactory in respect of workmanship, deployment of sufficient labour or equipment, delay in execution of work or any other matter, BHEL shall have the right to engage labour at normal ruling rates and get the work executed through other agency and debit the cost to the contractor and the contractor shall have no right to claim compensation thereof. In such a case, BHEL shall have the right to utilize the materials and tools brought by the contractors for the same work.

1.10.9.35 DOCUMENTATION

1.10.9.35.1 The following information shall be furnished by the bidder within two weeks of award of contract for purchaser's approval

a) Bar chart covering planned activities at site
b) Detailed organization chart
c) Details of T&P available with contractors with documents proofs.

1.10.9.35.2 The following information shall be furnished by the bidder after testing and inspection: Test certificates of various tests conducted at site. All inspection and test certificates shall be signed by BHEL representative also.

VOLUME-IA PART – I CHAPTER - XI

PROGRESS OF WORK

The scope of the work will comprise of following but not limited to the following:

1.11 PROGRESS AND MONITORING OF WORK

1.11.1 Refer forms F -14, F-15 as per relevant chapters of Vol-1A Part-II of TCC. Also refer Form F-16 to F-18 in Volume I D of Volume -I Book-II. Plan and review will be done as per the above formats.

1.11.2 Contractor is required to draw mutually agreed monthly construction programs in consultation with BHEL well in advance monthly as per the Form-14. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL. Progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled program shall be discussed for actions to be taken for achieving targets. Contractor shall also present the program for subsequent week. The contractor shall constantly update / revise his work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of nonconformities.

1.11.3 The contractor shall submit daily, weekly and monthly progress reports, manpower reports, materials reports, consumables (gases / electrodes / ferules / lugs) report, T&Ps availability report and other reports as per Performa considered necessary by the Site Engineer as per the BHEL formats.

1.11.4 The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.

1.11.5 The monthly report ending on 24th of every month shall be submitted as a booklet and shall contain the following details :-

a) Colour Progress photographs to accompany the report should be submitted.

b) Construction progress in terms of quantity, CUM, etc., completed as relevant to the respective work areas against planned.

c) Site Organization chart of engineers & supervisors as on 24th of the month with further mobilization plan

d) Category- wise man hours engaged during the previous month under the categories like fitters, electricians, welders, riggers, khalasis, grinder-men, gas-cutters, crane operators, store keepers, lab technicians, helpers, security etc. Data will be spilt up under the work area .

e) Consumables report giving consumption of all types of gases and electrodes during the previous month (as applicable).

f) Availability report of cranes/T&Ps

g) Safety implementation report in the format

h) Pending material and any other inputs required from BHEL for activities planned during the subsequent month.

1.11.6 The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.

1.11.7 During the course of construction, if the progress is found unsatisfactory, or if the target dates fixed from time to time for every milestone are to be advanced, or in the opinion of BHEL, if it is found that the skilled workmen like fitters, operators, technicians etc employed are not sufficient BHEL will induct required additional workmen to improve the progress and recover all charges incurred on this account including all expenses together with BHEL overheads from contractor's bills.

1.11.8 It is the responsibility of the contractor to provide all relevant information on a regular basis regarding construction progress, laborer availability, equipment deployment, testing, etc.

1.11.9 The progress reports shall indicate the progress achieved against plan, indicating reasons for delays, if any. The report shall also give remedial actions which the contractor intends to make good the slippage or lost time so that further works can proceed as per the original plan the slippages do not accumulate and affect the overall programme.

1.11.10 The contractor to reflect actual progress achieved during the month and will be submitted to BHEL, so that slippages can be observed and necessary action taken in order to ensure that the situation does not get out of control will update the construction schedule forming part of this contract each month.

VOLUME-IA PART –I CHAPTER -XII

MATERIAL HANDLING

1.12.1 Open land as available shall be provided by BHEL on free of cost basis. Contractor shall maintain one centralized fenced store cum fabrication yard at his own cost. Hard surfacing of this yard and all round drain shall be carried out by the contractor at his own cost within the quoted rate. The bidder shall make complete arrangement of necessary security personnel, to safeguard all such materials in his custody. Materials issued will be used only for construction of permanent work. The contractor shall take care of material issued by BHEL and shall protect the same from theft, damage and weathering.

1.12.2 The system for receipt, storage & issue of materials shall be available with vendors for easy traceability.

1.12.3 Periodic audit of system of purchasing, storing and issue, etc. will have to be carried out by the vendors. BHEL will also audit the same.

1.12.4 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.

1.12.5 Excessive rusting of steel must be avoided. In case, due to any cause attributable to the contractor, rusting of steel for BHEL issued 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.

1.12.6 The contractor shall maintain proper store account for all the BHEL issued materials and shall give three copies every month computerised reconciliation statement of such account to the BHEL with running bill.

1.12.7 All structural steel shall be stacked plate size wise and thickness wise beams, channels and angles shall be stacked separately on sleepers.

1.12.8 Materials shall not under any circumstances taken out of the project site unless otherwise permitted by BHEL.

VOLUME 1A PART-1 CHAPTER XIII

ACCOUNTING OF MATERIALS ISSUE

The material issued to the contractor by BHEL will be accounted as follows:

1.13.1 ISSUE OF STEEL

The steel shall be issued to the contractor on the following basis:

(a) Structural Steel: Weighment basis (Unit – MT)

All the steel issued by the BHEL shall be properly accounted for. The total quantity of steel required for the work will be calculated from the approved Bar Bending schedule, fabrication drawings, approved laps, chairs and lugs. The measurement for payment as well as for accounting shall be based on the sectional weights as indicated in the following IS specifications. No rolling tolerances shall be accepted in any case for issue, return of materials, reconciliation and payment purposes.

IS: 808 (Latest revision)	Beams, Channels and Angles
IS: 1730 (Latest revision)	Plates, Sheets and Strips/Flats
IS: 1732 (Latest revision)	Rounds including deformed high yield strength bars.
IS:1786 (Latest revision)	Reinforcement steel

In case any such sectional weights are not available in the above documents, the manufacturer recommendation shall be binding.

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.

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 the contractor from BHEL stores.

The contractor shall submit to the engineer, a statement indicating estimated quantity of steel required during a quarter, at least two months in advance of the 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.

1.13.2 RETURN OF MATERIALS

All surplus steel and all wastage materials will be taken back on weighment basis.

Surplus, unused and untampered 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.

All wastage / scrap (including melting scrap, wastage, un usable scrap) shall be promptly returned to the stores and a receipt obtained for material accounting purposes. Return of such material will not be entitled to any transportation and incidental charge.

1.13.3 SCRAP & SERVICEABLE MATERAILS:

1. All Structural steel of length above 2 M except M.S. Plate shall be considered as serviceable materials provided the materials is in good and acceptable condition. Structural steel in length less than 2 M shall be treated as scrap.
2. Plates having both sides greater than 1 Metre OR if any side is less than 1 M but greater than 0.5 M and the total area is equal or greater than 2 Sq. Metre shall be considered as serviceable.

1.13.4 STEEL CONSUMPTION AND WASTAGE

STRUCTURAL STEEL (ROLLED SECTION, PLATES ETC.) CONSUMPTION & WASTAGE.

A) CONSUMPTION: -

The theoretical consumption of various sections shall be based on approved drawings. Weights shall be calculated considering the sectional weights as per Indian standard. No extra shall 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.

i) Actual consumption = Issue – Surplus.

Surplus = Un-tampered & unused quantity of steel and
Serviceable materials as stipulated under clause "Scrap and Serviceable Materials (Refer Clause 1.13.3 above)" returned by the contractor to BHEL store along with relevant documents.

ii) Wastage = Actual consumption – Theoretical consumption.

b) WASTAGE

Allowable wastage: - 4% (FOUR percent) of the theoretical consumption shall be considered. Wastage shall be considered as cut pieces and scrap material, measured as per actual weightment basis. Invisible wastage (max limit to 0.5%), if any, shall be considered to be included in the specified 4 % allowable wastage.

S.No	CONSUMPTION OF STRUCTURAL STEEL (ROLLED SECTION, PLATES)	BASIS OF ISSUE & PENAL RECOVERY
S-1	Theoretical consumption (without considering any wastage, scrap or loss) as per spec. & drg.	Free

S-2	Wastage limited to plus Four percent (+4%) of the aforesaid theoretical consumption (S-1) towards allowable wastage including invisible wastages (invisible wastages limited to 0.5% of theoretical consumptions)	Free
S-3	Wastage beyond four Percent (4%) of the aforesaid theoretical consumption (S-1)	Penal Rate

RECONCILIATION OF MATERIALS

The contractor shall submit a reconciliation statement of steel issued to him along with each RA Bill.

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 in contractor's custody at site.

At the time of submission of bills by the contractor, if it is noticed by BHEL that the wastage is high and calls recovery at the penal rate, then, BHEL will proceed for recovery for the excess wastage as per penal recovery rates as specified.

The reference drawings for actual material consumption to be used for the purpose of reconciliation shall be drawings prepared by the BHEL and drawings approved by BHEL for fabrication works and such other drawings approved by BHEL. This shall also include the bar bending schedule prepared by the contractor and approve by BHEL.

1.13.5 RECOVERY OF MATERIAL

If wastage exceeds the specified limit, the recovery of excess wastage shall be made from monthly R/A Bill at the Penal Rate.

PENAL RATE OF STRUCTURAL STEEL MATERIALS (MS plates, MS flats, rolled steel joists, channels, and angles, MS pipes, Chequered Plates, etc in sizes and lengths as available) shall be **Rs. 48,615/- per MT** plus GST and/or other taxes & duties.

VOLUME-IA PART – II CHAPTER 1

CORRECTIONS / REVISIONS IN SPECIAL CONDITIONS OF CONTRACT, GENERAL CONDITIONS OF CONTRACT AND FORMS & PROCEDURES

Sl No: 1

Clause 4.1.11 of SCC is deleted.

Sl No: 2:

OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT MANAGEMENT/ QUALITY ASSURANCE PROGRAMME

The following clauses in Occupational Health, Safety & Environment Management / Quality Assurance Programme published in Chapter-IX of Special Conditions of Contract (Volume I Book-II) is revised as under.

Chapter IX Clause 9.1 is modified as below:

Contractor will comply with HSE (Health, Safety & Environment) requirements of BHEL as per the "HSE Plan for Site Operations by Subcontractor" (Document No. HSEP: 14 Rev01) enclosed.

Chapter IX Clause 9.1.1 to 9.1.25 stands deleted.

Chapter IX Clause 9.2 to 9.62 stands deleted.

Sl No: 3:

Clause No. 10.5 on RA Bill Payments, in Special Conditions of Contract (SCC), Volume-IB, Book-II, is revised as under:

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.

Sl No: 4

The EARNEST MONEY DEPOSIT (EMD) clause 1.9 published in General Conditions of Contract (Volume I Book-II) is revised as under.

1.9 EARNEST MONEY DEPOSIT

1.9.1 Every tenderer must furnish the prescribed amount of Earnest Money Deposit (EMD) to BHEL PSSR, only in the following forms: -

i. Electronic Fund Transfer credited in BHEL account (before tender opening).
ii. Through Online EMD payment portal, before tender opening, by following these steps.
    1. Visit www.onlinesbi.com -> Go to State Bank Collect (In the tab section)
    2. Click Check box to proceed for payment -> Click on Proceed
    3. Under State of Corporate/Institution ->Select Tamilnadu
    4. Under Type of Corporate/Institution -> Select PSU – Public Sector Undertaking ->Go
    5. Under PSU – Public Sector Undertaking Name -> Select BHEL PSSR CHENNAI and Submit
    6. Under Select Payment Category ->-> SCT Tender EMD & Tender Fees
iii. Banker's cheque or Pay order or Demand Draft in favour of 'Bharat Heavy Electricals Limited' (along with offer) and payable at Chennai.
iv. 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) along with the offer.
v. In case EMD amount is more than Rs. Two Lakhs, Tenderer has the option to submit Rs. Two lakhs in the forms described above in clause no. 1.9.1. (i) to (iv) and the remaining amount over and above Rs. Two Lakhs in the form of Bank Guarantee from Scheduled Bank (along with the Offer).

Note:

a) Proforma for Bank Guarantee for EMD- Form WAM 23 is enclosed with this Tender in Volume-1A Part II Chapter 9.
b) The Bank Guarantee shall be valid for at least six months from the due date of tender submission mentioned in the Notice Inviting Tender.
c) Date of Expiry of Claim shall be as given in Proforma of Bank Guarantee (in lieu of Earnest Money)-Form WAM 23.

Bank Details for the purpose of Taking EMD BG

Name and Address of Beneficiary:	Bharat Heavy Electricals Ltd. #690, EVR Periyar Building, Nandanam, Anna Salai, Chennai - 35
Name of Bank of Client :	State Bank Of India

Bank Branch Address:	SBI Saidapet Branch, EVR Periyar Building, Nandanam, Anna Salai, Chennai - 600035
IFSC Code :	SBIN0000912
Account No. :	10610819499

Details for SFMS (Structured Financial Messaging System) transmission of BG

Bank and Branch	SBI TFCPC Branch
Branch Code	5056
IFSC Code	SBIN0005056

1.9.2 EMD shall not carry any interest.

1.9.3 EMD by the Tenderer will be forfeited as per NIT Conditions, if:

i. After opening the tender and within the offer validity period, the Tenderer revokes his tender or makes any modification in his tender which is not acceptable to BHEL.

ii. The Contractor fails to deposit the required Security deposit or commence the work within the period as per LOI/Contract

1.9.4 EMD given by all unsuccessful tenderers will be refunded normally within 15 days of award of work.

1.9.5 EMD of successful tenderer will be retained as part of Security Deposit.

1.9.6 EMD by the tenderer shall be withheld in case any action on the tenderer is envisaged under the provisions of extant" Guidelines on Suspension of Business dealings with suppliers/contactors" and forfeited / released based on the action determined under these guidelines.

Sl No: 5

SECURITY DEPOSIT: The SECURITY DEPOSIT (SD) clause 1.10 published in General Conditions of Contract (Volume I Book-II) is revised as under.

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 given below:

1.10.2 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.

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

1.10.4 Modes of deposit:

1.10.4.1 The balance amount to make up the required Security Deposit of 5% of the contract value may be furnished in any one of the following forms

i. Cash (as permissible under the extant Income Tax Act)
ii. Local cheques of Scheduled Banks (subject to realization)/ Pay Order/ Demand Draft/ Electronic Fund Transfer in favour of BHEL
iii. 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.
iv. 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.
v. Securities available from Indian 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 endorsed/ hypothecated/ pledged, as applicable, in favour of BHEL and discharged on the back)

(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)

1.10.5 At least 50% of the Security Deposit including the EMD should be deposited in any form as prescribed before start of the work and the balance 50% of the Security Deposit will be recovered by deducting 10% of the gross amount progressively from each running bills of the contractor till the total amount of the required Security Deposit is collected.

1.10.6 The recoveries made from running bills (cash deduction towards balance SD amount) will be released against submission of equivalent Bank Guarantee in the prescribed formats, but only once, before completion of work.

1.10.7 The Security Deposit shall not carry any interest.

1.10.8 If the value of work done at any time exceeds the contract value, the amount of Security Deposit shall be correspondingly enhanced and the excess Security Deposit due the enhancement shall be immediately

deposited by the Contractor or recovered from payment/s due to the Contractor.

1.10.9 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 Date of Expiry of Claim shall be as given in the prescribed formats for Bank Guarantee towards Security Deposit.

1.10.10 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.

1.10.11 Penalty for Delayed Remittance of Security Deposit

If the contractor fails to furnish SD before start of work, in line with 1.10.3 above, Simple Interest against delayed remittance of the Security Deposit shall be deducted from the sub-contractor at the rate of SBI PLR + 2% on the value of 50% SD of the contract, for the delayed period (i.e., period between start of work and date of remittance of Initial SD, i.e., atleast 50% of SD). In case, the delayed period has different SBI PLR rates, Simple Interest shall be calculated based on different rates by considering the corresponding time period. On similar lines Penalty shall be levied for delayed remittance of Additional Security Deposit (if applicable).

Note: - Bank details & SFMS details provided above in Sl. No. 04 Earnest Money Deposit) may be used for the purpose of arranging Bank Guarantees towards Security Deposit / Additional Security Deposit also.

Sl No: 6

Clause 2.7.2 and 2.7.3 in GCC regarding Rights of BHEL is revised as under:

2.7.2.

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

i. Contractor's poor progress of the work vis-à-vis execution timeline as stipulated in the Contract, backlog attributable to contractor

including unexecuted portion of work does not appear to be executable within balance available period considering its performance of execution.

ii. Withdrawal from or abandonment of the work by contractor before completion of the work as per contract.

iii. Non-completion of work by the Contractor within scheduled completion period as per Contract or as extended from time to time, for the reasons attributable to the contractor.

iv. Termination of Contract on account of any other reason (s) attributable to Contractor.

v. Assignment, transfer, subletting of Contract without BHEL's written permission.

vi. Non-compliance to any contractual condition or any other default attributable to Contractor.

Risk & Cost Amount against Balance Work:

Risk & Cost amount against balance work shall be calculated as follows: Risk & Cost Amount= [(A-B) + (A x H/100)]

Where,

A= Value of Balance scope of Work (*) as per rates of new contract

B= Value of Balance scope of Work (*) as per rates of old contract being paid to the contractor at the time of termination of contract i.e. inclusive of PVC & ORC, if any.

H = Overhead Factor to be taken as 5

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

* Balance scope of work (in case of termination of contract):

Difference of Contract Quantities and Executed Quantities as on the date of issue of Letter for

'Termination of Contract', shall be taken as balance scope of Work for calculating risk & cost amount. Contract quantities are the quantities as per original contract. If, Contract has been amended,

quantities as per amended Contract shall be considered as Contract Quantities.

Items for which total quantities to be executed have exceeded the Contract Quantities based on drawings issued to contractor from time to time till issue of Termination letter, then for these items

total Quantities as per issued drawings would be deemed to be contract quantities.

Substitute/ extra items whose rates have already been approved would form part of contract quantities for this purpose. Substitute/ extra items which have been executed but rates have not been approved, would also form part of contract quantities for this purpose and rates of such items shall be determined in line with contractual provisions.

However, increase in quantities on account of additional scope in new tender shall not be considered for this purpose.

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

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

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

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

i). Let the time period from scheduled date of start of work till termination of contract excluding the period of Hold (if any) not attributable to contractor = T1

ii). Let the value of executed work till the time of termination of contract= X

iii). Let the Total Executable Value of work for which inputs/fronts were made available to contractor and were planned for execution till termination of contract = Y

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

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

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

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

Following sequence shall be applicable for recoveries from contractor:

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

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

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

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

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

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

SL No: 7

In addition to clause 2.7.9 of General Conditions of Contract (GCC), a New clause 2.7.9.1 is added as below.

2.7.9.1 Penalty for Intermediate Milestones

2.7.9.1.1 M1 and M2 shall be intermediate Milestones for this work.

2.7.9.1.2 In case of slippage of these identified Intermediate Milestones, Delay Analysis shall be carried out on achievement of each of these two Intermediate Milestones in reference to Form 14.

2.7.9.1.3 Incase delay in achieving M1 milestone is solely attributable to the contractor,0.5% per week of executable contract value* limited to Maximum 2% of executable contract value will be withheld.

2.7.9.1.4 Incase delay in achieving M2 milestone is solely attributable to the contractor,0.5% per week of executable contract value* limited to maximum 3% of executable contract value will be withheld.

2.7.9.1.5 Amount already withheld, if any, against slippage of M1 milestone, shall be released only if there is no delay attributable to contractor in achievement of M2 milestone.

2.7.9.1.6 Amount required 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.

2.7.9.1.7 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 intermediate milestones shall be adjusted against LD or released as the case may be.

2.7.9.1.8 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 in to recovery.

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.

SL No: 8

OVERRUN COMPENSATION (ORC)

The **OVERRUN COMPENSATION (ORC)** clause 2.12 published in General Conditions of Contract (Volume I Book-II) is revised as under.

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	13^{th}-24^{th} 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 demobilized) 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.

Sl No: 9

Clauses 2.13.1, 2.13.6 & 2.13.7 in GCC on Interest Bearing Recoverable Advances,

9.1 Clauses 2.13.1,2.13.6 & 2.13.7 in GCC is revised as under:

9.1.1 Clause 2.13.1 in GCC is revised as "Normally no advance payment shall be payable to the contractor. Mobilization 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".

9.1.2 Clause 2.13.6 in GCC is revised as "The rate of interest applicable for the above advances shall be the Base rate of State Bank of India prevailing at the time of disbursement of the advance + 6%, and such rate will remain fixed till the total advance amount is recovered".

9.1.3 Clause 2.13.7 in GCC is revised as "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 90% of contract value."

Sl. No: 10

Clause 2.14.1 on Quantity Variation in General Conditions of Contract (GCC), Volume-IC, Book-II, is revised as under:

2.14.1 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 (-) 30% of awarded contract value."

Sl No: 11

PRICE VARIATION COMPENSATION (PVC)

The PRICE VARIATION COMPENSATION (PVC) clause 2.17 published in General Conditions of Contract (Volume I Book-II) is revised as under.

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 executed 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	PERCENTAGE COMPONENT ('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. Civil + Mechanical + Electrical and / or CI or Civil + Mechanical or Mechanical + Electrical and / or CI), the Component ('K') for various categories shall be as per respective packages as above

E) As per the 'MONTHLY WHOLE SALE PRICE INDEX' for the respective Commodity and Type, published by Office of Economic Adviser, Ministry of Commerce and Industry, Government of India. (Website: http://www.eaindustry.nic.in/download_data_0405.asp). Revisions in the index or commodity will be re adjusted accordingly.

2.17.3 **Void**

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)

XN = 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 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, the 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, the 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):

vii. 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.

viii. PVC will be applicable for the work done after "base date"/" revised 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).

2. PVC shall be applicable for the work done after revocation of Force Majeure.

3. PVC for the work done after revocation of Force Majeure shall be worked out on the basis of indices applicable for the respective month on 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.

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 items due to quantity variation

Sl No: 12

Clauses 2.21 in GCC regarding Arbitration is amended as below

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 **Chennai** (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 enclosed in Vol 1A Part II Chapter 12. 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 enclosed in Vol 1A Part II Chapter 12 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.

Sl No: 13: Reverse Auction

The chapter Reverse auction procedure published in 'Forms and Procedures' of Volume I Book-II stands deleted. (Explanation: Reverse auction is not applicable for this tender).

Sl No: 14

Existing format on Monthly Performance Evaluation of Contractor, as available in Form No F-14 of Volume ID Forms and procedure stands Deleted. Form No.- F-14 (Rev 01) is enclosed.

Sl No: 15

Existing format on Monthly Performance Evaluation of Contractor, as available in Form No F-15 of Volume ID Forms and procedure stands Deleted. Form No.- F-15 (Rev 02) is enclosed.

Sl No:16

Clause 2.22 in GCC regarding Retention Amount is revised as under:

2.22 Performance Security Deposit

2.22.1 After award of work, Vendor shall submit 5% of the contract value towards Performance Security Deposit, in the form of (a) or (b) below.

(a) CASH (DD/ Online payment), 5% of the contract Value towards Performance Security Deposit, before commencing the contract

(or)

(b) Recovery 5% from Each Running Bill towards Performance security deposit.

(Note: Subcontractor has to choose either Option (a) or (b) before issue of Detailed LOI).

(c) However, Performance Security Deposit on part of PVC will be recovered at the rate of 5% from every running bill towards performance security deposit.

2.22.2 Refund of Performance Security Deposit:

a) 50% of Performance Security Deposit shall be released along with the final bill.

b) Balance 50% will be released after completion of Performance Guarantee Period (i.e., 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 Performance Security Deposit, amount can be released on commencement of the Guarantee Period, on submission of equivalent Bank Guarantee.

The performance security deposit mentioned herein above, is in addition to Security Deposit as per Sl No. 5 above.

Sl No: 17

Existing format for Integrity Pact, as available in Volume ID Forms and procedure stands Deleted. Revised Format is enclosed.

Sl No: 18

Existing format on No Deviation Certificate, as available in Form No F-03 of Volume ID Forms and procedure stands Deleted. Revised Form No.- F-03 Rev 01 is enclosed.

Sl. No.: 19

PRICE BID OPENING

Clause 1.6 (v) in General Conditions of Contract (Volume IC Book-II) regarding Price Bid opening is revised as under.

1.6 (v) Price Bids submitted in E-Procurement portal https://www.bhel.abcprocure.com by the shortlisted bidders only shall be opened.

Sl No: 20

Existing format for BANK GUARANTEE FOR SECURITY DEPOSIT, as available in Form No. F-11 (Rev 00) of Volume ID Forms and procedures stands deleted. Refer Proforma of Bank Guarantee (in lieu of Security Deposit)-Form WAM 22 provided in Chapter-10, Part-II of Volume-IA Technical Conditions of Contract.

Sl No: 21

Clause 2.15.5 of GCC in Extra Works is revised as under:

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 108/- per man hour.

VOLUME-IA PART – II

CHAPTER 2-14

In the next 473 pages as below:

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CHAPTER 4	Technical Specification for Labour Colony	10
CHAPTER 5	HSE Plan For Site Operations By Subcontractor	82
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SECTION-XIII

TECHNICAL SPECIFICATION FOR PROPERTIES, STORAGE AND HANDLING OF COMMON BUILDING MATERIALS

CONTENT

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	SCOPE	VII-C/S-XIII : 1
2.00.00	MATERIALS	VII-C/S-XIII : 1
3.00.00	STORAGE AND HANDLING OF MATERIALS	VII-C/S-XIII : 6

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SECTION-XIII

TECHNICAL SPECIFICATION FOR PROPERTIES, STORAGE AND HANDLING OF COMMON BUILDING MATERIALS

1.00.00 SCOPE

The scope of this Section is to specify the properties, storage and handling of common building materials unless otherwise mentioned in drawings or schedule of items.

2.00.00 MATERIALS

a) **Bricks**

i) Common Burnt Clay Bricks : Bricks for general masonry work shall conform to IS: 1077-1970 and for face brick work shall conform to the specifications in IS: 2691-1972.

Bricks for general masonry work shall be of first class (Class-A) quality, well burnt, of uniform size, shape and colour free from cracks, flaws warpage or nodules or free lime, having a frog 100mm in length 40 mm in width and 10mm to 20mm deep on one of its flat sides and omit clear ringing sound when struck. Fractured surface shall show uniform texture free from grits, lumps boles etc.

Compressive strength shall be as per table-1 below. The bricks, when tested, shall have a minimum average compressive strength for various classes as given in Table-1 below. The compressive strength of any individual brick tested shall not fall below the min. average compressive strength specified for the corresponding class of brick by more than 20%. In case compressive strength of any brick tested exceeds the upper limit for the corresponding class of bricks, the same shall be limited to upper limit of the class as specified in Table-1 for the purpose of calculating the average compressive strength.

The average value of water absorption of bricks when tested shall not be more than 20% by weight.

All bricks shall have rectangular faces and sharp straight edges. Maximum permissible chippage for face bricks shall be 6 mm at the edges and 10 mm for corners. The rating of efflorescence shall not be more than 'moderate'.

Each brick shall have the manufacturer's identification marks clearly marked on the frog. Representative samples shall be submitted and approved sample shall be retained by the Engineer for future comparison and reference. The colour and texture of face bricks shall be up to the specification and defective bricks shall be removed immediately from site at the Contractor's own cost.

TABLE-1

Class Designation	Average compressive strength			
	Not less than		Less than	
	N/mm^2	(kg/cm^2)	N/mm^2	(kg/cm^2)
12.5(125)	12.5	(125)	15.0	150
10 (100)	10	(100)	12.5	125
7.5 (75)	7.5	(75)	10	100
5 (50)	5	(50)	7.5	75
3.5 (35)	3.5	(35)	5.0	50

ii) Fly Ash Lime Bricks (FLAG Bricks): The Fly Ash Lime Bricks (flag Bricks) shall conform to IS 12894. Visually the bricks shall be sound, compact and uniform in shape free from visible cracks, warpage, flaws and organic matter. The bricks shall be solid and with or without frog on one of its flat side. Fly ash shall confirm to IS 3812.

Note : This item will be operated only for load bearing structure up to 2 storied and for non-load bearing walls 23cms thick for multi-storeyed buildings.

Bottom ash used as replacement of sand shall not have more than 12 % loss on ignition when tested.

Sand : Deleterious materials, such as clay and silt in the sand shall preferably be less than 5%.

Lime : Lime shall confirm to class 'C' hydrated lime of IS 712

Additives : Any suitable additive considered not detrimental to the durability of bricks may be used.

iii) **Clay Fly Ash Bricks :** The clay fly ash bricks shall conform to IS 13757. The bricks shall be sound, compact and uniform in shape and colour. Bricks shall have smooth rectangular faces with sharp and square corners. The bricks shall be free from visible cracks, flaws, warpage, nodules of free lime and organic matter, the bricks shall be hand or machine moulded. The bricks shall have frog of 100 mm in length 40 mm width and 10 to 20 mm deep on one of its flat sides. If made by extrusion process may not be provided with frogs. Fly ash shall conform to grade I or Grade II of IS 3812.

iv) **Mechanised Autoclave Fly Ash Lime Brick:** These bricks shall be machine moulded and prepared in plat by appropriate proportion of fly ash and lime. The autoclave fly ash bricks shall conform to IS 12894. Visually, the bricks shall be sound, compact and uniform shape, free from visible cracks, warpage and organic matters. The brick shall be solid with or without frog, and of 100/80 mm in length, 40 mm width and 10 to 20 mm deep one of its flat side as per IS 12894. The brick shall have smooth rectangular faces with sharp corners and shall be uniform in shape and colour. Fly ash shall conform to IS 3812 and lime shall conform to class 'C' hydrated lime of IS 712.

b) **Stone**

All stones shall be 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 earthy appearance. Stone showing mottled colours shall not be used for face work. A stone shall not absorb more than 5 per cent of its weight of water after 24 hours immersion and for laterite this percentage is 12%. 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. The compressive strength of common types of stones shall be as per Table below.

TABLE-2

Type of stone	Maximum Water Absorption Percentage by weight	Minimum Compressive Strength kg/sq.cm
Granite	0.5	1000
Basalt	0.5	400
Lime stone(Slab & Tiles)	0.15	200
Sand stone (Slab & Tiles)	2.5	300
Marble	0.40	500
Quartzite	0.40	800
Laterite(Block)	12	35

c) **Lime**

Lime shall be stone lime and conform to the specification Building Limes - IS: 712. Lime putty may be prepared from hydrant lime or quick lime. Hydrated lime shall be mixed with water to form putty and stored with reasonable care to prevent evaporation for at least 24 hours before use. Quick lime shall be shaked with enough water to make a cream, passed through a No. 0 Sieve and then stored with reasonable care to prevent evaporation for at least 7 days before use.

d) **Cement**

Cement used shall be ordinarily Portland cement conforming to Code for ordinary cement in IS: 269 and shall be fresh when delivered. The Contractor shall submit the manufacturer's certificate for each consignment of cement procured to the Engineer. If the cement is procured by the Owner and issued to the Contractor, the Contractor shall satisfy himself at the time of taking delivery that the quality, quantity and freshness of cement are up to the specified standards. No complain later on regarding the cement supplied by the Owner shall be entertained and all rectification work on this account shall be done by the Contractor at his own expense. 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.

e) **Coarse Aggregates**

Coarse aggregates shall be as per IS:383 latest edition, consisting of hard, strong and durable pieces of crushed stone and shall be free from organic or clay coatings and other impurities like disintegrated stones, soft flaky particles etc. and any other material liable to affect the strength, durability or appearance of concrete.

Aggregates other than crushed stone conforming to the provisions of specification may be used if permitted by the Engineer.

Washing of aggregates by approved means shall be carried out, if desired by the Engineer.

Grading of coarse aggregates shall generally conform to IS:383 and shall be such as to produce a dense concrete of the specified proportions and strength and of consistency that will work readily into position without segregation.

f) **Sand**

Sand shall be hard, durables, 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 pyrities, alkalis, salts, coal, mica 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 corrosions to any metal in contact with such mortar, plaster or concrete. All sand shall be properly graded. Unless otherwise directed by the Engineer all sand shall pass through IS Sieve No. 240 and 15 to 35% of and for masonry mortar and 5 to 50% of sand for plaster shall pass through IS Sieve No. 30. Sand for concrete shall conform to IS: 383.

g) **Water**

Water shall be clean, fresh and free from organic matters, acids or soluble salts and other deleterious substances which may cause corrosion, discolouration, efflorescence etc.

h) **Reinforcement**

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust, oil and grease or other coatings which may impair proper bond. Structural steel shall conform to IS: 226. Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement shall conform to IS: 432 Cold twisted steel bars shall conform to IS: 1786. 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 galvanised.

3.00.00 STORAGE AND HANDLING OF MATERIALS

a) Bricks

Bricks shall not be dumped at site. They shall be stacked in regular tiers, even as they are unloaded, to minimise breakage and defacement of bricks. Bricks selected for different situation of use in the work shall be stacked separately.

b) Stones

Stones shall be stored at site in manner approved by the Engineer. Dressed stone for wall facing, paving etc. shall be stored with special care to avoid defacement of faces and edges or damp and rust stains.

c) Lime

Lime shall be stored in weatherproof sheds.

d) Cement

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.

e) Coarse and Fine Aggregates

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.

f) Reinforcement

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.

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SECTION-IX

TECHNICAL SPECIFICATION
FOR
FABRICATION OF STRUCTURAL STEELWORK

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SECTION-IX

TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEELWORK

1.0.0 SCOPE

This specification covers supply, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork in general covered under the scope of the contract. However, for any special structures such as rail & road bridges, steel chimney, tanks, transmission towers, furnace structures, etc., the relevant Indian Standard or IRC specification and Codes of Practices shall be given due consideration over & above this specification.

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 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 approved design drawings marked 'Released for construction'.

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) Prepare and submit monthly materials reconciliation statement showing effective utilization of raw steel materials supplied from EPC contractor's store for time to time assessment of scrape generation.

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 Despatch lists, 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.

2.2.0 **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.

2.3.0 **Codes and standards**

All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard Specification, any other standard practice, as may be specified by the Engineer shall be followed :

IS : 800 - Code of practice for general construction in steel.

IS : 801 - Code of practice for use of cold formed light gauge steel structural members in general building construction.

IS : 806 - Code of practice for use of steel tubes in general building construction.

IS : 808 - Dimensions for rolled steel beams, channels and angle sections.

IS : 812 - Glossary of terms relating to welding & cutting of metals.

IS : 813 - Scheme of symbols for welding.

IS : 814 - Covered electrodes for metal arc welding of carbon and carbon manganese steel.

IS : 815	-	Classification coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel.
IS : 816	-	Code of practice for use of metal arc welding for general construction in mild steel.
IS : 817	-	Code of practice for training & testing metal arc welders.
IS : 818	-	Code of practice for safety and health requirements in electric and gas welding and cutting operations.
IS : 819	-	Code of practice for resistance spot welding for light assemblies in mild steel.
IS : 822	-	Code of practice for inspection of welds.
IS : 919 (Part - 1&2)	-	Recommendations for limits and fits for engineering.
IS : 1161	-	Steel Tubes for structural purposes.
IS : 1182	-	Recommended practice for Radiographic Examination of fushion welded butt joints in steel plates.
IS : 1200 (Part - 8)	-	Method of measurement of steel work and iron work
IS : 1239 (Part - 1&2)	-	Mild steel tubes, tubulars & other wrought steel fittings
IS : 1363 (Part - 1 to 3)	-	Hexagon head bolts, screws & nuts of product grade C
IS : 1364 (Part - 1 to 5)	-	Hexagon head bolts, screws and nuts of product grade A & B
IS : 1365	-	Slotted counter sunk head screws (dia. 1.6 to 20 mm)
IS : 1367 (Part - 1 to 18)	-	Technical supply conditions for threaded steel fasteners.
IS : 1608	-	Method for tensile testing of steel products.
IS : 1730	-	Dimensions for steel plate, sheet and strip for structural and general engineering purposes.

IS : 1852	-	Rolling and cutting tolerances for hot-rolled steel product.
IS : 1977	-	Structural steel (Ordinary quality)
IS : 2016	-	Plain washer
IS : 2062	-	Steel for general structural purposes.
IS : 2629	-	Recommended practice for hot-dip galvanising of iron and steel.
IS : 2633	-	Method for testing uniformity of coating on zinc coated articles.
IS : 3644	-	Code of practice for ultrasonic pulse echo testing by contact and immersion method.
IS : 3757	-	High Strength Structural Bolt
IS : 4000	-	High strength bolts in steel structure
IS : 4759	-	Specifications for hot-dip zinc coatings on structural steel and other allied products.
IS : 4923	-	Hollow steel sections for structural use.
IS : 5334	-	Code of practice for magnetic particle flaw detection of weld.
IS : 5369	-	General requirements for plain washers and lock washer.
IS : 6005	-	Code of practice for phosphating of iron and steel.
IS : 6649	-	Specification for hardened and tempered washers for high strength structural bolts and nuts.
IS : 6623	-	Specification for high strength structural nuts.
IS:7215	-	Tolerances for fabrication of steel structures.
IS : 7280	-	Bare wire electrode for submerged arc welding
IS : 8500	-	Structural steel micro alloyed (medium & high strength quality).

IS : 8629 (Part - I to III)	-	Code of practice for protection of iron steel & structures from atmospheric corrosion.
IS : 9595	-	Recommendation for metal arc welding of carbon manganese steels.

PAINTING

IS : 117	-	Specification for ready mixed paint, brushing, finishing, exterior, semi-gloss, for general purposes.
IS : 128	-	Specification for ready mixed paint, brushing, finishing, semi-gloss for general purposes, black.
IS : 1477 (Part - I & II)	-	Code of practice for painting of ferrous metal in building
IS : 2074	-	Ready mixed paint, air-drying red-oxide zinc chrome priming.
IS : 2339	-	Specification for aluminium paints for general purposes in dual container.
IS : 2932	-	Specification for enamel, synthetic exterior type - I.
IS : 2933	-	Specification for enamel, synthetic exterior type - II.

2.4.0 **Conformity with Designs**

Except where the standard connection details are furnished, the contractor shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer Keeping in view the maximum utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract.

2.5.0 **Materials to be used**

2.5.1 **General**

All steel materials shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, 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 of materials supplied by the contractor 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 tonnes or less of any particular section.

The arc welding electrodes shall conform to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and amperage (Polarity in case of D.C. supply) for which the electrodes are suitable.

2.5.2 **Steel**

All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable :

IS : 801 - Cold formed light gauge steel structural member.

IS : 806 - Steel tubes in general building construction.

IS : 1161 - Steel tubes for structural purpose.

IS : 1977 - Structural steel (Ordinary quality) St-42-0

IS : 2062 - Steel for general structural purpose

IS : 8500 - Structural steel-microalloyed (Ordinary & high strength quality)

In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable.

2.5.3 **Electrodes**

All electrodes to be used under the Contract shall comply with any of the following Indian Standard Specifications as may be applicable :

IS : 814 - Covered electrodes for metal arc welding structural steel

IS : 815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel.

IS : 7280 - Base wire electrode for submerged arc welding.

2.5.4 **Bolts and Nuts**

All bolts and nuts shall conform to the requirements of Indian Standard Specification IS:1367 - Technical Supply Conditions for Threaded Fasteners.

Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable.

a) Mild Steel : All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm2 and a minimum elongation of 23 per cent on a gauge length of 5.6 ÖA, where 'A' is the cross sectional area of the test specimen :

IS : 1367 - Technical supply conditions for threaded fasteners.

IS : 1608 - Method for tensile testing of steel other than sheet, strip, wire and tube.

b) High Tensile Steel : The material used for the manufacture of high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS:1367 or as approved by the Engineer.

2.5.5 **Washers**

Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract :

IS : 1977 - Structural steel (Ordinary Quality) St-42-0

IS : 2062 - Steel for general structural purpose

IS : 8500 - Structural steel - microalloyed (medium & high strength quality)

IS : 6623 - High Strength Structural Nuts

IS : 6649 - Hardened and tampered washers for high strength structural bolts & nuts.

2.5.6 **Paints**

Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to the Indian Standard Specification IS:2074 - Ready mixed Paint, Air Drying, Red Oxide - Zinc Chromate Priming.

In highly corrosive environment other type of primer such as epoxy rasin based zinc rich primer ~~(such as blast steel EZ1 of Shalimer Paints Ltd., or equivalent)~~ may be necessary.

2.6.0 **Storage of Material**

2.6.1 **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.

2.6.2 **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 length-wise 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.

2.6.3 **Electrodes**

The electrodes for electric are 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.

2.6.4 **Bolts, Nuts and Washers**

Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length and quality.

2.6.5 **Paints**

Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.

2.7.0 **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)	Bolts, Nuts & Washers	:	Manufacturer's certificate, dimension checks, material testing.
c)	Electrodes	:	Manufacturer's certificate, thickness and quality of flux coating.
d)	Welders	:	Qualifying Tests

e) Welding sets : Performance Tests

f) Welds : Inspection, X-ray, Ultrasonic tests

g) Paints : Manufacturer's certificate, physical Inspection reports

h) Galvanizing : Tests in accordance with IS : 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products.

2.8.0 **Standard Dimensions, Forms and Weights**

The dimensions, forms, weights and tolerances of all rolled shapes bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards.

2.9.0 **Shop Drawings**

The contractor shall within thirty (30) days after the award of the Contract submit to the Engineer the Schedule of Fabrication and delivery of structural steelwork for approval. He shall, within forty-five (45) days after the award of the contract start to submit progressively for approval, the shop drawings based on the approved Design Drawings and, before proceeding with the fabrication work, shall get the said shop drawings approved in accordance with the contract.

The sequence of submission of shop drawings for approval shall match with the approved fabrication and delivery schedule. The approval for the shop drawings will be accorded only towards the general conformity with the design requirements as well as specification and will ensure the correctness of general arrangement for centre line dimensions and levels, Section sizes, and adequacy of connections including splice joints as to the no. of bolts, weld length, size of gusset/end plates. The correctness of all other details like cutting lengths, matching of holes, notch dimensions, match markings, bill of materials, bolt list etc. will be entirely the contractor's responsibility. The approval of the 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 shop drawings shall include but not be 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 bolt location etc.

c) Details of all connections with supporting calculations.

d) Comparison sheets to show that the proposed alternative section, if any, are as strong as the original sections shown on the Design Drawings.

e) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.

f) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof.

The shop drawings shall give all the necessary information for the fabrication, erection and painting of the steelwork in accordance with the provisions of this Specification. Shop drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Shop drawings shall give complete information necessary for fabrication of various components of the steelwork, including the location, type, size and extent of welds. These shall also clearly distinguish between shop and field 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 shop drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked -up stresses and distortion. Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification --IS:813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length.

The Contractor shall be responsible for and shall pay for 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.

3.0.0 WORKMANSHIP

3.1.0 Fabrication

3.1.1 General

All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS:800 - Code of Practice for use of Structural Steel in General Building Construction and other relevant Indian Standards or equivalent.

3.1.2 **Straightening Material**

Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification IS:1852 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600 Deg. C.

3.1.3 **Cutting**

Cutting shall be effected by shearing, cropping or sawing. 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 gauges 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.

3.1.4 **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.

3.1.5 **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 without web cleats shall be not more than 3 mm at each end, but where, for practical reasons, greater clearance is necessary, suitably designed cleatings shall be provided.

3.2.0 **Bolted Construction**

3.2.1 **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 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 bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the 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 H8 as specified in IS:919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

Holes for bolts shall not be formed by gas cutting process.

3.2.2 **Assembly**

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 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.

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 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 out through 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.

3.3.0 **Welded Construction**

3.3.1 **General**

Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS:817.

3.3.2 **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.

3.3.3 **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 Deg.).

The work shall be positioned for flat welding whenever practicable.

3.3.4 **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. Where it is impossible to avoid high residual 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 shop splicing not more than three sub-sections, each made in accordance with this paragraph.

When required by the Engineer, welded assemblies shall be stress relieved by heat treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Engineer.

3.3.5 **Welding Technique**

All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross- section. Groove welds made with the use of the backing of the same material as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness.

Groove welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the Contract.

To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to the relevant Indian Standards.

3.3.6 **Temperature**

No welding shall normally be done on parent material at a temperature below (-) 5 Deg.C. However, if welding is to be undertaken at low temperature, adequate precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40 mm thick and the temperature is between (-) 5 Deg. C and 0 Deg. 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 handwarm. 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 Deg. C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard.

3.3.7 **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.

3.3.8 **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.

3.4.0 **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 0.2 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc., after welding 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 or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 2.0 mm.

3.5.0 **Slab bases and caps**

Bases and caps fabricated out of steel slabs, except when cut from 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.

3.6.0 **Lacing bars**

The ends of lacing bars shall be neat and free from burrs.

3.7.0 **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.

3.8.0 **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.

3.9.0 **Architectural Clearances**

Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances.

3.10.0 **Shop Connections**

a) All shop connections shall be welded as specified on the Drawings.

b) 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 Owner.

3.11.0 **Castings**

Steel castings shall be annealed

3.12.0 **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 despatch. 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 interchangeability.

3.13.0 **Shop Painting**

3.13.1 **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 mechanical cleaning methods to remove loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by 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 through sweeping with a fibre brush.

After completion of the pre-cleaning, the metal surface shall be immediately painted with red oxide zinc chromate primer conforming to IS : 2074.

In highly corrosive environment, all steelwork shall be given a coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned by sand blasting to SA 2/1/2 grade minimum. The shop paint shall be epoxy rasin based zinc rich primer ~~such as Blast Steel EZ1 of Shalimer Paint Limited or equivalent.~~

3.13.2 **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.

3.13.3 **Contact Surfaces**

Contact surface shall be cleaned in accordance with Sub-clause 3.13.1 before assembly.

3.13.4 **Finished Surfaces**

Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

3.13.5 **Surfaces adjacent to field welds**

Unless otherwise provided for, surfaces within 50 mm of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

3.14.0 **Galvanizing**

3.14.1 **General**

Structural steelwork for switchyard or other structures as may be specified in the Contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS : 2629 - Recommended practice for Hot-Dip Galvanising 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.

3.14.2 **Surface Preparation**

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, dirt, 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.

3.14.3 **Procedure**

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested in accordance with IS:2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS:4759 - Specification for Hot-dip zinc coatings on Structural Steel & other allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.
Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes

damaged after having been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surfaces during transport and handling. Damages, if occur, shall be made good in accordance with the provisions of this Specification or as directed by the Engineer.

4.0.0. INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

4.1.0 Inspection

Unless specified otherwise, inspection to all work shall be made by the Engineer or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative 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.

4.2.0 Testing and Acceptance Criteria

4.2.1 General

The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost, unless otherwise specified in the Contract. 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.

4.2.2 Steel

All steel supplied by the Contractor shall conform to the relevant Indian Standards. Except otherwise mentioned in the Contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T. or less of any particular section for tests to conform to relevant Indian Standards. Cost of all tests shall be borne by the Contractor.
All material shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair their strength, durability and appearance.

4.2.3 **Testing Criteria for checking Lamination in raw steel plates**

All raw steel plate of thickness more than 20 mm supplied by the contractor shall be checked against lamination before procurement & prior to commencement of fabrication work in the following ways as directed by the Engineer :

a) Ultrasonic testing along the edge of specified points of the plates shall be carried out to delete lamination in the plates, if any.

b) If the results of the tests in (a) are not satisfactory, the whole area of the plates shall be checked by ultrasonic testing at specified nodal points formed at equidistant grid locations. The spacing of the grids shall be determined from tests in (a) or as directed by the Engineer.

If the results of the above tests are not satisfactory, the plates shall not be taken up for fabrication work. Even after fabrication at shop, if the Engineer requires any ultrasonic testing to detect lamination of plates, the same shall be carried out by the Contractor. If the plates in the fabricated item is found to be laminated, the component will be rejected.

4.2.4 **Welding**

All electrodes shall be procured from reliable manufacturers with test certificates. The correct grade and size of electrode which has not deteriorated in storage shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tonnes of welded fabrication, the Engineer may ask for at least 1 (one) test-destructive or non-destructive including X-ray, ultrasonic test or similar, the cost of which shall be borne by the Contractor. In the event of further tests as may be desired by the Engineer, the cost of such test shall be borne by the Contractor if the results are found to be unsatisfactory; and if the test shows no defect, the cost shall be borne by the Owner. In cases of the test results showing deficiency, the Engineer shall have option to reject or instruct any remedial measures to be taken free of charge to the Owner.

4.2.5 **Bolts, nuts and washers**

All bolts, nuts and washers shall be procured from reputed manufacturer approved by the Engineer and shall conform to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards. Cost of all such testing shall have to be borne by the Contractor.

4.2.6 **Shop painting**

All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of the relevant Indian Standards.

4.2.7 **Galvanizing**

All galvanizing shall be uniform and of standard quality when tested in accordance with IS:2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS:4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products.

4.3.0 **Tolerance**

The tolerances on the dimensions of individual rolled steel components shall be as specified in IS:1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures other than steel railway & road bridges, structures subjected to dynamic loading (like wind, seismic etc.) and thin walled construction (like box girders) shall be as specified in IS:7215 - Tolerances for Fabrication of Steel Structures.

4.4.0 **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 the test results obtained at the Contractor's works by independent tests at an approved laboratory and should the items, so tested, be found to be unsatisfactory, the costs shall be borne by the contractor, and if satisfactory, the costs shall be borne by the Owner.

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 an acceptance certificate, upon receipt of which, the items will be shop painted, packed and despatched. 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.

4.5.0 **Delivery of Materials**

4.5.1 **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.

4.5.2 **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.

4.5.3 **Packing and Shipping**

All projecting plates or edges and all ends of members of joints shall be stiffened, all straight members and plates, shall be bundled, all screwed ends and machined surfaces shall be suitably packed and all bolts, nuts, washers, and small loose parts shall be packed separately in order to prevent damage or distortion during shipping.

Shipping shall be strictly in accordance with the sequence stipulated in the agreed programme. Payment may be held up for items sent in advance of the sequence till they could be erected. The Contractor shall include and provide for in his rates, the freight and other charges for despatching the materials to the worksite and also for securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All packings shall allow for easy removal and checking at site. Special precautions shall be taken against rusting, corrosion, breakage or damage otherwise of the materials. 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 package shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads.

After delivery of the materials at site, all packing materials shall automatically become the property of the Owner without any extra payment.

Notwithstanding anything stated here in before, 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 progressive bills of the Contractor.

Necessary advise regarding the shipment with relevant details shall reach the Engineer at least a week in advance.

5.0.0. INFORMATION TO BE SUBMITTED

5.1.0 With Tender

The following information are 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 shop drawings

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 steel work including miscellaneous steelwork

vii) Final date of completion of all shipments

Time required for completion being one of the main criteria for selecting the successful bidder, it is desired that the bidder quotes the minimum time required by him for completing the work.

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.

c) **Matching Steel**

A rough indication of the quantities and details of matching steel sections required to start the work shall be furnished.

5.2.0 After Award

After award of the Contract the successful Tenderer is to submit the following :

a) Complete fabrication drawings, material lists, cutting lists, bolt lists, field welding schedules based on the design drawings furnished to 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 of 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 and scrap.

d) Results of any test as and when conducted and as required by the Engineer.

e) Manufacturer's mill test report in respect of steel materials, bolts, nuts and electrodes as may be applicable.

6.0.0 RATES

6.1.0 General

In general, even though it may not be specifically mentioned in the Schedule of Items, the rates for items mentioned in the Schedule of Items shall include cost of all materials consumed in the work or incidental to it, hire charges of tools and plants, cost of labour, insurance, all transport charges including taking delivery of raw steel from Contractor's Site Stores and transporting the same to the Contractor's fabricating workshop and delivery of finished fabricated materials ~~back~~ to sites, all taxes, royalties,, making approaches, security and safety arrangements, power, fuel, lubricant, preparation of all fabrication drawings, material lists, cutting lists, bolt lists, field welding schedule, services, supervision, overheads, profits etc. complete in all respects unless certain items specifically excluded by the terms and conditions of the Contract and as mentioned in the following sub-clauses.

6.2.0 Fabrication

The rates quoted for fabrication of various categories of steelwork shall specifically include taking delivery and transport of raw steel from the stockyard as mentioned in the Contract upto the Contractor's fabricating shop and one shop coat of approved metal protection paint but exclude any transport of the fabricated materials. The rates for fabrication shall also include supply of all electrodes required for shop and field work including 10% extra for field work.

6.3.0 ~~Transport~~

The rate quoted for transport shall include all C.I.F. from the Contractor's fabricating shop upto the Site and loading of the fabricated materials on railway wagons or trucks at the fabricating shop but shall generally exclude unloading at site(which is generally included in the rate for erection). But, in case the terms & conditions of the contract so desire, the cost of unloading of the fabricated material at site shall also be included in the quoted rates for transport.

6.4.0 **Bolts, nuts and washers**

The rates quoted for the supply of bolts, nuts and washers shall include the total cost of delivery of the materials at site or to the Owner's Site stores as directed by the Engineer.

7.0.0 **METHOD OF MEASUREMENT**

7.1.0 **Fabrication**

Measurement shall be in tonnes and based on the unit weights as per relevant Indian Standards and on the following considerations : -

a) All members, except plate works paid under rates for bunkers, tanks, etc., will be measured square.

b) All plate works paid under rates for bunkers, tanks, etc. as applicable will be measured as actual.

c) No deduction will be made for bolt and/or holes and/or holes upto 25 Sq.Cm.

d) Unless otherwise specified no allowance shall be made for weld metals in case of welded steel structure.

7.2.0 **Supply of bolts, nuts and Washers**

The supply of bolts, nuts and washers will be measured on standard unit weight basis or actuals whichever is less.

7.3.0 **Transport**

The measurement for transport of fabricated steelwork will be for the net weight of the fabricated materials as measured under Sub-clause 7.1.0 excluding the weight of all packing and supporting materials necessary for transport.

8.0.0 **PAYMENT**

Unless mentioned otherwise in the tender / contract document, for fabricated materials delivered to Site, the Contractor shall be entitled to 90% of the value of the materials supplied and the balance 10% shall be paid only after the final erection, and aligning of the fabricated materials. In addition, the Security Money as stipulated in the Contract, shall be deducted from each payment.

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SECTION-X

TECHNICAL SPECIFICATION
FOR
ERECTION OF STRUCTURAL STEEL WORK

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SECTION-X

TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEEL WORK

1.0.0 SCOPE

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at Site, and/or from Contractor's Site Stores or store Yard, installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

The 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 the 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, 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 center 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 brought to the notice of the Engineer. 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, leveling, bolting, welding and securely fixing the fabricated steel structures in accordance with the Drawings or as directed by the Engineer.

f) Painting of the erected steel structures if required by the Contract.

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 bolt if required.

iv) Welding of connections in place of bolting for which holes are either not drilled at all or wrongly drilled during fabrication. Welding in place of bolting will be permitted only at the discretion of the Engineer.

v) Refabrication of parts damaged beyond repair during transport and handling or Refabrication of parts which are incorrectly fabricated.

vi) Fabrication of parts omitted during fabrication by error, or subsequently found necessary.

vii) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.

viii) Carry out tests in accordance with this Specification if directed.

2.2.0 **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.

2.3.0 **Codes and Standards**

All work under this Specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specification and codes of Practice of equivalent :

IS-800	:	Code of Practice for general construction in steel
IS-456	:	Code of Practice for plain or reinforced concrete
IS-7205	:	Safety Code for erection of Structural Steel work
IS-12843	:	Tolerance for erection of Steel Structures

2.4.0 **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 design criteria detailed in the approved erection drawings and/or other stated document. All work shall conform to the provisions of the relevant Indian Standard Specifications and/or the instructions of

the engineer. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specification and /or the instructions of the Engineer.

2.5.0 **Material**

2.5.1 **General**

All fabricated steel structures and connection materials shall be supplied by the Contractor for fabrication work. The Contractor for erection work will take delivery of all the materials from the Contractor's Stores or storage yard at Site. The Contractor may also have to take delivery directly from railway wagons or trucks at Site as per terms & condition of the contract, in which case he shall have to unload the materials and perform all formalities like checking of materials and attend to insurance matters in accordance with Sub-Clause 2.1.0 and as specified herein before.

While taking delivery, the Contractor will check the quantity, quality and the sizes of the materials and verify the adequacy of the same in accordance with the Drawings and Specifications. In case the Contractor finds any material inadequate, he shall inform the Engineer immediately prior to taking delivery of the same. No claim whatsoever, in respect of bad quality, shortages or difference in size will be entertained once the delivery is taken and the Contractor shall make good any such deficiency, if detected later, either by repair or with fresh material as may be directed by the Engineer at the Contractor's Own cost.

Excepting all field connection materials like bolts, nuts, washers and electrodes, which will be supplied by the fabrication Contractor to the extent of 10% in excess of the estimated requirements as per Drawings, all other consumables like oxygen and acetylene gas, paints, fuels, lubricants, oil, grease, cement, sand, aggregates and any other material that may be required for the execution of the works in accordance with the contract will be supplied by the contractor for erection work and will be deemed to have been included in this rates.

2.5.2 **Materials to conform to Indian Standards**

All materials required to be supplied by the Contractor under this Contract shall conform to the relevant Indian Standard Specifications.

2.6.0 **Storage of materials**

2.6.1 **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.

2.6.2 **Yard**

The Contractor will have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other materials which will be delivered to him by the Owner according to the Contract. The yard shall have proper facilities like, drainage, lighting, 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 should 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.

2.6.3 **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.

2.7.0 **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 :

a) Erection : Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.

b) Grouting : Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency and strength of grout.

c) Painting : Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

2.8.0 **Taking Delivery**

The erection Contractor shall take delivery of fabricated structural steel and necessary connection materials supplied by the fabrication Contractor from railhead, trucks and/or the Owner's stores at site as may be necessary and as per terms & conditions of the contract or as directed by the Engineer. He shall check, unload, transport the materials to his stores for proper storing at his own cost. The erection 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 erection 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.

3.0.0 **WORKMANSHIP**

3.1.0 **Erection**

3.1.1 **Plant and equipment**

The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be efficient, dependable, in good working condition and shall have the approval of the Engineer.

3.1.2 **Method and sequence of erection**

The method and sequence of erection shall have the prior approval of the Engineer. The Erection shall arrange for most economical method and sequence available to him consistent with the Drawings and Specifications and such information as may be furnished to him prior to the execution of the Contract.

3.1.3 **Temporary bracing**

Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install, free of cost to the Owner, 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 responsibility of the Contractor in respect 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 be removed immediately upon completion of the steel erection and shall return to the Owner's store in good condition if the materials are supplied by the Owner otherwise permission shall be given to Contractor to take out the materials from the project site. The Owner may remove and return the materials in good condition to the Contractor without any charge if they have been left in place under other agreed arrangement.

3.1.4 **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 by-laws of state, Municipal or other local authorities.

3.1.5 **Setting out**

Positioning and leveling 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. Concrete foundations, where required, shall be made by other agencies. Anchor bolts and other anchor steel shall be embedded by other agencies. The Contractor

shall check the positions and levels of the anchor bolts, etc. before concreting and get them properly secured against disturbance during pouring operations. He shall remain responsible for correct positioning. For heavy columns, etc. the Contractor shall set proper screed bars if desired by the Engineer, 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 allowable under this Specification.

No permanent field connections by bolting or welding shall be carried out until proper alignment and plumbing has been attained.

3.1.6 **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-1 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 x dia. or 200 mm	Bolt length exceeding 8xdia. 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 nut 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. 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 IS : 1367
20	59.94
22	81.63
24	103.73

NOTE :

The above torque values are approximate for providing tensions of 14.7 MT for 20 mm dia., 18.2 MT for 22 mm dia; and 21.2 MT 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 torque wrench.

In either of the above two methods, if required, for bolt entering and wrench operation clearances, tightening may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds.

Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this sub clause.

3.1.7 **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.

3.1.8 **Holes, cutting and fitting**

No cutting of sections, flanges, webs, cleats, 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, or his own work to accommodate other trades, unless such work is clearly specified in the Contract or directed by the Engineer. Wherever such work is 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.

3.2.0 **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.

3.3.0 **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.

Admixtures like aluminium powder, "ironite" or equivalent may be required to be added to the grout to enhance certain desirable properties of the grout.

Alternatively, the grouting may be done with non-shrink high strength free flow cementious grout (ready mixed) like Conbextra-GP-1 or "Sika grout - 214", or "Anchor NSG" or approved equivalent.

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 leveled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned.

3.4.0 **Painting after erection**

Field painting, if required to be done by the erection Contractor, shall only be done after the structure is erected, leveled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. However, touch up paintings, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the erection 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 rainy 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 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 assembly. Bolts and fabricated steel members which are galvanized or otherwise treated and steel members to be encased in concrete shall not be painted.

The specification for paint and workmanship shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable to the project. The number of coats and the shades to be used shall be as specified or as directed by the Engineer.

3.5.0 **Stainless Steel Plate Lining in Bunker Hopper**

The hopper portion of the coal bunkers shall be lined with stainless steel plates of 4 mm thickness. The stainless steel shall be of AISI 304 quality. The work includes supply, fabrication, welding and fixing of stainless steel lining plate to bunker M.S. plate as per drawing & specification.

The stainless steel liner shall be fixed to the tanker hopper MS shall be plug welding using special electrodes (such as, Inox-CW coding AWS-310-16, ISMBOS-311 or Inox-D2 coding AWSE-309-16, ISMB 04-311 manufactured by Advani Oerlikon Ltd. or equivalent). Such plug welding shall be done by drilling 21.5 mm dia. holes at 300 mm centre to centre both ways as per drawings. The plug welding shall be ground flush with the lining plate.

3.6.0 **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.

3.7.0 **Safety Measures during Erection**

The safety measures to workmen and supervisors during all types of erection work (e.g., use of lifting appliances, slingning, welding, gas cutting, etc.) should be taken as per IS : 7205. When any statutory provisions exist, the same shall be complied with in addition to the provisions contained in the above code.

4.0.0 **TESTING AND ACCEPTANCE CRITERIA**

4.1.0 **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 of either fabrication or erection of steelwork whoever is responsible for it and no payment towards the cost of the dismantled portion and any connected work shall be made to the Contractor, unless it is proved that the deficiency is due to reasons beyond the Contractor's scope. On the basis of the tests, the Engineer will decide whether the fabricator or the erector is responsible for the unacceptable member or structure and his decision will be final. In case it is established that the unacceptability of the member or structure is due to design deficiency, the cost of replacement and/or modifications will be borne by the Owner. 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 responsible,

to the satisfaction of the Engineer. The cost of the tests specified hereinafter shall be borne by the Owner. 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 4.1.1, 4.1.2 and 4.1.3. The method of testing and application of loading shall be as approved by the Engineer.

4.1.1 **Stiffness Test**

In this test, the structure or member shall be subjected, in 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.

4.1.2 **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 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.

4.1.3 **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.

4.1.4 **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 herein before 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 4.1.1. herein before.

4.2.0 **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 steelwork applicable to this Project and as specified below:

I. **For Buildings Containing Cranes**

Component	**Description**		**Variation Allowed**
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

Component	Description		Variation Allowed
	ii)	For a column greater than 10M but less than 40M height any 10M	ii) ± 3.5 mm from true vertical for length measured between connection levels, but not more than ± 7.0 mm per 30 m length
	c)	For adjacent pairs of columns across the width of the building prior to placing of truss.	± 9 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 level supposed to be at the same level.	3 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 not greater than 10 mm which ever is the least
	b)	Lateral displacement of top chord at centre of span from vertical plane running through centre	1/250 of depth of truss or 20 mm whichever is the of supports least

Component	Description		Variation Allowed
Crane Girders & Tracks	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 thermit 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 Deg.C per unit length.	

II. **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 10M 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.

4.3.0 **Acceptance**

Structures and members which have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.1.0, 4.1.1, 4.1.2, 4.1.3 and 4.1.4 and other applicable provisions of this Specification and are within the limits of tolerances specified in Sub-clause 4.2.0 and/or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfilment of the provisions of this Contract.

5.0.0 **INFORMATION TO BE SUBMITTED**

5.1.0 **Before Tender**

Along with the Tenders the Tenderers will be required to submit the following information :

5.1.1 **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.

5.1.2 **Constructional Plant and Equipment, Tools, Temporary Works & Manpower**

A detailed list of all Constructional Plant & 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.

5.1.3 **Erection yard**

A site plan showing the layout and location of the erection yard proposed to be established by the Tenderer shall 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.

5.2.0 **After award of the Contract**

After award of the contract, the Contractor shall submit the following :

5.2.1 **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.

5.2.2 **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 5.2.1 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.

6.0.0 **RATES**

Even though it may not be specifically mentioned in the Schedule of Items, the rates shall include all work to be provided by the Contractor in accordance with Sub-clause 2.1.0 of this Contract and cost of all materials and labour required to complete the work or incidental to it, hire charges of Constructional Plant and Equipment and erection tools, insurance, all necessary transport, taxes and royalties, making necessary arrangements for approaches, yard, security, safety and other facilities, power, fuel, lubricant, services, supervisions, overheads, profits etc. complete in all respects. It shall also include cost of all other work and supplies not specifically mentioned but reasonably implied as being necessary to complete the works in all respects in accordance with the Contract.

7.0.0 **METHOD OF MEASUREMENT**

7.1.0 **Erection**

All measurement shall be in tonnes and based on the theoretical unit weights as per Indian Standard and on the following considerations :

a) All members, except plate work paid under rates for bunkers, tanks, etc. shall be measured square.

b) All plate work paid at rates for bunkers, tanks, etc. shall be measured as actual.

c) No deduction shall be made for bolt and/or holes for other purposes upto 25 Sq.cm. in area.

d) Unless otherwise specified in the case of welded steel structure, no allowance shall be made for the weld metal.

e) No separate payment shall be made for field connection materials such as permanent bolts, nuts, washers, erection bolts and nuts. No extra payment shall be made for site welding.

7.2.0 **Grouting**

The measurement of grouting the stanchion and other base plates shall be on the basis of theoretical volume of the voids to be filled in Cu.M. without any deduction for the volume of embedments. Edges of the grouting shall be measured square neglecting chamfers, if any.

7.3.0 **Painting**

The finish painting, other than touch up and other painting, if required to be done within the quoted rates as per this Specification, shall be measured on the basis of the tonnage of the structure erected and painted calculated on the basis of Sub-clause 7.1.0.

8.0.0 **PAYMENT**

Unless mentioned otherwise in the Tender/Contract document for fabricated materials erected, aligned, plumbed, levelled and grouted, the Contractor shall be paid 95% (ninety-five percent) of the value of erection. the balance 5% (five percent) shall be paid after acceptance of the structure withstanding necessary tests in accordance with the Contract. Necessary deductions towards Security Money shall be made from all bills of the Contractor in accordance with the Contract.

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SECTION-XV

QUALITY ASSURANCE AND INSPECTION FOR CIVIL AND STRUCTURAL WORK

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SECTION-XV

QUALITY ASSURANCE AND INSPECTION FOR CIVIL AND STRUCTURAL WORK

1.00.00 INTRODUCTION

1.01.00 This part of the specification covers the sampling, testing and quality assurance requirement (including construction tolerances and acceptance criteria) for all civil and structural works covered in this specification.

1.02.00 This part of the technical specification shall be read in conjunction with other parts of the technical specifications, general technical requirements & erection conditions of the contract. Wherever IS code or standards have been referred they shall be the latest revisions.

1.03.00 The rate for respective items of work or price shall include the cost for all works, activities, equipment, instrument, personnel, material etc. whatsoever associated to comply with sampling, testing and quality assurance requirement including construction tolerances and acceptance criteria and as specified in subsequent clauses of this part of the technical specifications. The QA and QC activities in all respects as specified in the technical specifications/ drawings / data sheets / quality plans / contract documents shall be carried out at no extra cost to the owner.

1.04.00 The contractor shall prepare detailed construction and erection methodology scheme which shall be compatible to the requirements of the desired progress of work execution, quality measures, prior approvals if any and the same shall be got approved by the Engineer. If required, work methodology may be revised/ reviewed at every stage of execution of work at site, to suit the site conditions by the contractor at no extra cost to the owner.

2.00.00 QUALITY ASSURANCE PROGRAMME

2.01.00 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 sub-contractor's premises or at the OWNER'S 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 OWNER or their authorized representative after discussions before the start of work. The QAP shall be generally in line with IS/ISO Systems.

The contractor shall furnish complete QA & QC programme for the work envisaged which may include the following

- Organization structure for the management and implementation of the proposed quality assurance programme
- Quality System Manual
- Design Control System
- Documentation and Data Control System
- Qualification data / details for Contractor's key personnel
- The procedure for purchase of materials, parts, components and selection of subcontractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased, etc.
- System for shop manufacturing and site erection controls including process, fabrication and assembly
- Control of non-conforming items and system for corrective actions and resolution of deviations
- Inspection and test procedure both for manufacture and field activities.
- Control of calibration and testing of measuring testing equipment.
- System for Quality Audits
- System for identification and appraisal of inspection status
- System for authorizing release of manufactured product to the OWNER
- System for handling, storage and delivery.
- System for maintenance of records
- Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of work/ equipment/component.

3.00.00 **QA AND QC MANPOWER**

3.01.00 The contractor shall nominate one overall QA coordinator for the contract detailing the name, designation, contact details and address at the time of post bid discussions. All correspondence related to Quality Assurance shall be addressed by the contractor's QA coordinator to OWNER. OWNER shall address all correspondence related to Quality issues to the contractor's QA coordinator. The contractor's QA coordinator shall be responsible for co-ordination of Quality activities between various divisions of the contractor and their sub-vendors on one hand & with OWNER on the other hand.

3.02.00 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 contractor's QA&QC manpower required to be deployed at site is enclosed at Annexure-I. Based on the finalized L-2 network and the approved Field Quality plan, the contractor shall finalize and submit a deployment schedule of QA&QC personnel along with their details to OWNER for approval/ acceptance and further shall ensure their availability well before the start of the concern activity.

3.03.00 The QA&QC in-charge shall have the organizational freedom and authority to implement the requirements of these quality assurance arrangements, free from commercial and programme restraints. The QA&QC setup of the contractor shall consist of qualified and experienced Civil, Electrical, Mechanical Engineers and Laboratory assistants with their supporting staff both at their works and site.

3.04.00 The deployment of man power for QA & QC set up shall be affected on the basis of agreed manpower deployment schedule, which shall be prepared by the contractor based on the L-2 network and the same shall be submitted to the engineer-in-charge for acceptance.

4.00.00 **SAMPLING AND TESTING OF CONSTRUCTION MATERIALS**

4.01.00 The method of sampling for testing of construction materials and work / job samples shall be as per the relevant IS / standards / codes and in line with the requirements of the technical specifications / quality plans. All samples shall be jointly drawn, signed and sealed wherever required, by the contractor and the engineer or his authorized representative.

4.02.00 The contractor shall carry out testing in accordance with the relevant IS / standards/codes and in line with the requirements of the technical specifications/quality plans. Where no specific testing procedure is mentioned, the tests shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer. All testing shall be done in the presence of the engineer or his authorized representative.

4.03.00 Before execution of any civil work the contractor shall conduct full-scale suitability tests on various construction and building material such as fine and coarse aggregates, cement, reinforcement, construction chemicals, supplementary cementitious materials and construction water to ascertain their suitability for use and the concrete mix designs conducted from reputed institutes such as NCB-Ballabhgarh, CSMRS-Delhi, IIT's, etc. as agreed by the engineer. The test samples for such full scale testing shall be jointly sampled and sealed by the engineer and contractor, thereafter these shall be sent to the concerned laboratory through the covering letter signed by field quality assurance (FQA) representative of the engineer.

4.04.00 The contractor shall timely initiate the action with regard to the evaluation of aggregates and other building material including concrete mix design, so as to ensure completion of these tests before start of civil works at site, thereby not affecting any project work. The test reports and recommendations for suitability of the materials including concrete mix design shall be promptly submitted by the contractor to the engineer.

4.05.00 Evaluation of aggregate for potential alkali-aggregate reactivity shall be carried out as per following scope of work

A. Evaluation of Aggregates for Mechanical / Physical Properties

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

b) To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material, soundness, silt content, clay content and organic impurities as per IS: 2386.

c) To prepare evaluation report based on test results of a) and b) above and to advise regarding suitability of fine and coarse aggregates.

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

a) To carry out petrographic analysis and accelerated Mortar bar Test on aggregate samples (1N NaOH at 80 deg. Centigrade for 14 days as per ASTM 1260, or the method established/ developed by CSMRS for 22days test).

b) To prepare a report based on test results of a) above and to advise regarding suitability of aggregates to be used and further testing required if any.

5.00.00 LABORATORY AND FIELD TESTING

5.01.00 The field laboratory for QA and QC activities shall be constructed and set-up by the contractor in line with the indicative field QA&QC laboratory set-up enclosed at Annexure-II. The Laboratory building shall be constructed and installed with the adequate facilities to meet the requirement of envisaged test setup. Temperature and humidity controls shall be available wherever necessary during testing of samples. The quality plan shall identify the testing equipments/ instrument, which the contractor shall deploy and equip the field quality laboratory for meeting the field quality plan requirements. The contractor shall furnish a comprehensive list of testing equipments/ instrument required to meet the planned/scheduled tests for the execution of works for OWNER acceptance/ approval. The contractor shall mobilize the requisite laboratory equipment and QA&QC manpower at least 15 days prior to the planned test activity as per the schedule of tests.

5.02.00 All equipments and instruments in the field shall be calibrated before the commencement of tests and then at regular intervals, as per the manufacturer's recommendation and as directed by the OWNER. The calibration certificates shall specify the fitness of the equipments and instruments within the limit of tolerance for use. Contractor shall arrange for calibration of equipments and instruments by an NABL / NPL accredited agency and the calibration report shall be submitted to OWNER.

5.03.00 The tests which cannot be carried out in the field laboratory shall be done at a laboratory of repute. This includes all IITs, NCB, CSMRS, reputed government / autonomous laboratories / organizations, NITs and other reputed testing laboratories. The test samples for such test shall be jointly selected and sealed by the engineer and thereafter these shall be sent to the concerned laboratory through the covering letter signed by OWNER engineer. The test report along with the recommendations shall be obtained from the laboratories without delay and submitted to OWNER.

5.04.00 Based on the schedule of work agreed with the engineer-in-charge and the approved FQP, the contractor shall prepare a schedule of tests and submit them to the engineer-in-charge and organize to carry out the tests as scheduled /agreed.

6.00.00 PURCHASE AND SERVICE

6.01.00 The major items/ equipments/ components to be manufactured in the shop of the contractor i.e. in-house items and those procured from sub-vendors / sub-manufacturer / sub-contractors i.e. bought out items (BOIs) shall be listed out by the contractor in their bid proposal.

6.02.00 An indicative list of major bought out items (not exhaustive) and services for civil works is enclosed at Annexure- III, for which the contractor shall submit the requisite details / lists of manufacturer's in their bid proposal. The list of manufacturers/ sub-vendors for all the BOIs envisaged in contract shall be included in the bid proposal by the contractor which shall be discussed / reviewed by the OWNER during post bid discussions and the list of proposed manufacturers / sub-vendors for each of the BOIs shall be agreed/ approved. If any item is left out or gets included during detailed engineering, the contractor shall propose the manufacturer's / sub-vendor's details for review / approval of OWNER, prior to initiating the procurement of such materials.

6.03.00 Where the manufacturers are placed in details required ("DR") category, the details of the manufacturers / sub-vendors placed in the "DR" category shall be submitted to the OWNER for approval in the prescribed OWNER format within the period agreed at the time of post bid discussions. The contractor's proposal shall include vendor's site facilities, expertise, facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-Contractors proposed. The formats for furnishing above details shall be given to the Contractor at post bid discussion stage. Monthly progress reports on sub-contractor detail submission / approval shall be furnished. Such manufacturers / sub-vendors approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

6.04.00 To facilitate advance planning of material testing/ approval of bought out items, well before the start of activity as per L-2 network, representative samples shall be procured by the contractor from approved sub-vendors and submitted to the engineer for his approval before bulk procurement at least two months prior to start of works. In case of manufacturers test certificate (MTC) is submitted for acceptance, it shall be clearly traceable and correlated with the consignment received at site. MTC of all bought out items shall essentially contain all the test parameters / characteristics specified in the Technical specifications / standards / codes. In case the manufacturer’s test certificate does not mention these details, sample from each lot shall be tested for these properties at the third party lab acceptable to OWNER. Approval of material / sample by the engineer shall not relieve the contractor of his responsibility, for their conformance to the specification, as well as the requisite performance and quality of material.

6.05.00 Structural steel supply is in the scope of the EPC contractor and shall be procured from approved vendors of APGENCO only as shown in the ANNEXURE-V. In case of non-availability of some of the sections with the approved vendors, the contractor may propose to procure the sections from the re-rollers of the main steel producers, the name of such re-rollers will have to be cleared by corporate quality assurance of OWNER for which details such as BIS approval, main steel producer's approval, past experience for production of sections of specified material, details of machines plants testing facilities etc., Confirmation that the process control and manufacturing of steel sections by re-rollers shall be same as that of main steel producers,

that billets for re-rolling will be sourced from main steel producers only shall be furnished with regards to re-roller.

6.06.00 Even after clearance of re-rollers, induction of billets with identified and correlated Mill test certificates (TC's) in the process of re-rolling, sampling of steel, quality checks thereof and stamping of final product for further identification and correlation with TC's prior to dispatch shall be the responsibility of the contractor and these shall be performed in presence of the authorized representative of the main Contractor.

6.07.00 Reinforcement steel supply is in the scope of the contractor and shall be procured from approved vendors of APGENCO. In case any size /diameter specified is not available with main steel producers and are proposed to be supplied from the conversion agent of the main steel producer the name of such conversion agent / re-roller shall have to be approved by OWNER for which details such as BIS approval, Main steel producer's approval, Past experience for production of sections of specified material, details of machines, plants testing facilities etc., and confirmation that the process control and manufacturing of steel sections by re-rollers is the same as that of main steel producers, that billets for re-rolling are sourced from main steel producers only shall be furnished with regards to re-roller.

7.00.00 MANUFACTURING QUALITY PLAN AND FIELD QUALITY PLAN

7.01.00 All materials / components and equipment covered under the scope of work, shall be procured by the contractor for the purpose of the contract, after obtaining the written approval of the OWNER, which are to be manufactured at shop/ factory of the vendor/sub vendor shall be covered under a comprehensive quality assurance programme. The contractor's purchase specifications and inquiries shall call for Manufacturing Quality Plans (MQP) to be submitted by the sub-contractor/ sub-supplier/ sub-vendor. The MQP called for from the sub-contractor shall detail out for all the components and equipment, various tests / inspection, to be carried out as per the requirements of this specification and standards mentioned therein, quality practices and procedures followed by contractor's / sub-contractor's / sub-supplier's quality control organization, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. Such quality plans of the vendors / sub-vendors shall be submitted to the OWNER for approval for MQP and such approved quality plans shall form a part of the purchase order / contract between the contractor and sub-contractor. The quality plans shall be submitted on electronic form e.g. CD or E-mail in addition to hard copy, for review and approval of OWNER. After approval the same shall be submitted in compiled form on CD in addition to hard copy.

7.02.00 The contractor shall furnish copies of the reference documents/ plant standards / acceptance norms/ tests and inspection procedure etc., as referred in quality plans. These quality plans and reference

documents/standards etc. will be subject to OWNER approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, OWNER shall identify customer hold points (CHP), i.e. test/ checks which shall be carried out in presence of the OWNER engineer or his authorized representative and beyond which the work shall not proceed without consent of OWNER in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to OWNER along with technical justification for approval and dispositioning.

7.03.00 Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the OWNER for reference / record by the contractor along with a report of the purchase orders placed so far for the contract.

7.04.00 Well before the start of the work, the contractor shall prepare and submit the Field Quality Plans (FQP) and obtain approval of OWNER, which shall detail out for all the works, equipments, services, quality practices and procedures etc in line with the requirement of the technical specifications to be followed by the contractor at site. This FQP shall cover for all the items / activities covered in the contract / schedule of items required, right from material procurement to completion of the work at site. An Indicative Field Quality Plan for civil works is enclosed at Annexure - IV-A (Indicative FQP for civil works) & Annexure - IV-B (Indicative FQP for structural steel works).

8.00.00 DISPOSITIONING OF NON CONFORMITIES

8.01.00 The non-conformity for the site works on being detected / noted shall be reported by the contractor in the standard format of OWNER under the system of dispositioning of non conformity report (NCR) to the engineer. The dispositioning of the NCR relating to equipment, assemblies, materials condition or process during construction / erection shall describe the proposed correction and also include the preventive / corrective action plan for future.

9.00.00 QUALITY AUDIT

9.01.00 OWNER reserves the right to carry out quality audit and quality surveillance of the quality management and control activities, systems and procedures of the contractor or their sub-contractor. The contractor shall provide all necessary assistance to enable the OWNER carry out such audit and surveillance. The contractor shall also take necessary measures, raise NCRs wherever required based on the audit findings / observations.

10.00.00 **QA DOCUMENTATION PACKAGE**

10.01.00 The contractor shall be required to submit the QA documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (√) mark. Typical contents of QA documentation pertaining to field activities as per approved MQP, FQP and other agreed manuals / procedures, prior to commissioning of individual system shall generally contain the Quality Plan, Material mill test reports, Non-destructive examination results / reports, Heat Treatment Certificate/Record, Non-conformance Reports, CHP, Certificate of Conformance (COC)and MDCC.

11.00.00 **GENERAL QA REQUIREMENTS**

11.01.00 The contractor shall ensure that the works, BOIs and services under the scope of contract whether manufactured or performed within contractor's works or at his subcontractor's premises or at the OWNER'S site or at any other place of work are in accordance with the OWNER technical specification, applicable standards / codes, approved drawings / data sheets / quality plans and BOQ. All the works, BOIs and services shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer.

11.01.01 **Storage and Handling of Construction Materials**

All materials shall be stacked and stored by the Contractor as per IS-4082 and as per the requirements specified in OWNER Technical Specification.

11.01.02 **Excavation and Filling Works**

The contractor shall submit a work methodology covering various items of works for alt stages of excavation and filling works. This methodology shall broadly include the quantity wise and classification wise identification of source of excavation and filling, suitability tests as per specification requirements, method of stockpiling, transportation, placement, spreading , compaction, equipment, list of protocols, in-situ tests, third party lab test if required, acceptance checks for final clearance.

For blasting work at site if required, the contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at site. The contractor shall install and operate equipment {such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with the technical specification requirements in association with the specialized blasting agency. The contractor shall submit the un-priced copy of the award on the specialized blasting agencies to OWNER, highlighting the scope of services / work awarded to them by contractor. The services of such specialized blasting agency shall be available through out the period in which the blasting work is undertaken at

site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (man-in-charge) and thoroughly acquainted workmen, All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the contractor.

Tolerance for finished surface level shall be within 20 mm of the level shown in the drawing. For an unimportant area, tolerance up to +75mm shall be acceptable at the discretion of the engineer. However, these tolerances shall be applicable for localized areas only.

Acceptance criteria shall be

a) When only one set of sample is tested, then all individual samples collected an tested should pass without any deviation

b) For retest of any sample two additional samples shall be collected and tested, and both should pass without any deviation.

c) Where a large number of samples are tested for a particular test then 9 samples out of every 10 consecutive samples tested shall meet the specification requirement.

11.01.03 **Masonry and Allied Works**

The execution, finishing, testing and acceptance of masonry related works shall be as per the provisions of technical specifications / relevant practices IS code. Local depressions on account of faulty workmanship, broken / chipped edges shall not be acceptable.

All masonry shall be built true and plumb within the tolerances prescribed as below, Care shall be taken to keep the perpends properly aligned. Unless specified otherwise the tolerances in construction of masonry works shall be as below: :

Sl. No.	Type of Check	Tolerance
	Deviation in verticality in total height of any wall of a building	Shall not exceed ± 12.5mm (more than one storey) + 6mm per 3m height (within a storey)
	Deviation from the position shown on the plan of any brickwork	Shall not exceed 12.5mm (more than one storey)
	Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment	Shall not exceed 6mm

Sl. No.	Type of Check	Tolerance
	Deviation of bed joint from horizontal in any length, and it	Shall not exceed 6mm (upto 12m) Shall not exceed 12.5mm total (in any length over 12m)
	Deviation from the specified thickness of bed-joints, cross-joints or perpends	Shall not exceed ± 3mm
	Finished plastered surface	Deviation not more than 4 mm when checked with a straight edge of 2 m length placed against the surface
	The average thickness of plaster	Not be less than the specified thickness
	The minimum thickness over any portion of the surface	Not less than the specified thickness by more than 3 mm for plaster thickness above 12mm and 1 mm for ceiling plaster

11.01.04 **Concrete Works**

For concreting works provisions of technical specifications and IS: 456 shall apply. A detailed methodology for concrete works shall be submitted by the contractor to OWNER for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for concrete works shall broadly contain the suitability of source of aggregates, cement, admixture, water and reinforcement steel, etc. The available concrete mix design recommended from a specialist institute, results of trial mix carried out at site, method / control of batching, mixing, transportation, layer wise placement, compaction, fixing / removal of form work, staging, fixing of water stops at appropriate locations along with specials, expansion joints, contraction joints and construction joints, cover blocks and method of curing, methodology of repair of newly placed hardened concrete, testing and sampling of concrete during production and placement and acceptance checks for final clearance.

The equipment, deployment of manpower and machinery shall be arranged by the contractor to ensure the continuous rate of placement of specified grade of concrete so as to prevent segregation, bleeding, formation of cold joints, temperature control for concreting in extreme weather conditions and for mass concreting works,

Exposed surfaces of concrete shall be kept continuously in a damp or wet condition for at least seven days from the date of placing concrete in case of ordinary Portland cement, not be less than 10 days for concrete exposed to dry and hot weather conditions, at least 10 days or period may be extended to 14 days where mineral admixtures or blended cements are used. Approved curing compounds may be used in lieu of moist curing with the permission of engineer-in-charge.

Reinforcement steel shall conform to relevant IS codes. Lapping / spacing of reinforcement shall be so staggered that under no circumstances more than 50% of bars at any cross section shall be lapped. Corrosion resistance Steel shall be used for the foundations wherever specified in the technical specification. Sample test for 3% of the number of mechanical bars grips subject to a minimum of three, shall be carried out up to the yield strength of reinforcement of bars.

Test shall be conducted for the water tightness of the liquid retaining structures as per technical specifications, IS 3370 and IS 6494.

All the materials, equipments, processes used in pre cast concrete work shall conform to the requirements for the cast-in-situ concrete.

If fly ash is used in concrete, source of supply shall be checked for suitability as per IS 3812 (Part-I). Routine tests for retention of particles on 45µ sieve and loss on ignition shall be carried out on each lot of fly ash before its use. The storage of fly ash shall be similar to that of cement. Separate Silo for fly ash shall be provided in the batching plant. Validation of Mix design using fly ash shall be carried out by an approved specialist agency, before start of concrete production.

The acceptance criteria of concrete shall be in accordance with clause no,16 of IS 456. However in exceptional circumstances and that too in non-critical areas, the engineer may accept concrete work which is marginally unacceptable as per the criteria laid down in IS 456. For such accepted work, payment shall be made at a reduced rate pro rata to the concrete cube strength obtained, against that stipulated.

All records of concreting, reinforcement, testing of materials, as-built dimensions, the details of the rectification, etc, shall be maintained as given below. Four copies of such record in a bound form shall be submitted to owner for their record and future reference.

a) Testing data/report of aggregates including petrographic examination & potential reactivity of aggregate and repeated temperature cycle tests wherever specified.

b) Mix design details and record of trial mixes carried out at site

c) Testing records of admixture as per IS-9103 / ASTM C494 including third party test reports.

d) Approved scheme for concreting

e) Hourly records of concreting including pour card

f) Protocol indicating the dimensional tolerance and details of inserts

g) Records giving the details of rectification giving the location of grouting, the quantity of grout used at each location, type of grout used

h) Bar bending schedule.

i) Location and details of mechanical anchoring used for reinforcement.

j) Protocol giving the details of checking of reinforcements before concreting and conformance to the reinforcement details as shown in the construction drawings

k) Photographs showing the areas where rectification works have been carried out. Photographs should be taken before and after rectification

l) Temperature control record of concrete at the time of placement if applicable.

m) Details of curing, staging and fixing / removal of formwork, checklist for formwork as per Clause 9.9 and Annexure-C of IS 14687 including all machine foundations.

n) Batching Plant shall be calibrated regularly at least once in a 3 months Computerized output shall be taken for each batch of production of concrete. For concreting works of ash pipe pedestals, mixer with weight batcher may be used. Production and supply of concrete from batching plant shall conform to the provisions of IS 4926.

o) Dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances for pre cast members as per OWNER Technical Specification. Load test on Pre cast members (except pre- cast tiles to be laid in the reservoir) shall be carried out @ 2% up to 1000 nos., @1% from more than 1000 nos. precast members of one type. The load test shall be carried out as per the provisions of IS-456

TOLERANCES			
Description of Item/ Structural Element		**Max (mm)**	**Min (mm)**
Cast In Situ Concrete			
1.	Faces of concrete in foundations and structural members against which back fill is placed	+25	-10
2.	Eccentricity of footing as percentage of footing width in the direction of placement	2% but limited to 50mm	
3.	Top surfaces of slabs and of concrete to receive base plates to be grouted	+5	-5
4.	Alignment of beams, lintels, columns, walls, slabs and similar structural elements	+5	-5
5.	Cross sectional dimensions of walls, slabs and similar structural elements	+5	-5

TOLERANCES				
Description of Item/ Structural Element			**Max (mm)**	**Min (mm)**
6.	Deviation from specified dimensions of cross-section of columns and beams		+12	-6
7.	Alignment of holding down bolts without sleeves		+1.5	-1.5
8.	Alignment of holding down bolts with sleeves		+5	-5
9.	Level of holding down bolt assemblies		+10	-10
10.	Embedded Parts (in any direction).		+5	-5
11.	Level of embedment for equipment support		+1.5	0
12.	Level of embedment for other embedded parts		+5	-5
13.	Centers of pockets or holes with greatest lateral dimension not exceeding 150mm		+10	-10
14.	Variation in steps • Riser • Tread		 +1.5 +3.0	 -1.5 -3.0
Pre- Cast Concrete				
15.	Length:	+/-0.1 percent	+/-5	+ 10
16.	Straightness or Bow	1/750 of the length	+/-5	+/-10
17.	Cross-sectional dimensions	+/- 3 mm or +/- 0.1 percent whichever is greater		
18.	Squareness:	When considering the squareness of the corner the length of the two adjacent sides being checked shall be taken as the base line. The shorter side shall not vary in length from the perpendicular by more than 5 mm.		
19.	Flatness :	The maximum deviation from a 1.5m straight edge placed in any position on a nominal plant surface shall not exceed 5 mm.		

Placing of reinforcement and for cover	Clause 12.3.1 and 12.3.2 of IS 456
Formwork	Clause 9.6 of IS 14687 and 11.1 of IS 456
Batching	Clause 10.2.2 of IS 456

11.01.05 **Structural Steel Work**

For structural steel works provisions of technical specifications and IS: 800 shall apply. A detailed methodology for structural steel works shall be submitted by the contractor to OWNER for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The contractor shall submit the welding procedures specification (WPS), heat treatment procedures, NDT procedures etc. at least ninety days before scheduled start of erection work at site. All welding and brazing shall be submitted to the OWNER and carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the OWNER.

All brazers, welders and welding operators employed on any part of the contract either in the contractor's / sub-contractor's works or at site or elsewhere shall be qualified as per AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the OWNER.

The records of welding procedure qualification and welder qualification test results shall be furnished to the OWNER for approval. However, where required by the OWNER, the tests shall be conducted in presence of OWNER / authorized representative.

No welding shall be carried out on cast iron components for repair. All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

All Non-destructive examination shall be performed in accordance with written procedures as per International Standards and as mentioned elsewhere in the technical specification. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to OWNER.

Low hydrogen electrode (AWS E-7018) for welding of High/Medium tensile steel, for M.S (IS 2062 Gr. A/Gr. B, IS 8500) sections thickness above 20mm shall be used. Preheating and Post weld heat treatment requirements shall be complied as specified in the technical specification / approved WPS.

The requirements of pre-heating shall be

Thickness of thickest part at the area of welding/heat affected zone	Welding using other than low hydrogen welding electrodes IS-2062	Welding using tow hydrogen welding electrodes or submerged arc welding IS 2062
Upto 20 mm (including)	None	None
Over 20 mm to 40 mm (including)	Not allowed	$20^{U}C$
Over 40 mm to 63 mm (including)	Not allowed	$66^{U}C$
Over 63 mm	Not allowed	$110^{U}C$

The following tests / checks shall be carried out for structural steel works

Sl. No.	**Tests / Checks**	**Quantum / Standard**
1.	Physical and chemical properties of material if supply in the scope of contractor	As per relevant codes, review of correlated mill test certificates or check testing in absence of MTC
2.	Ultrasonic test on plates above 40mm	As per ASTM A435
3.	Welding procedure & welders qualification test	AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards
Fillet Weld		
4.	Macro-etch examination on production test coupons for main fillet welds	Minimum one joint per built up beams, columns and crane girder etc.
5.	tension member of crane girder	Dye penetration test on 25% weld length
6.	All other fillet welds	DPT on 25% of the total length. Dye penetration test shall be carried out to the root run.

Sl. No.	Tests/Checks	Quantum/Standard
Butt Weld		
7.	DPT	100% after back gouging on ail butt welds except for coal bunker bins 10% after back gouging-For coal bunker bins 100% of the total length. Dye penetration test shall be carried out to the root run after back gouzing.
8.	Mechanical testing of production test coupons	Minimum one joint per built up beam, column and crane girder.
9.	Radiography test on butt welds (In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. Wherever RT is not feasible UT to be carried out with the approval of the engineer)	100% RT on butt welds of tension flange (bottom flange) of crane girders 10% RT weld length of each welder on butt welds, except for crane girders and coal bunker 5% spot RT on butt welds / at inaccessible locations UT on butt welds- For coal bunker bins 100% radiography test shall be carried out for the plates of 32mm thick and above. 25% radiography test shall be carried out for the plates below 32mm thick. 100% radiography test shall be carried out of the crane girders and bunker girders irrespective of thickness of the plate.
10.	Ultrasonic testing on full penetration welds (other than butt welds)	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints
11.	Control assembly check in shop before erection	1st and further every 10th set of identical structure

Sl. No.	Tests /Checks	Quantum / Standard
12.	Dimensional tolerances during fabrication and erection	as per IS-7215 and IS-12843
13.	Surface Preparation and Paint thickness	SA 2.1/2 , By elcometer random after each coat, each member
CW Liners site fabrication (Field shop) test		
14.	WPS.PQR& welder's Qualification	100%
15.	DPT on root run	100% DPT for pipes upto 1200mm diameter
16.	DPT after back gouging	100% DPT for pipes above 1200mm diameter
17.	UT	Not recommended.
18.	RT	5% RT
19.	DPT on finished butt welds	10% DPT
20.	Hydraulic tests	1.5 times the design pressure or 2 times the working pressure which ever is higher.
CW Liners erection site test		
21.	WPS.PQR& welder's Qualification	100%
22.	DPT on root run	100% DPT for pipes upto 1200mm diameter
23.	DPT after back gouging	100% DPT for pipes above 1200mm diameter
24.	UT	Not recommended.
25.	RT	5% RT
26.	DPT on finished butt welds	10% DPT
27.	Hydraulic tests	1.5 times the design pressure or 2 times the working pressure which ever is higher. In cases where hydraulic test is not possible the same may be substituted with 100%RT
28.	Tolerances	As per approved drawings, as per IS : 7215 for fabrication and IS : 12843 for erection of steel structures

11.01.05.1 **Stoplog and Trash Racks**

Structural design shall be as per IS 5620 and IS 4622 and as per details given in technical specifications. The trash rack to be provided shall be Type-1 trash rack (removable section rack), conforming to IS: 11388 (latest). Filling valves shall be provided in the stop logs to balance the water pressure before lifting the stop log. Leakage test shall be carried out in the stop logs as per the methodology specified in the technical specification. The leakage measured shall not be more than 5 liters/ minute /meter of length of seal under maximum head. Radiographic examination or magnetic particle testing or other comparable tests shall be carried out for determining the soundness of steel castings and shall be conducted by the contractor as per the technical specification requirements. The contractor shall submit a manufacturing and field quality plans in OWNER format incorporating all the quality aspects mentioned in the technical specifications.

The lifting beam is to be tested for twice the weight of the heaviest component to be lifted by the beam. IS 13591 shall be referred for measurement of the deflection and acceptance criteria.

11.01.05.2 **Coal Tar Anti-Corrosion Tape**

Coal tar anti corrosion tape shall conform to the requirements of technical specifications. The Manufacturers test certificate for each lot of supply of the coal tar anti corrosion tape shall contain the softening point, needle penetration, filler content, breaking load in the longitudinal direction, service temperature, direct impact test, cathodic disbanding and solubility, in case the manufacturer's test certificate does not mention these details, sample from each lot shall be tested for these properties at the third party lab acceptable to OWNER.

Tests for Adhesion**,** holiday test and thickness shall be carried out at site**.**

11.01.06 **Painting Works**

Painting works shall be carried out as per the provisions of technical specifications. A detailed methodology for painting works shall be submitted by the contractor to OWNER for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for painting works shall broadly contain the source of approved brand of paints, shot / sand blasting as specified, minimum acceptable size of shot used for blasting, application of primer, intermediate coat and final coat, experience of applicator, etc. testing of painting work and acceptance checks for final clearance. For PU coating works if specified, material shall be procured from OWNER approved source and the application of the PU coating shall be carried out by an experienced authorized applicator of the material supplier approved by OWNER. A separate quality plan and methodology for PU coating works shall be submitted by the contractor for

approval of OWNER. Based on the approved quality plan, the tests on material and works shall be got conducted at specialist laboratories like IICT Hyderabad, CECRI Karaikudi.

11.01.07 **Sheeting Works**

All bought out items shall be procured from the manufacturer's approved by engineer and tested as per relevant IS Codes/ Specification. Raw material of colour coated sheets shall meet the chemical & physical properties as per relevant standards / codes referred in the approved data sheet. It shall be tested for colour match, bare metal thickness, weight of Z/AZ coating, thickness of painting system, reverse impact, T-Bend adhesion, scratch resistance, salt spray test for 1000 Hrs. and any other test / properties as specified in the technical specifications. Colour coated sheets shall be marked with video jet printing at the interval not more than 2m bearing manufacturer's name, date and time of manufacturing. Fasteners shall also be tested for 1000 hrs salt spray test as per the requirement of technical specifications.

Bonded Mineral Wool Insulation shall meet the requirements of thickness, density, thermal Conductivity, all other tests as per the technical specifications and IS-8183.

For sheet installation no gas cut opening shall be allowed at the site, whenever opening is specified these shall be properly cut in the factory and shall be filled with lipping / flashing for true shape / dimension etc. The sheets/ packets shall be stacked neatly clear off the ground at an angle to the ground, over a base pallet to provide drainage. Water / moisture should not be allowed to stagnate on surface, or in between layers. This can damage the coating, and cause corrosion.

11.01.08 **Tile Works**

The execution, finishing, testing and acceptance of tile works shall be as per the provisions of technical specifications. The material for tile works shall be procured from the OWNER approved brand / source**.** Local depressions on account of faulty workmanship, tiles / natural stones with cracked or broken / chipped edges shall not be acceptable.

The tests shall be carried out on acid resistant bricks / tile- water absorption, compressive strength, resistance to acid, flexural strength, dimensions and all other tests as per IS 4860 and IS 4457, bitumastic ready mixed paint as per IS 158, bitumastic as per IS 9510, potassium silicate, resin type and sulphur type mortars as per IS 4832, part I, II and III, surface preparation for painting as per IS 2395, epoxy painting shall be carried for required coating thickness and dry film thickness.

11.01.09 **Fire Proof Doors**

Fire Proof doors shall be tested for the requirements mentioned in the Technical Specification. The type test of the doors shall be carried out at CBRI Roorkee for minimum 2 hours fire rating and its Fabrication drawing shall also be approved by CBRI, Roorkee. DFT of paint of Fire Proof Doors and its fittings and fixtures as per BOQ shall be checked. The doors shall be finished with suitable fire retardant painting system

11.01.10 **Water Proofing**

The execution, finishing, testing and acceptance of water proofing works shall be as per the provisions of technical specifications. The material for the works shall be procured from the OWNER approved brand / source and the works shall be executed by the authorized applicator of the supplier.

Water proofing shall be tested for water tightness by creating a pond of water minimum 25 mm height on area of 6 m x 6 m, for the period of 48 hrs on fully dried elastomeric membrane surfaces. Minimum 5% area of the roof shall be subjected to water tightness test. Such test necessarily be conducted on vulnerable areas like drain channel / drain head. No dampness shall be visible on the underneath side of roof (i.e. ceiling), parapet and wall junctions etc. which have been subjected for testing. The above testing shall be earned out prior to application of wearing course.

11.01.11 **Piling Work**

For piling works provisions of technical specifications, approved drawings, BOQs and relevant IS codes / standards shall apply. The piling works shall be executed by the agency meeting the qualifying requirements as specified. A detailed methodology for piling works shall be submitted by the contractor to OWNER for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for piling works shall broadly contain the method of boring, stability of bore hole, termination criteria, tests / checks for termination level, fabrication of cage, cage lowering, concrete batching / mixing, transportation, placing, recording of the time of construction operations, method of conducting initial and routine load tests, testing and sampling of concrete during production and placement and acceptance checks on piles for final clearance.

The equipment, deployment of manpower and machinery shall be arrangement by the contractor to prevent the collapse of bore hole and to ensure continuous rate of placement of specified grade of concrete.

The piling works shall be executed as per the technical specifications, approved drawings, relevant codes / standards, FQP and BOQ. In addition to the requirements of technical specifications, the following shall also be ensured while execution of piling works :

a) Time gap between completion of pile boring and start of concreting should be kept to the minimum. However the maximum time gap shall not be more than 6 hours.

b) Muck Debris should be removed from the pile bore by air lift technique(by keeping the tremie & air pipe as close as to bottom of pile bore) i.e. after completion of boring, after completion of SPT(wherever applicable), after lowering reinforcement cage, but before start of concreting.

c) Density of bentonite slurry shall be checked from the sample taken from the bottom of pile bore (not at 1.0 m above the bottom of the pile bore)

d) Minimum two welding sets shall be kept ready to join the two cages of reinforcement by engaging 3 or more welders. This will ensure the lowering of R/F cage in minimum time.

e) While lowering the R/F cage into the pile bore, two hooks shall always be used to ensure balanced/symmetrical insertion of cage into the pile bore.

f) Concrete cover blocks at the junction of two R/F cage shall be ensured before lowering the second segment.

g) Surge concreting of about 1.0 cum shall be ensured at the start of concreting (i.e. in the first pour), by suddenly allowing to fall through the tremie pipe from the funnel. This will help in displacing left out muck/debris in the pile bore (by the impact).

h) Continuous feeding of concrete shall be ensured by deploying at least two transit concrete mixers (if required to be deployed) and mixing done through concrete batching plant (if deployed). Cold joints in the pile shall be avoided.

i) In a pile group, SPT shall be carried out at termination level in the pile, taken up first.

j) Bentonite slurry circulation to be ensured from start of boring to start of concreting. Flushing of bentonite slurry will only ensure maintaining of density of bentonite slurry uniformly and will not allow bentonite jelly to settle at the bottom, whereas air lift technique with bentonite circulation will ensure removal of muck debris from the bottom of pile bore.

k) Properties of drilling mud shall be checked prior to commencement of the piling work and thereafter, minimum once per week or as found necessary by the engineer. One sample consisting of 3 specimens shall be tested for the above.

l) Low strain pile integrity test on all job piles and test piles shall be conducted as specified in the Technical Specification. This test shall be suitably used to identify the piles for routine tests. High Strain dynamic test shall be done as per the technical specification. The frequency of the test shall be as per the BOQ

m) For Working Piles: Minimum one sample consisting of 6 test cubes shall be made for first ten piles. Out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength. Minimum one sample of 6 test cubes for every 25 nos. of piles shall be tested, out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength

Pile Load Test

Pile load testing shall conform to the requirements of IS-2911 (Part IV) and the technical specification. Initial load tests as specified in the contract documents shall be conducted to assess the safe load carrying capacity of pile before start of work. To verify the load carrying capacity of the working piles, routine load test shall be conducted.

Pile load-testing procedure and the test setup / scheme shall be submitted for approval of OWNER. The contractor shall use the test setup having arrangement for anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge for both vertical compression and uplift (tension) Load test (initial) on piles. The cost of reaction system / piles shall deem *to* be included in the cost of test piles

All the gauges and instruments shall be calibrated before the start of the tests on test piles and working piles and the calibration record shall be verified before start of execution of the test.

11.01.12 **Water Supply, Drainage & Sanitation**

Material used for sanitary and plumbing fittings and fixtures shall conform to and be tested as per the requirements of relevant IS Codes specified in OWNER technical specification.

The obstructions in sewer lines shall be checked by inserting a smooth ball, of diameter 13 mm less than the pipe bore at the high end of the sewer or drain. If absence of any obstructions, such as yarn or mortar projecting through the joints, ball shall roll down the invert of the pipe and emerge at the lower end. The straightness shall be checked by means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of the light may be observed. The mirror will also indicate obstruction in the barrel, if the pipeline is not straight.

The service pipes shall be slowly and carefully charged with water, allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under test / working condition of pressure and flow, when all draw-off taps are closed. The service pipes shall be checked for satisfactory support and protection from damage, corrosion and frost.

11.01.13 **Architectural & Misc. Works**

Material used for sanitary and plumbing fittings and fixtures, floor finishes and allied work shall conform and tested as per the requirements of relevant IS Codes specified in OWNER technical specification.

Fabricated item like metal doors, windows, ventilators, louvers, rolling shutters and grills etc. shall be checked for correctness of locations and smoothness of operation and fixtures. All controls and locking devices shall give fault free performance. Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 2.5 mm.

Materials used in glass and glazing shall be procured from source approved by OWNER and shall conform to the requirements of the Technical Specification and IS Codes.

False ceiling panels shall be best quality material in thickness and properties called for in the specification / schedule of items. Material Test Certificate to be submitted before bulk supply.

All bought items covered in the scope of contract shall be procured from sources approved by OWNER and shall conform to the requirements of the technical specifications and referred standards / codes.

11.01.14 **Road Work**

Quality Assurance and testing requirements for roadwork shall be as per the MOSRTH-Specification (Section 900), IRC specifications or CPWD specifications as specified in the technical specifications and BOQ of the contract.

The testing and sampling shall include the checks on earth work for embankment and subgrade, sub bases and bases and bituminous constructions. The sampling and testing of concrete pavements shall be as per the respective items of earthwork, subgrade / sub-base, concrete, etc.

11.01.15 **Fabric Expansion Compensator**

Each layer of fabric Compensator shall be checked for thickness, unit weight, tensile strength & elongation, composite layer of the expansion joint shall be tested for temperature withstandability test.

Thermal Insulation shall be checked for thickness, density, thermal conductivity test and all other tests as per IS:8183.

Tests and checks on all other items shall be carried out as per relevant codes.

11.01.16 **QA Requirements for Slip form Shuttering**

1. The monitoring of the leveling of the yoke and the platform of the slip form shuttering to be done in each shift to avoid tilt during the casting of the chimney shell.

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

3. Suitable removal/ reduction of overhung / excess yoke beam length shall be affected with the decrease in the diameter of Chimney shell, as per the approved plan.

4. The laser centering method to be deployed for chimney alignment and Monitoring of chimney centre should be done by laser instruments at least two points. Monitoring/Recording of the same shall be done in each shift of 8 hours

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

6. The outage of the alignment of chimney centre shall be prevented by creating a counterbalance for alignment purpose to avoid differential loading, arising out of placement of reinforcement bars at one side or unloading of concrete in a hopper at one side of the platform for slip form shuttering.

11.01.17 **QA Requirements for Dyke Work/Impervious Soil Fill/ Other Fill Works**

The suitability of the fill materials from each source using laboratory/ field tests shall be determined / ascertained by the contractor prior to start of filling work and shall be approved by Engineer. The fill material free from shingle, salts, organic matters, roots sod or any other foreign substances shall be used for filling.

11.01.17.1 **Embankment Filling**

The fill materials shall be free from debris, wood, vegetable matter and other deleterious matter. Control tests shall be carried out in laboratory from time to time to determine whether the fill produced by methods employed satisfies the requirements of the specifications. Routine field tests shall also be carried out by the Engineer and the work shall be inspected regularly. Field density test should be particularly and specially made in the following areas:

a) Where the degree of compaction is doubtful.

b) Where embankment operations are concentrated i.e. where 2 or more layers are placed one over the other on the same day.

c) To represent every 2000 cum in case of earth and/or 1000 cum in case of ash placed in the embankment.

d) Atleast one test for every full or part shift of compaction operations and

e) Atleast one test for every 250 m length of dyke in each layer. The Engineer shall determine whether the desired results are being obtained.

QA&QC test for Embankment Filling shall be carried out in line with the Technical Specification, PART-B.

11.01.17.2 **Impervious Soil Filling**

The suitability of the material from each source shall be determined by laboratory tests and shall be approved by Engineer. QA&QC test for Impervious Soil Filling shall be carried out in line with the Technical Specification, PART-B. The spreading of the next layer shall be carried out only after the underlying layer has been approved by the Engineer or his authorized representative.

11.01.17.3 **Sand Blanket, Chimney And Filter**

The material for blanket, chimney and sand filters shall consist of clean sound and well graded coarse sand. The materials shall be free from debris, wood, vegetable matter and other deleterious matter. The gradation of sand material shall meet the requirements as specified. QA&QC test for Sand Blanket, Chimney and Filter shall be carried out in line with the Technical Specification, PART-B.

11.01.17.4 **Graded Coarse Aggregate Filter**

The coarse aggregate material shall consist of durable well graded broken rock of hard stone variety from the specified quarries and shall be approved prior to being transported to the area of deposition. The materials shall range in the size from 10 mm to 75 mm and shall satisfy the specified filter criteria. QA&QC test for Graded Coarse Aggregate Filter shall be carried out in line with the Technical Specification, PART-B.

11.01.17.5 **Rock-Toe, Rip-Rap Works, Rr Masonary**

Rock toe shall be formed with rock material consisting of sound, durable and well-graded broken rock obtained from approved quarries and shall be of approved quality. The materials shall range in size from 10 to 45 cm. QA&QC test for rock-toe, rip-rap works hall be carried out in line with the Technical Specification, PART-B.

11.01.17.6 **Slope Protection Works**

Slope protection works with dry brick packing or ash-cement/ soil-cement mortar ash cement concrete on the slopes, confined within brick masonry panel walls shall be constructed with approved quality of materials. Slope protection works with turfing on downstream slope shall be as per IRC standards. Slope protection works with ash cement concrete on the downstream slopes shall be constructed with approved quality of materials. QA&QC tests for slope protection works shall be carried out in line with the Technical Specification, PART-B.

11.01.17.7 **Bentonite Liner**

Construction Quality Control (CQC) tests as indicated in Table shall be performed by the Contractor's Quality Control Team at regular intervals upon completion of the Soil-Bentonite liner.

QCQ Requirements for Impervious Liner

Parameter	Test Frequency per layer
Moisture Content	1 per 5,000 Cum
Field Density	1 per 5,000 Cum
Falling Head Permeability	1 per 25,000 Cum

All CQC test results shall achieve the required values as established by the engineer. Failure to achieve these values shall require re-working of the Impervious mixture in the failed areas.

12.00.00 **SHOP TEST EOT CRANES, OTHER CRANES & HOIST**

1.0 **Hooks**

1.1 All tests including proof load test as per relevant IS/BS/DtN shall be carried out.

1.2 MPI/DPT shall be carried out after proof load test.

2.0 **Steel Casting**

2.1 DPT on machined surface shall be carried out.

3.0 Girders, end carriage.crab, gear box and rope drum

3.1 The plates of thickness 25mm and above shall be ultrasonically tested.

3.2 NDT requirements on weldments shall be as follows:

a)	BUTT WELDS IN TENSION	:	100% RT AND 100% DPT
b)	BUTT WELDS IN COMPRESSION	:	10% RT AND 100% DPT
c)	BUTT WELDS IN ROPE DRUM	:	100% RT AND 100% DPT
d)	FILLET WELDS	:	RANDOM 10% DPT

4.0 Forging (Wheel, Gears, Pinions, Axle, Hooks & Hook Trunion)

4.1 All forgings greater than or equal to 50 mm diameter or thickness shall be subjected to ultrasonic testing.

4.2 DPT/MPI shall be done after hardfacing and machining.

5.0 Wire rope shall be tested as per relevant standard.

6.0 Reduction gears shall be tested for reduction ratio, backlash & contact pattern. gear box shall be subjected to no-load run test to check for oil leakage, temperature rise, noise and vibration.

7.0 The cranes shall be completely assembled at shop for final testing. all tests for dimension, deflection, load, overload, hoisting motion, cross travel etc. as per is-3177 shall be carried out at shop.

8.0 All electric hoists shall be tested as per is-3938 and chain pulley blocks shall be tested as per is-3832.

13.00.00 **CATHODIC PROTECTION**

Quality of cathodic protection system shall be as per given table.

IMPRESSED CURRENT CATHODIC PROTECTION

Transformer Rectifier Unit

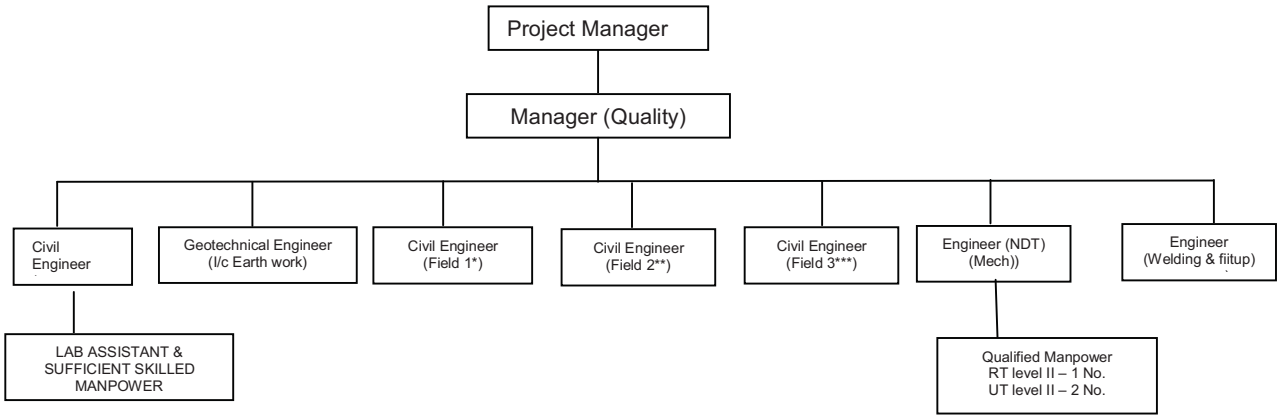
Attributes Characteristics → / Items / Components / Sub-assembly ↓	Make, Model, Type, Rating & Finish	Chemical & Mechanical Tests	Sheet Steel Pretreatment & Painting process checks	Operational & Functional Checks	Conform to relevant Standard	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features of TRU as per OWNER specification	Efficiency Test on TRU & Transformer	Heat Run Test	Ratio & Polarity Test on TRU	HV & IR Test
Rectifier Transformer (IS : 2026)	Y				Y			Y			Y
Electronic Components	Y				Y						
PCB & Electronic Cards	Y				Y						
Control & Selector Switches (IS : 6875)	Y			Y	Y						
Indicating Meters (IS : 1248)	Y			Y	Y						
Indicating Lamps (IS : 13947)	Y			Y	Y						
Air Break Switches / Fuses (IS : 13947/13703)	Y			Y	Y						
Control Terminal Blocks (IS : 13947)	Y				Y						
Control Transformer (IS : 12021)	Y			Y	Y						
Push Buttons (IS : 4794)	Y			Y	Y						
MCB (IS : 8828)	Y			Y	Y						
PVC insulated Copper control wires (IS : 694)	Y				Y						
Sheet Steel (IS : 513)	Y	Y	Y		Y						
Synthetic Rubber Gaskets	Y	Y			Y						
Annunciator	Y			Y							
Transformer Rectifier Unit	Y					Y	Y	Y	Y	Y	Y

Notes

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2. Makes of all major Bought Out Items will be subject to OWNER approval.

QA & QC ORGANISATION SETUP



NOTE :

1. The above organization setup is minimum however their deployment shall be as per the agreed deployment schedule. The contractor shall prepare a manpower deployment schedule in line with the finalized work plan and the same shall be submitted to the engineer-in charge for acceptance/ approval.

2. The contractor shall mobilize the QA& QC manpower in line with the finalized manpower deployment schedule and shall ensure their availability well in advance (15 days approx.) of the beginning of the concerned activity/ work.

3. The contractor shall further mobilize required number of skilled & supporting staff and additional resources, if any to meet the work schedule.

4. For concrete work 2 Nos. (one for foundation work & one for superstructure)

5. ** For lines and levels -1 No.

6. *** For Finishes and cladding work -1 No

TYPICAL QA/QC LAB EQUIPMENT

Sl. No.	Equipment	Nos.
1	Vicat Apparatus with deskpot	2
2	Le chatelier flask	2
3	Le chatelier Mould	2
4	Cube Moulds for cement testing	12
5	Vibration Machine	1
6	Length comparator	2
7	Shrinkaqe Bar mould	2
8	Sieve shaker	1
9	Sieves for sand, coarse & fine aqgregate	1 set for each
10	Sieves for coarse aggregate for Road	1 set
11	Proctor testing equipment '	2 sets + 18 cores
12	Slump testing equipment	6 sets
13	Oven	2
14	Physical balance	1
15	Rapid moisture meter	2
16	Thermometer	4
17	Burret	2
18	Measuring cylinders	9
19	Measuring flasks	3
20	Compression testing machine	2 sets of 2000 kN capacity each
21	Cube moulds	30
22	Electronic balance	2 (12 kg capacity), 2 (200 mg capacity)
23	pH balance	As per requirement
24	Radiographic facilities	As per requirement. Party should deploy BARC approved agency for carrying out RT
25	Mechanical weighinq machine	1 (100 kg capacity)
26	Ultrasonic testing machine	As per requirement
27	D.P. Test kit	10
28	Vernier 300 mm. 600 mm	2
29	Micrometer (0.25 mm) out side (25.00)	2
30	Radioqraphy film viewer	2
31	Inside Micrometer 25-750 dia	2
32	Digital elcometer for paint thickness	2
33	Baking oven for electrode	3
34	Portable ovens	2
35	Rebar detector to locate the reinforcement before core cuttinq operation	1
36	Concrete coring machine (55mm, 60mm upto 150 mm dia core bit)	1
37	Rebound hammer	1
38	Ultrasonic pulse velocity tester	May be arranged from specialist laboratory.

1. The equipments listed above are indicative and required to be mobilised as minimum requirement, additional equipment if any .required for successful completion of work shall be provided /arranged by the contractor.

2. All test reports/ inspection reports have to be computerized and maintained on LAN with an access to the owner

3. Computers - 2 Nos. shall be deployed with Windows operating system and connected to the OWNER server

4. Based on the schedule (L2/L3 Network), Quality control & Quality Assurance work plan shall be finalized by the contractor and the same shall be submitted to the engineer-in-charge for acceptance/approval. The Finalized work plan shall be maintained on the computer to be accessed by the owner for database and day to day monitoring.

INDICATIVE LIST OF BOUGHT OUT ITEMS FOR CIVIL WORKS

Sl. No.	Bought Out Item	Proposed Make	Proposed list of Manufacturers
1.	Cement, if procured by Contractor		
2.	Structural and Reinforcement Steel, if procured by Contractor		
3.	Construction Chemicals- admixtures, waterproofing, accelerators, Epoxy Resin, grouts etc.		
4.	Bitumen, Bitumen Impregnated Fiber Board Joint Filler, Joint Sealing Compound, Bituminous Compound, Joint Sealant		
5.	Colour Coated Sheets		
6.	Paint and Painting System, PU Coating		
7.	Floor Tiles / Flooring/ Acid & Alkali resistant tiles		
8.	Glass and Glazing		
9.	False Ceiling - Glass Reinforced Gypsum System, Mineral Fiber Board System, Pre-painted Coil Coated Steel System		
10.	PVC water stops, hydrophilic strips,		
11.	Particle Boards, Plywood, Fire proof doors		
12.	Roof Water Proofing		
13.	Electro-Forged Gratings		
14.	Anodized Aluminum Sections		
15.	Fittings and fixtures for water supply works		
16.	PVC Pipes and accessories		
17.	Polyethylene water storage tank		
18.	Heavy duty anchor fasteners		
19.	Stop log. Trash Rack, Lifting Beam etc.		
20.	PTFE Bearing		
21.	Flexible Open Bellow Strap		
22.	HDPE Liner		
23.	Cathodic protection system		
24.	Anti weed treatment		
25.	HSFG Bolts		
26.	Any other specific high value and critical bought out Item required, meeting the specification requirements		

Note : The Bidders are required to indicate the list of proposed manufacturers/ sub-vendors for each of the BOI in their Bid proposal, which shall be discussed for finaiization at post bid stage.

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN									ANNEXURE-IVA
		ITEM : CIVIL WORK SUB-SYSTEM: GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.		Q.P.NO.: REV. NO.; DATE: PAGE:		1 0 Page 18 of 18	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	D*	Remarks
1	2	3		4	5	6	7	8	9	D*	10
14.4											
i		moisture content (for concrete and mortar only)	as required	B	Physical	Once per week	IS:2386, IS:363 and Technical Specifications		SR/TR		
ii		gradation- grain size analysis	sieve set	A	Physical	Once for each source	IS -2386 Part I. IS :9429 & IS :383 and Technical Specifications		SR/TR	√	
iii		specific gravity	pycnometer	A	Physical	Once for each source	IS:2386 part-I and Technical		SR/TR	√	min 2.40
14.5	Rock Material for Rip Rap, Rock Toe and Random Rubble Masonry										
i		Specific gravity	as required	A	Physical	Once for each source	IS:1122 and Technical Specifications		SR/TR	√	Min 2.5
ii		sulphate soundness	Chemicals, oven balance etc,	A	Physical	Once for each source	IS:1126and Technical Specifications		SR/TR	√	Maximum 10% weight loss after five cycles
iii		Impact Value	Impact Value testing appratus	A	Physical	Once for each source	IS:2386 and Technical Specifications		SR/TR	√	Max. 30%
iv		Water absorption	Balance, oven	A	Physical	Once for each source	IS:2386 and Technical Specifications		SR/TR	√	Minimum 2.5%
v		slake Durability	as required	A	Physical	Once for each source	IS:10050 and Technical Specifications		SR/TR	√	Minimum 85 % after two cycles of 10 minutes
vi		placement profile thickness	as required	B	Physical	Random in each shift	IS:8237 and Technical Specifications		SR/TR	√	
15.0	GEOTECHNICAL INVESTIGATION WORK										
i		Deployment of approved Geotechnical Investigation Agency - Equipments, Manpower etc	As required/agreed	A	Physical	Once before commencement of work	As per technical specifications and relevant IS Codes		SR	√	
ii		Execution of Geotechnical Investigation locations, type etc as per scheme	As required / agreed	B	Physical	Each Location	As per technical specifications and relevant IS Codes		SR	√	
iii		Collection of disturbed and undisturbed samples, their packing and storage	As required / agreed	B	Physical	each sampling	As per technical specifications and relevant IS Codes		SR		
iv		Conducting filed tests as per investigation scheme- such as, SPT/ERT/SCPT/PLT/PMT etc	As required / agreed	B	Physical	each field test	As per technical specifications and relevant IS Codes		SR		
V		Submission of Field Borelogs in approved format	As required / agreed	B	Review	Within 24 hours after completion of each BH	As per technical specifications and relevant IS Codes		SR	√	
vi		Submission of laboratory test schedule and selection of samples for laboratory testing	As required / agreed	A	Review and acceptance	as per consultation with Engineer during dispatch of samples to approved laboratory	As per technical specifications and relevant IS Codes		SR	√	
VII		Submission of Final Geotechnical investigation report along with recommendations	As required / agreed	B	Physical	After completion of investigation work and review of draft reports	As per technical specifications and relevant IS Codes			√	
		Legend to be used: Class #: A - Critical, B-Major, C=Minor, SR, TR, MTC, LB									

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN						ANNEXURE IVB			
		ITEM : STRUCTURAL STEEL WORK		QP NO.:			PROJECT:				
				REV. NO.:		0	PACKAGE:				
		SUB-SYSTEM: FABRICATION & ERECTION		DATE:			CONTRACT NO.				
				PAGE:		7 of 7	MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments		Class* of check	Type of Chech	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
ii		Tolerance OD / ovality	steel tape	B	Measurement	100%	As per approved drawing		SR		
13.8	HYDRO TESTING										
		Leakage tightness	Hydro test Arrangement	A	Leakage tests	100%	Tech Specificatiort		SR	√	For shop welded joints before encasement in concrete/ painting and erection joints
14.00	STOP LOG GATE, TRASH RACK AND LIFTING BEAM										
14.1	MATERIAL										
		Check Quantity (in case of receipt) and completeness and damage, surface defects		C	Visual	100%	Challan / Release No damage, surface defect note		SR	√	
14.2	ERECTION										
		Alignment levelling	Plumb, Piano wire,water level	C	Measurement	100%	Specfication/ Approved drawing		Inspection Report		Welding, if any, involved at site will be done by welders and procedure qualified as per ASME-IX in presence of OWNER's Engineer
14.3	PAINTING / SURFACE PREPARATION										
i		Shade		B	Visual	100%	Specfication/ Approved drawing		Inspection Report		The type of painting/ surface treatment of parts shall be as per Technical
ii		DFT	Elcometer	A	Measurement	Random	Specfication/ Approved drawing		-do-	√	
14.4	TESTING										
i.	Free movement of stop log / trash rack in guides under dry and under full water condition	Lowering or raising for full length for 2/3 times		A	Physical	100%	Smooth operation, Tech. Specification, iS:4622		-do-		
ii	Leakage for stop Log	Measurement of leakage	As read,	A	Physical	100%	Leakage rate within limit		-do-	√	Maximum leakage rate 5 litre/minute/metre length of seal under max-head as per IS:4622
iii	Load test for lifting beam	Load Test	As reqd.	A	Physical	100%	No deflection /No Deformation		-do-	√	
		LEGEND: D * Records, identified with Tick* (√) shall be essentially included by supplier in QA									
		Legend to be used: Class #: A= Critical, B=Major, C=Minor, SR, TR, MTC, LB									
Manufacturer/ Sub supplier	Main-supplier	Categorization Witnessing & Accepting (As per owner QA&I System) Category 'A' FQA Engineer In association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer ;SR - Site Register, TR= Test Report,MfrTC = Manufacturer's Test Certificate									
Signature		This document shall be read in conjunction with owner Tech. Specifications, BOQ, Drawings									

VOLUME : VII-C

SECTION-XX

TECHNICAL SPECIFICATION
FOR
METAL DOORS, WINDOWS, VENTILATORS, LOUVRES, CURTAIN WALL, STRUCTURAL GLAZING, ETC.

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SECTION-XX

TECHNICAL SPECIFICATION FOR METAL DOORS, WINDOWS, VENTILATORS, LOUVRES, CURTAIN WALL, STRUCTURAL GLAZING, ETC.

1.00.00 SCOPE

The work in general shall consist of supplying and/or erecting and installing of all metal doors, windows, ventilators, louvers, glazed partitions, etc. as shown on drawings with all materials complete excluding supply of glass and glazing. The scope of work shall also include the assembly and the Owner from the store at site shall supply erection of all doors, windows, louvers, glazed partitions, etc. for which fabricated materials. Supplying and/or fixing of all door and window accessories and hardware are also included in the scope.

2.00.00 INSTALLATION

2.01.00 Materials

Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS: 1038 and IS: 1361 or as specified in drawing and schedules.

Steel sheets for frames, shutters, louver blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating doors, windows, partitions, etc. shall be extruded sections conforming to IS: 733 and 1285 for chemical composition and mechanical properties. The stainless steel screws shall be grade AISI 304.The alloy used shall conform to IS Designation HE 9-WP of IS: 733.

Hardware and fixtures shall be as specified in “Schedule of Fixtures” and the best quality from approved list of manufacturers shall only be used. The Tenderer shall specifically state the list of manufacturer’s materials he proposes to use. “Schedule of Fixtures” is for the purpose of stating the minimum requirement and 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 closers shall conform to IS: 3564 and shall be suitable for doors weighing 61-80 Kg. unless otherwise stated in schedule. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or the closer 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 & endurance test stated in IS: 3564 Appendix- A.

The Contractor shall submit **three** samples of each type of hardware to the Engineer for approval. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the Contractor towards the end for incorporation in the job.

The mastic for caulking shall be of best quality from a manufacturer approved by the Engineer. In general, the mastic for fixing of metal frames shall be as per IS: 1081 and/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 G sheets. They shall be mortised, reinforced, drilled and tapped for hinges and 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 supplied. 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 comprised of two 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 centers.

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 beveled or rebated. Where shown on drawing or called for in the schedule of items the

doors shall be sound deadened by filling the inside voids with mineral wool or other suitable approved materials.

Doors shall be mortised, reinforced, drilled and tapped in shop for hinges, locks and bolts. They shall also be reinforced for closers, push-plates and other surface hardware where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown in drawing, provision shall be made for fixing glazing, vision panels, louvers etc. glazing mouldings shall be of 18 G steel or extruded aluminium sections with profiles shown in drawing and suitable for fixing 6 mm glass. Louvres 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 furniture. The frames shall be made from best quality 16 G mild steel sheets.

Wherever required as shown on drawings, provisions for fixing glass panes, louvers, etc. shall be made.

The manufacturing shall be done as specified in “Double Plate Flush Door Shutters”.

d) **Sliding Doors**

These shall be manufactured as per drawings and specification. These shall be fabricated from mild steel sheet.

The shutter shall be double or single leaf shutter as specified. The shutters shall be fabricated of specified size of M.S. angle iron frame diagonally braced with the same size of M.S. angle riveted/ welded together with 3mm gusset plate at junction to form a rigid frame. Sliding doors shall be either double plate or single plate construction as called for in drawings and schedules 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 shown on drawings or call for in the Schedule of Items, these shall be provided with top and bottom guide rails of specified size angles or T-irons and 25mm diameter pulley or with 25mm diameter ball bearing at the bottom and guide block with steel pulleys at the top. The shutters shall be provided with locking arrangement, handles, stoppers, and holdfasts, other fittings as specified in the description of item. Doors shall close positively to exclude rainwater from seeping in. When called for in schedule, sliding doors shall withstand specified wind

loads without buckling or jamming. The door shall slide freely under all ambient conditions.

The guide rail shall be sufficiently long and continued along the wall on both ends so that the sliding shutters can against the walls, giving full opening when so required.

FIXING : The guide rail shall be fixed to the floor by means of anchor bolts embedded in the cement concrete floor. The steel section at the top shall be suitably supported from the walls. Two channel sections shall be suitably fixed vertically below the extreme clamps in the wall and floor to avoid the shutter from going out of the supports at top and bottom. A suitable clamping arrangement will be provided at either end of the opening to avoid the shutters from rolling back into the opening.

The adjoining work damaged in fixing shall be made good to match the existing work.

e) **Door Threshold**

Door threshold shall be provided as shown on drawing. Doors without threshold shall have bottom tie of approved type.

f) **Steel Windows, Sashes, and Ventilators etc.**

These shall conform in all respects to IS: 1038 and IS: 1361 latest editions and as shown on drawings. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, pivot arrangements for ventilators, etc. or as shown on drawings or called for in the Schedule of Items.

All welds shall be dressed flush on all exposed and contact surfaces.

Where composite unit openings are shown on drawings, the individual window units shall be joined together with requisite transoms and mullions as shown on drawings. All windows shall be outside glazed fixed with putty or metal glazing beads as shown on the drawings and/or specified under Schedule of Items. 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) 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 0.6 mm 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.

Where required factory made evenly baked powder coated coloured aluminium extruded sections shall be used. DFT shall not be less than 0.8 mils. Colour shall be as per Colour Schedule or as per instruction of the Engineer-in-Charge.

All work shall be fitted and shop assembled to a first class job and ready for erection. Shop joints shall be made to hairlines and then welded or braced by such method as will produce a uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.02.03 **Fire Door**

Hollow metal fire rated doors should be as per IS 3614 Part-1 & Part-2.It should be made of pressed Galvanised steel conforming to IS 277. It should be tested at CBRI or ARAI for maximum rating of 2 hrs with vision panel. Test certificates should be available for vision lites/ panels as part of the fire door assembly. Independent glass test certificates will not be accepted. Manufacturer test certificate shall cover doors both single and double leaf and all doors supplied should be within the tested specimen, deviation in specification and sheet thickness other than what is mentioned in the test certificates will not be allowed. Proper label conforming the type of door and the hourly rating is mandatory.

Door Frame : Door frame shall be double rebate profile of size 143 x 57 mm made out of 1.60mm (16 gauge) minimum thick G.I. sheet (zinc coating not less than 120gm/sqm) duly filled with vermiculite based concrete mix. Suitable for mounting 60 minutes fire rated door shutters. The frame is fitted with intumuscent fire seal strip of size 10 x 4 mm (minimum) all-round the frame and fixing with dash fastener of approved size and make, including applying a coat of approved brand fire resistant primer. Frames shall be metered and field assembled with self tabs. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Rubber door silencers should be provided on the skirting jamb. Frames should be provided with

black plate bracket for installation on a finished plastered masonry wall opening. Once frame installed should be grouted with cement & sand slurry of approved proportion necessary for fire doors on the clear masonry opening.

Door Shutter : Door shutters will be 50 mm thick (unless otherwise stated in the drawing) of 60 minutes fire rating conforming to IS: 3614(Part-II) tested and certified as per laboratory approved by Engineer-in-Charge with suitable mounting on door frame, consisting of vertical styles, lock rail, top rail 100 mm wide, bottom rail 200 mm wide, shall fully flush double skin door with or without vision lite. Door shall be manufactured from 1.6 mm (16 gauge) minimum thick SWG G.I. sheet (zinc coating not less than 120gm/sqm) duly filled FR insulation material and fixing with necessary stainless steel ball bearing hinges of approved make (if mentioned in the drawing) including applying a coat of approved fire resistant primer. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. All doors shall be factory prepared for receiving appropriate hardware and provided with necessary reinforcement hinges, locks and door closers. The edges should be interlocked with a bending radius of 1.4 mm. For pair of doors astragals has to be provided on the meeting stile for both active and inactive leaf. 200 x 300mm Vision lite wherever applicable should be provided as per manufacturer's recommendation with a beeding and screws from inside. The glass should be 6 mm clear borosilicate fire rated glass of relevant rating of the door.

The door leaf and frame shall have passed minimum 250hours of salt spray test.

Paint : All doors and frames shall be finished with etched primer coating, stove zinc phosphate primer and thermosetting polyurethane aliphatic grade paint of approved colour.

Rate : Rate should include supply and installation of door and hardware set as mentioned in the door and hardware schedule.

2.03.00 **Structural Glazing**

Aluminium semi unitised vertical Structural glazing system with single glass vision panel and spandrel panel of approved make having main frame of verticals and horizontals made out of specially designed extruded aluminium sections to withstand wind pressure of 175 kg/sq.m at a height of 40m and fabricated, fixed at all levels, elevation and heights to the Masonry / RC walls with necessary clamps, brackets and anchor fasteners. All clamps and brackets shall be Mild Steel Hot dip galvanized minimum 80 microns thick and shall conform to IS: 4759-1996. The extruded aluminium section shall be anodised in approved colour with a anodic coating of minimum 20 microns. Extruded section shall be of 6063 T5 or T6 alloy conforming to ASTM B 221. Any other fastening straps, nuts, bolts, rivets, washers, Fire stops at all floor levels etc. shall be in stainless steel SS 304 grade. All tapes shall be of approved make.

The system shall be designed to withstand a wind pressure of 200 kg/Sqm and shall be fixed to the masonry/RC walls with necessary clamps, brackets and anchor fasteners, clamps and brackets shall be Hot dip galvanized minimum 80 microns thick, all complete as per manufacturer's manual and specifications. The spandrel panel shall have 50mm thick fiber glass insulation of 48 kg/cum density of approved make conforming to IS-8183 and 1.0 mm thick Twiga black tissue conforming to BS 476 Part 7. This insulation shall be enclosed in a GI tray fabricated out of 1mm thk. GI sheet and fixed to the glazing framework with stainless steel fasteners.

The gap between the GI framework and the concrete framework shall be sealed with Aluminium flashing fixed with stainless steel fasteners. All gaps shall be sealed with Silicone sealant of approved brand. Insulation should be provided in between the Structural glazing aluminium frame work (i.e., behind the spandrel glazed panel) and the structure. Providing 6 mm thick toughened fully tempered hard coated glass of blue/green/blue-green or approved colour having VLT = 35 to 50 % ,External reflectance= 6 to 15% ,Internal reflection = 8 to 15%, Solar factor = 0.36 to 0.43, U Factor = 2.8 to 3.0 W/sqm K etc.

2.04.00 **Aluminium Curtain Wall System**

2.04.01 **General**

1) Aluminium Curtain Wall System shall be designed for the following effects :

   a) Permanent Deformation, thermal expansion.

   b) Wind and seismic load

   c) Air and water infiltration or leakage.

   d) Lateral deflection per floor height

2) Unless otherwise specified the design of the system shall be prepared by the specialized firm for executing such works and submitted to the EIC / Department for approval after detailed scrutiny and checking design calculations and drawings.

3) The work shall bear five years guarantee. It will be obligatory on the part of the contractor to execute the work systematically and conduct the necessary mock-up unit tests, before taking up the work to the satisfaction of EIC / Department.

2.04.02 **Specification for Materials used for Curtain Wall**

1	Glazing	Glazing work shall be as specified in the description of the item and / or as described under the chapter Glass & Glazing of this book.
2	Framing system	Aluminium anodized extruded sections manufactured by reputed approved manufacturers, for all types of members like brackets, mullions, transom etc.
3	Sealant	As specified in the item or silicon sealant
4	Insulation	50 mm thick rock wool of minimum density 48 kg/cum sandwiched with black polythene sheet 100 micron on one side and aluminium foil of 100 micron on the other side or as specified by manufacturer at spandrel area. The surface after fixing insulation shall be plain without any distortion
5	Heat Reflective Toughened Glass	As specified elsewhere in the specification. Colour of any shade approved by the Engineer-in-Charge.

2.04.03 **Aluminium Alloy Extruded Sections**

Extruded sections to be used for fabrication of framing system for curtain walls shall be manufactured and supplied by approved reputed companies. In absence of specific extruded section, sections available conforming to BIS specification, manufactured by approved reputed companies, shall be used in the works. Dimensions and weights of the sections shall be as per approved drawings.

2.04.04 **Components, General specifications, Glazing, Panelling etc. for Curtain Wall System :** These shall be generally as per relevant Chapters in this book.

2.04.05 **Scope of Work**

2.04.05.01 **Preliminary Requirements**

i) The contractor shall design, test, fabricate, deliver, install and guarantee all construction necessary to provide a complete curtain wall system, all in conformity with the drawings and approval of the Engineer-in-Charge.

ii) Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the drawings,

iii) **The curtain wall system shall also include the following activities :**

a) Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings, metal closure, windows etc.

b) All anchors attachments, reinforcement and steel reinforcing for the systems required for the complete installations.

c) All thermal insulation associated with the system. (d) All fire protection associated with the system.

d) All copings and closure and metal cladding to complete the system.

e) All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system.

f) Isolation of dissimilar metals and moving parts,

g) Anticorrosive treatment on all metals used in the system, (i) Polyester powder coating aluminium sections,

iv) **The contractor shall also be responsible for providing the following :**

a) Engineering proposal, shop drawings, engineering data and structural calculations in connection with the design of the curtain wall system.

b) Mock-ups, samples and test units.

c) Performance testing of the curtain wall framing and glazing assembly. (d) Co-ordination with the work of other trade.

d) Insulation with glass wool 48 kg/cum at spandrels area.

e) All final exterior and interior cleaning and finishing of the curtain wall system.

f) Protection.

g) As built record drawings and photographs.

h) Guarantees and warranties.

i) All hoisting, scaffolding, staging and temporary services.

j) Conceptualising and design of a suitable maintenance system for curtain glazing,

v) The water tightness and structural stability of the whole curtain wall system shall be the prime responsibility of the contractor. Any defect or leakage found within the guarantee period shall be sealed and made good all at the risk and cost of the contractor.

vi) The curtain wall system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects, specific details should be designed to accommodate thermal and building movements.

2.04.06 **Design Requirements**

i) Curtain wall shall comply with all government codes and regulations, building bye-laws, if any.

ii) All curtain walling, individual aluminium and glass components and all completed work shall be designed and erected to comply with the following requirements.

2.04.06.01 **Basic requirement**

The basic design and architectural requirements shall consist of the size of window, net glass area, ventilator, configuration of windows and spandrels to be retained. However the contractor may propose alternatives on the construction details for approval of the Engineer-in-Charge, provided that all basic functional and architectural requirements are fulfilled.

2.04.06.02 **Quality Consideration and other Activities**

i) The contractor while submitting the detailed design calculations should submit the following information on the quality of materials to be used and other aspects as detailed below:

1) Metal quality, finishes and thickness

2) Glass quality, coating and thickness and proposed manufacturer's brand names.

3) Aluminium extruded sections including mullions and transoms together with structural calculations and proposed manufacturer's brand name and also the name of agency proposed for fabrication work.

4) Arrangement and jointing of components.

5) Field connections especially mullion to mullion and transom to mullion.

6) Fixing and anchorage system of typical wall unit together with structural calculations.

7) Drainage system and provision in respect of water leakage in the curtain wall system.

8) Provisions for thermal movements.

9) Sealant and sealing methods.

10) Glazing Method

11) Wind load and seismic load and any other specific load considered in the design

ii) Design concept over lighting protection link-up system of the curtain wall for connection and incorporation into the lighting conductor system of the building (Lighting conductor system of the building shall be done by other approved specialized agency).

iii) The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case these tolerances exceed those specified in the specification.

2.04.06.03 **Tolerances :** Any parts of the curtain wall, when completed, shall be within the following tolerances:

1) Deviation from plumb level or dimensioned angle must not exceed 3 mm per 3.5 m length of any member, or 6 mm in any total run in any line.

2) Deviation from theoretical position on plan or elevation, including deviation from plumb, level or dimensioned angle must not exceed 9mm total at any location.

3) Change in deviation must not exceed 3mm for any 3.5 m run in any direction.

2.04.06.04 **Samples :** The contractor shall also submit samples of aluminium extruded sections; mullion and transom sections in lengths of 300 mm with the same finish and workmanship as per the tender proposals and 300 mm x 300 mm samples of glass for approval of the EIC. (samples to include exposed screws and other exposed securing devices if any).

2.04.06.05 **Ancillary Requirements to be fulfilled by the contractor**

i) The contractor / approved specialized agency shall submit a maintenance manual for the curtain wall system inclusive of all metal parts, glass and finish etc.

ii) During detailed design scrutiny and also during the actual execution of the work any additions and extra provisions that will have to be made as per theoretical requirements or site conditions shall be implemented and executed by the contractor at his own cost, without claiming any thing extra under any circumstances.

2.04.07 **Execution of work**

2.04.07.01 Performance Testing - General Requirements

i) Mock-up units shall be constructed by the contractor and tested to determine the structural stability as well as air and water infiltration or leakage at glazing beads and all other joints designed into the face of the building.

ii) After the approval of structural calculations and the drawing for construction of the curtain wall, one test unit for performance testing of the curtain wall shall be constructed by the contractor at an independent laboratory or at a laboratory approved by the Engineer-in-Charge.

iii) Erect mock-up under manufacturer's / Fabricator's direct supervision and employ workmen as they would be employed during the actual erection at the job site.

iv) The contractor shall submit to the Engineer-in-Charge the test procedures to be adopted, test schedule and location for testing before the work of actual testing is taken up.

v) Prior to the fabrication of test units, the contractor shall submit shop drawings and design calculations of the test unit for approval of the Engineer-in-Charge.

vi) The contractor shall not start the work of erection of curtain wall on site till the approval for the successful completion of the mock up test and clear instruction in writing to start the work is received from the Engineer-in-Charge.

vii) The decision of the Engineer-in-charge in respect of the procedure to be adopted, in conducting the mock-up test and the judgment over the net results, shall be final and binding on the contractor.

2.04.07.02 **Test of Wind Pressure**

i) The equivalent load of wind pressure or wind suction shall be given to the test unit as increasing or decreasing the inside pressure in the "pressure chamber" at which the test unit is fixed.

ii) The static wind pressure shall be applied up to 1.5 kpa at maximum wind pressure.

iii) The variation of dynamic pressure shall be of any approximate sine curve line.

iv) Deflection on each observational points of the test unit shall be observed and recorded under static pressure as described above.

v) Any damage and harmful permanent deformation on any parts except sealing materials shall not be found at maximum wind pressure.

vi) The deflection on the main structural parts in this condition shall not exceed :

1) 1/175 of the span between supports or 20 mm, whichever is less for vertical elements.

2) 1/250 of the span between supports for horizontal elements.

3) The extent of recovery of deformation, 15 minutes after the removal of the test load, is to be at least 95%.

2.04.07.03 **Test of Lateral Deflection per floor height**

i) Lateral deflection per floor height shall occur on the test unit, when the structural frame which fixes the test unit is deflected horizontally.

ii) The deflection of every ± 2.5 mm shall be increased up to ± 13 mm on the test unit (static deflection test)

iii) The dynamic deflection shall be applied up to ± 13 mm.

iv) The variation of dynamic deflection shall be of an approximate sine curve line, one period of 3 seconds.

v) The dimensions of the deflection on each observational point of the test unit shall be measured under the condition as described above and the damage shall be observed.

vi) Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall except the damage to sealant at maximum deflection.

2.04.07.04 **Water-tightness Test**

i) Water shall be sprinkled to the Test Unit' under wind pressure.

ii) Pressure shall not be applied to the test unit.

iii) The volume of the sprinkling water in one minute shall be 5 litres per sqm minimum.

iv) All water leakage and drainage system at the joint and the open able sash of the curtain wall system shall be observed from the outside of the chamber.

v) Hold the test two times, in sequence as described below, conforming to the above mentioned conditions.

vi) Water leakage shall not be observed inside at all parts of the test unit during first water-tightness test.

1) Install the test unit.

2) Hold first water-tightness test.

3) Hold test of wind pressure as described above.

4) Hold second water-tightness test.

5) Lateral deflection test.

2.04.07.05 **Test Report :** The contractor shall submit five copies of test report to the Engineer-in-charge.

2.04.07.06 **Cost of Performance Test**

i) The contractor shall allow in his tender for the cost of the performance testing and fabrication, erection, corrections to and demolition of the test units including any special provision required in the testing laboratory for the tests mentioned above.

ii) The contractor shall allow for amendments and adjustments to the mock-up unit as instructed and required by the Engineer-in-Charge / Architect or the consultant.

iii) If the mock-up test unit fails to pass the initial testing, the contractor shall make the necessary corrections to the test unit and shall get the test unit retested by the testing laboratory until it passes the test.

iv) Cost of corrections to the test unit and the cost of retesting shall be borne by the contractor.

v) The contractor shall be allowed six calendar months time after the work is awarded to set up the test unit and conduct the required test as described above to the satisfaction of the Engineer-in-charge.

vi) In case the contractor fails to conduct the necessary tests as described above or fails to meet the required test results, without any genuine cause within the allotted period of six months, the Engineer-in-charge shall be free to rescind the contract with all costs including the forfeiture of E.M.D. and any other securities deposited by the contractor under the condition of contract.

2.04.07.07 **Record of Test and Drawings**

i) The testing laboratory shall keep the approved copy of the shop drawing and calculations of the test unit at testing laboratory during testing of test unit.

ii) The testing laboratory shall accurately and nearly record on the above mentioned shop drawings all changes, revisions, modifications etc. made to test unit, which shall become the record drawing.

iii) On completion of testing and after approval of the test reports the testing laboratory shall submit the final record drawings to the Engineer-in-charge.

2.04.07.08 **Fabrication and Erection**

i) Frames shall be square and flat, both the fixed and openable frames shall be constructed of sections, which have been cut to length, mitred and mechanically jointed at the corners, Sub-dividing bar of units shall be tenoned and riveted into frames.

All frames shall have corners welded to true right angles. For jointing hollow sections flash butt welding, argon arc welding or mechanical jointing by inserts shall be used. (Gas welding or brazing shall not be done). Concealed screws shall be used for joining the sub-units.

ii) The grid for the curtain wall system shall be fabricated carefully with aluminium extruded sections like mullions and transom in the exactly same pattern as per the final drawings with amendments if any received from the laboratory after conducting the mock-up unit test.

iii) The sizes of different members of the curtain wall system shall be exactly as adopted for the mock-up unit tests and the grid shall be fixed to the building member as shown in the drawing, received after conducting the mock-up unit test.

iv) Care should be taken to see that any gap between the frame and support and the frame **itself is sealed with silicon sealant.**

v) Finish of grid frame shall be either anodized, organic coating, backed enamel finish or as specified in the item of work, no visual variation in anodizing / colour shall be accepted.

vi) Care shall be taken to see that the curtain wall system is not deformed, damaged during erection and it shall be protected from direct contact with wet or intermittent wet cement concrete mortar etc.

2.04.08 **Representative of the contractor**

Full time attendance of a qualified civil engineer with sufficient experience in construction of curtain wall system shall be provided for erection of test unit, all testing and later on actual construction.

2.04.09 **Performance Guarantee**

The contractor shall provide a performance guarantee as indicated in the Schedule of Quantities for a period of five years, to provide for expenses to cover the risk and cost of rectification of defect, noticed during the five years guarantee period. Guarantee period shall start from the date of completion and handing over of the project.

2.04.10 **Measurements**

i) The breadth and the height of the finished work including the openable windows shall be measured in metres and cm and the net quantity for payment shall be calculated in sqm up to two places of decimal.

ii) The area to be considered for measurement shall be the net area of the exterior face of the curtain wall as fixed including the openable windows, if any, as part of the curtain wall.

2.04.11 **Rate**

The rate shall include the cost of all operations described above including the cost of materials, labour, design, shop drawings, erection and testing, mock-up test units, fabrication, erection, finishing, scaffolding, undertaking performance guarantee etc. No other claims of any kind pertaining to this work shall be entertained.

2.05.00 **Aluminium Sun Louver With Stringer System**

Plain panel Aluminium Sun Louver system as per manufacturers specification of approved colour, shall consists of panel 84 mm wide x 16 mm deep x 0.6mm thick in standard length of upto 6m. The panel shall be coil coated in a continuous paint line, double baked and roll formed from stove enameled corrosion resistant aluminium Alloy AA 5050/3005 for higher strength and roll forming characteristics. The panel shall be clipped on to a backed & enamelled aluminium stringer 33mm wide x 86mm deep made from 0.95mm thick backed & enamelled aluminium alloy AA 5050 (sl.mg.) in standard length of 5 m in white colour with cutouts to hold the panels in a module of 86mm c/c. The first stringers shall be fixed at 150mm from both ends and thereafter at a distance of 0.75mm c/c depending on wind load. The stringer shall be fixed to a suitable sub-structure/wall with Nut/Bolt and washer.

Paint Finish

Panel shall have exterior paint finish which will be of 3 layers:

The Anorcoat Pretreatment

The colour coating and

Transparent top coat

The paint used shall be epoxy based & finished with a polyamide/Nylon coating. The paint system shall have the following characteristics.

Coating thickness	:	24-32 Microns
Gloss	:	28 (+/-5)
Gloss Variation	:	+/-3 units (within delivery)
Adhesive Impact/Bending	:	No Loss of Adhesive
Durability	:	Higher Category
Humidity Resistance	:	Blisters less than size 2

2.06.00 **Shop Coat or Paint**

The shop paint for steel doors, windows, etc. shall be best lead or zinc chromate primer paint from approved manufacturer conforming to IS 2074. 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 in the Schedule of Items all steel doors, windows, etc. shall be hot dip galvanised to give a coating weight of 1-1/2 - 2 Oz per sft. 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 before shipment from workshop be protected with a heavy coat of alkali paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer.

2.07.00 **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 upto 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 aluminum products by rust, mortar, etc.

2.08.00 **Assembly & Erection at Site**

In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to IS: 1081 and as shown on drawings. 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 as shown on drawing keeping proper lines and levels, and in approved workman like manner to give trouble free and leak-proof installations. The installation shall be done according to the 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 every 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 with 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 mastic cement in original sealed containers of manufacturer and shall apply it as per the instructions. 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 metre from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.

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) Provisions 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 aluminium surfaces shall be free from scratches, stains and discolouration. Anodised 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 engage positively. Keys 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 discolouration.

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 be 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 RATES

Rates shall be unit rates for items described in schedule.

6.00.00 METHOD OF MEASUREMENT

a) Supply and installation of doors shall be measured in number of each type used. The types shall be as shown on drawings and described in Schedule of Items.

b) Supply of windows shall be measured in number of each type of unit used either single or in combination.

c) Installation including assembly and erection of windows shall be measured in number of types of combinations mentioned in the Schedule of Items.

d) Supply and installation of louvers shall be measured for area of opening in which the louver is to be installed.

e) Supply of mullions and transoms shall be measured for net length of different types shown on drawings and described in Schedule. In computing the length, the length required for embedding in concrete or masonry shall not be considered. No extra payment shall be made for end or cover plates.

f) Vision panels, louvers to doors and insulation between door faces shall be measured for actual area and paid separately over the basic rate doors.

g) Glazing beads, weather stripping, fixing devices etc. shall not be measured separately but shall be included in the supply rate of respective items.

h) And curing or grouting to concrete and masonry or welding and drilling to steel required for installation shall be included in the installation rate. No separate payment shall be made for caulking and jamming or frames or making good to concrete or masonry.

I) Glass and glazing shall be measured and paid under relevant items.

j) Door and window fixtures, locks, door closures etc. shall be measured in actual numbers use.

7.00.00 I.S. CODES

Following are some of the important I.S. Codes as relevant to this section :

Steel doors, windows and ventilators	-	IS : 1038
Steel windows for industrial buildings	-	IS : 1361
Aluminium doors windows and ventilators	-	IS : 1948
Aluminium windows for industrial buildings	-	IS : 1949
Steel doorframes	-	IS : 4351
Code of practice for fixing and glazing of Metal (steel and aluminium) doors, windows, And ventilators.	-	IS : 1081
Wrought Aluminium and Aluminium Alloys, Bars, Rods and Sections (For General Engineer Purposes) – Specification	-	IS : 733
Wrought Aluminium and Aluminium Alloy sheet, and strip for General Engineer Purposes - Specification	-	IS : 737
Wrought Aluminium and Aluminium Alloy, Extruded Round Tube and Hollow sections (For General Engineering Purposes) –Specification	-	IS : 1285
Anodic coating on Aluminium and its Alloys – Specification	-	IS : 1868
Specification for Aluminium equal leg angles	-	IS : 3908
Specification for Aluminium unequal leg angles	-	IS : 3909

Dimensions for wrought Aluminium and Aluminium Alloys bars, rods and sections.	-	IS : 3965
Method of testing anodic coating on aluminium and Its alloys	-	IS : 5523
Measurement of coating thickness by Eddy Current Method	-	IS : 6012
Floor springs (Hydraulically regulated) for heavy doors Specifications		IS : 6315
Dimensions of extruded hollow section and tolerances	-	IS : 6477

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SECTION-XXI

TECHNICAL SPECIFICATION FOR ROLLING STEEL SHUTTERS, GRILLS AND COLLAPSIBLE DOORS

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SECTION-XXI

TECHNICAL SPECIFICATION FOR ROLLING STEEL SHUTTERS, GRILLS AND COLLAPSIBLE DOORS

1.00.00 SCOPE

This specification covers the design, supply of materials, fabrication, delivery and erection of Rolling Shutters/Grills/partly closed and partly grilled/collapsible doors 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 of CR grade for shutters upto 4.5 M wide and not less than 2.25 mm thick of CR grade for shutters 5.5 M wide and above, machine rolled at 75 mm rolling centers, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load.

b) Rolling grills shall be constructed out of 6 mm dia. rods at 35 mm on centres running horizontally flexible connected with vertical links spaced not more than 200 mm centres. Alternatively, rolling grills shall be made from perforated slats of approved design reinforced with 6 mm 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 in the Schedule.

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 or as specified in Schedule.

f) Shafts shall be of steel pipe of sufficient size to carry the torsional 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 described in Schedule or as described by the Engineer.

i) Power unit shall be suitable for 3 phase, 50 cycle, 400 volt A.C. power supply and shall 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 Schedule or 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 galvanised and with all ends rounded to assure smooth operation and hand protection.

k) Reduction gears shall be high strength gray 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 openings upto 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 described in Schedule or 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 or as shown on drawings. One emergency hand chain/crank operation shall also be provided for use in case of failure of the electric system. Where called for in Schedule, externally mounted shutters shall be operated by control mechanism located inside the building.

2.04.00 **Rolling Shutters without grill**

Rolling shutters shall conform to IS 6248. These shall include necessary locking arrangement and handles etc. These shall be suitably fixing in the position as specified i.e. outside or inside on or below lintel or between jambs of the opening. The door shall be either push and pull type or operated with mechanical device supplied by the firm. Shutters up to 10 sq. metre shall be of push and pull type and shutters with an area of over 10 sq. metre shall generally be provided with reduction gear operated by mechanical device with chain or handle, if bearings are specified for each of operation, these shall be paid for separately.

Shutter : The shutter be built up of inter locking lath section formed from cold rolled steel strips. The thickness of the sheets from which the lath sections have been rolled shall be not less than 0.90mm for the shutters up to 3.5m width and not less than 2.25 mm thick of CR grade for shutters 5.5 M wide and above. Shutters above 9 metres width should be divided in 2 parts with provision of one middle fixed or movable guide channel or supported from the back side to resist wind pressure of 100 kg/sq.m. The lath section shall be rolled so as to have interlocking curls at both edges and a deep corrugation at the centre with a bridge depth of not less than 12 mm to provide sufficient curtain of stiffness for resisting manual pressures and normal wind pressure. Each lath section shall be continuous single piece without any welded joint. When interlocked, the lath sections shall have a distance of 75 mm rolling centers. Each alternate lath section shall be fitted with malleable cast iron or mild steel clips securely riveted at either ends, thus locking in the lath section at both ends preventing lateral movement of the individual lath sections. The clips shall be so designed as to fit the contour of the lath sections.

Spring : The spring shall be coiled type. The spring shall be manufactured from high tensile spring steel wire or strips of adequate strength conforming to IS 4454 - Part I.

Roller and Brackets : The suspension shaft of the roller shall be made of steel pipe conforming to heavy duty as per IS 1161 to carry the tortional load with a maximum deflection of $1/360^{th}$ of span. For shutter up to 6 metre width and height not exceeding 5 metre, steel pipes of 50mm nominal bore shall be used. The shaft shall be supported on mild steel brackets of size 375 x 375 x 3.15 mm for shutters up to clear height of 3.5 metre. The size of mild steel brackets shall be 500 x 500 x 10 mm for shutters of clear height above 3.5m and up to 6.5 m. The suspension shaft clamped to the brackets shall be fitted

with rotatable cast iron pulleys to which the shutter is attached. The pulleys and pipe shaft shall connected by means of pretensioned helical springs to counter balance the weight of the shutter and to keep the shutter in equilibrium in any partly open position.

When the width of the opening is greater than 3.5 mtr, the cast iron pulleys shall be interconnected with a cage formed out of mild steel flats of at least 32 x 6 mm and mild steel dummy rings made of similar flats to distribute the torque uniformly. Self aligning two row ball bearings with special cast iron casings shall be provided at the extreme pulley and caging rings shall have a minimum spacing of 15 mm and at least 4 number flats running throughout length of roller shall be provided.

In case of shutters of large opening with mechanical device for opening the shutter the roller shall be fitted with a purion wheel at one end which in contact with a worm fitted to the bracket plate, caging and pulley with two ball bearing shall be provided.

Guide Channel : The width of guide channel shall be 25mm the minimum depth of guide channels shall be as follows :

Clear width of shutter	Depth of guide channel
Up to 3.5 m	65mm
3.5m up to 8m	75mm
8m and above	100mm

The gap between the two legs of the guide channels shall be sufficient to allow the free movement of the shutter and at the same time close enough to prevent rattling of the shutter due to wind.

Each guide channel shall be provided with a minimum of three fixing cleats or supports for attachment to the wall or column by means of bolts or screws. The spacing of cleats shall not exceed 0.75 m. Alternatively, the guide channels may also be provided with suitable dowels, hooks or pins for embedding in the walls.

The guide channels shall be attached to the jambs, plumb and true either in the overlapping fashion or embedded in grooves, depending on the method of fixing.

Cover : Top cover shall be mild steel sheets not less than 0.90mm thick and stiffened with angle or flat stiffeners at top and bottom edges to retain shape.

Power unit : Power unit shall be suitable for 3 phases, 50 cycles, 400 volt A.C. power supply and shall 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 Schedule or 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.

Lock plates with sliding bolts, handles and anchoring rods shall be as per IS 6248.

Operating chains shall be of tested quality, heavily galvanised and with all ends rounded to assure smooth operation and hand protection.

Reduction gears shall be high strength gray cast iron, machine moulded from machine out patterns.

Fixing : The arrangement for fixing in different situations in the opening shall be as per IS 6248.

Brackets shall be fixed on the lintel or under the lintel as specified with rawl plugs and screws bolts etc. The shaft along with the spring shall then be fixed on the brackets.

The lath portion (shutter) shall be laid on ground and the side guide channels shall be bound with ropes etc. The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels and cover frames shall then be fixed to the walls through the plate welded to the guides. These plates and brackets shall be fixed by means of steel screws bolts, and rawl plugs concealed in plaster to make their location invisible. Fixing shall be done accurately in workmen like manner that the operation of the shutter is easy and smooth.

Measurements :

Clear width and clear height of the opening for rolling shuttering shutter shall be clear width and the clear distance between the sill and the soffit (bottom of lintel) of the opening shall be the clear height.

The area shall be calculated in square metres correct to two places of decimal.

Unless included in the main team, whether stripping at bottom bar and mullions shall be measured separately for length.

Cylinder locks shall be for actual numbers used. Pad locks shall be supplied by others.

Rate

The rate shall include the cost of materials and labour involved in all the operations described above including cost of top cover and spring except ball bearing and mechanical device of chain and crank operation, which shall be paid for separately.

2.05.00 **Rolling Grills – Shutters**

Rolling grill shutter is meant to provide visibility or ventilation or both, the degree of protection and safety is less as compared to a rolling shutter. The situations where a certain amount of ventilation combined with safety is required rolling shutter-cum-grill may be provided in which the rolling shutter may have a rolling grill portion either at the top or at the bottom or at both places. In addition, the rolling grill portion may also be provided in the middle of the shutter. The total height of the grill portion in all the segments of rolling shutter-cum grill shall not exceeded 1.0m and the height of the grill portion in any individual segment shall not be more than 0.5m.

Rolling grills shutters are similar in design, construction and operation to rolling shutters and all the provisions of Para 10.8 shall be applicable to rolling grills shutters except in respect of the shutter portion and shall conform to IS 6248.

Shutters

Rolling grill shutter and the rolling grill portion of the rolling shutter-cum grill shall be fabricated with 8 mm diameter mild steel round bars. Straight bars and bars bent to the required profile are placed alternatively and held in position with 20mm wide and 5mm thick mild steel flat links. Straight bars shall be spaced not exceeding 150mm centre to centre and the bars bent to required profile shall be placed symmetrically between two consecutive straight bars. Unless otherwise specified or directed by the Engineer-in-charge, bars placed alternatively with straight bars shall be bent to form a corrugated profile such that the pitch of the corrugation is 100 to 120mm and the depth of corrugation is 80 to 100mm. all the bent bars shall have uniform profile. Straight bar along with the adjoining bent bars on it both sides shall be held in position by passing the bars through holes in the links. Each link shall have three holes and the length of the links shall be such that the distance from the centre of the hole to the nearest edge of the flat is not less than the diameter of the hole. The corner of the links shall be rounded. All links shall be of uniform size and shape. The spacing of the links measured along the straight bar shall be the same as centre to centre distance between two consecutive crests/ troughts of the bars bent to the required profile. Each bar and link shall be continuous single piece without any joint.

Measurement & Rate

The measurement and rate shall be as specified in clause 2.02.01(g). In case of Rolling Shutter-cum-Grill, where the area of the grill portion is half or less than half the area of opening, it shall be measured and paid as rolling shutter and where the area of grill portion is more than half the area of opening, it shall be measured and paid as rolling grill.

2.06.00 **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. Wherever galvanized door not specified, the door shall be painted with synthetic enamel paint with two coats

2.07.00 **Erection**

Door shall be installed by the manufacturer or his authorised representative and all work shall be as per manufacturer's instructions. Any drilling or cutting to concrete, masonry etc. shall be made good after erection of shutters and all abrasion to shop coat shall be touched up. All electrical work shall be in strict accordance with the latest Indian Electricity Rules.

2.08.00 **Collapsible Gate / Door**

2.08.01 These shall be of approved manufacture and shall be fabricated from the mild steel sections.

2.08.02 The gates shall consist of double or single collapsible gate depending on the size of the opening. These shall consist of vertical double channels each 20 x 10 x 2 mm. at 10 cm. centre to centre braced with flat iron diagonals 20 x 5 mm and top and bottom rails of T- iron 40 x 40 x 6 mm @ 3.5 kg/m with 40 mm dia. ball bearings in every fourth double channel, unless otherwise specified. Wherever collapsible gate is not provided within the opening and fixed along the outer wall surface, T- iron at the top may be replaced by flat iron 40 x 10 mm.

The collapsible gate shall be provided with necessary bolts and nuts, locking arrangement, stoppers and handles. Any special fittings like spring, catches and locks, shall be so specified in the description of item where so required. The gate shall open and close smoothly and easily.

2.08.03 **Fixing**

T- iron rails shall be fixed to the floor and to the Lintel at top by means of anchor bolts embedded in cement concrete of floor and lintel. The anchor bolts shall be placed approximately at 45 cm centers alternatively in the two flanges of the T- iron. The bottom runner (T- iron) shall be embedded in the floor and proper groove shall be formed along the runner for the purpose. The collapsible shutter shall be fixed at sides by fixing the end double channel with T-iron rails and also by hold- fasts bolted to the end double channel and fixed in masonry of the side walls on the other side. In case the collapsible shutter is not required to reach the lintel, beam or slab level, a Tee-section suitably designed may be fixed at the top, embedded in masonry and provided with necessary clamps and roller arrangement at the top. All the adjoining work damaged in fixing of gate shall be made good to match the existing work, without any extra cost.

2.08.04 **Painting**

All the members of the collapsible gate including T-iron shall be thoroughly cleaned off rust, scales, dust etc. and given a priming coat of approved steel primer conforming to IS 2074 before fixing them in position.

2.08.05 **Measurements**

The height and breadth shall be measured correct to a cm. The height of the gate shall be measured as the length of the double channels and breadth from outside to outside of the end fixed double channels in open position, of the gate. The area shall be calculated in square metres, correct to two places of decimal.

2.08.06 **Rate**

The rate shall include the cost of materials and labour involved in all the operations described above.

3.00.00 **ACCEPTANCE CRITERIA**

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 **RATES**

Rates shall be unit rates for complete items for supply and/or erection of rolling shutters, including all drives, accessories, hardware etc. No extra payment shall be made for cutting, drilling, welding, grouting etc. to structure for installation of the shutters.

The rates shall include the mounting of controls, wire and wiring from the nearest junction box, conduit and other electrical connections.

5.00.00 **METHOD OF MEASUREMENT**

a) Rolling shutters or grills shall be measured for area of opening in which they shall be installed. Alternatively, shutters shall be measured for actual number of different sizes used.

b) Cylinder locks shall be for actual numbers used. Pad locks shall be supplied by others.

6.00.00 **I.S. CODE**

IS : 6248 - Metal rolling shutters and rolling grills.

IS : 10521 - Collapsible Gate

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SECTION-XXII

TECHNICAL SPECIFICATION FOR GLASS AND GLAZING

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SECTION-XXII

TECHNICAL SPECIFICATION FOR GLASS AND GLAZING

1.00.00 SCOPE

The work in general shall consist of supplying and fixing all glass and glazing including all clips, putty, mastic cement etc wherever required as shown on drawings and specifications, supply of metal glazing beads and neoprene gaskets shall not be included in this scope.

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, shall have 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) Clear glass shall be float glass and should be approved by the Engineer-in-Charge and shall be at least 4 mm thick for windows and for doors & glazed partitions shall be minimum 8mm thick or as indicated in doors' and windows schedule. It shall be clear, float transparent and free from cracks subject to allowable defects. The float glass shall conform to the IS 14900. The thickness of float glass shall be measured with micrometers or a calliper which is graduated to 0.01 mm or with a measuring instrument having an equivalent capacity.

b) Obscure glass shall have a cast surface in one side.

c) 24mm thick insulated double glazing having 6mm thick tinted heat-reflecting type float glass on outer side and 6mm thick clear float glass on inner side with 12mm air gap & hermetically sealed shall be mounted on 15 micron coloured anodised aluminium frame suitable for structural glazing system.

d) In general, the putty shall conform to IS: 400 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing. Quick setting putty glass is used where it shall be non-setting type.

e) The EPDM Gaskets shall be of size and profile as shown in drawings and as called for, to render the glazing, doors, windows, ventilators etc. air and water tight. Samples of gaskets shall be submitted for approval and the EPDM gasket approved by Engineer-in-Charge shall only be used. The contractor shall submit documentary proof of using the above material in the work to the entire satisfaction of Engineer-in-Charge.

The EPDM gasket shall meet the requirements as given in Table below :

SL. No.	Description	Standard Follow	Specification
1	Tensile strength kg.f/cm^2	ASTM-D 412	70 Min.
2	Elongation at break %	ASTM-D 412	250 Min.
3	Modulus 100% Kgf/cm^2	ASTM-D 412	22 Min.
4	Compression set % at 0º CC 22 Hrs.	ASTM-D 395	50 Max.
5	Ozone resistance	ASTM-D 1149	No visible cracks

Quality of glass

a) All glass shall comply with ECBC 2007 requirements.

b) Single glass panels shall have properties like –
VLT = 35 to 50%, external reflection=6 to 15%, internal reflection=8 to 15%, solar factor=0.36 to 0.43, U value=2.8 to 3.0 W/sqm K to be provided.

c) Double glazed panels with glass having properties like-
VLT = 30 to 45%, external reflection=8 to 20%, internal reflection=15 to 30%, solar factor=0.26 to 0.29, U value=1.8 to 1.9 W/sqm K. shall be provided.

2.02.00 **Reflective Glass**

Definitions

i) **Shading Coefficient** : The shading coefficient is the ratio of total solar transmittance to the transmittance through 3.2 mm (1/8") clear glass. Windows with low shading coefficient values improve comfort for building, lower the total cooling load of the building and help smooth out of the difference in cooling loads between perimeter & core zones.

ii) **Luminous Efficiency Constant (Ke)** indicates a windows relative performance in rejection solar heat-while transmitting day light. It is the ratio of the visible transmittance to the shading coefficient; clear glass which lets in roughly equal amounts of visible light and solar near-infrared energy has a Ke close to 1.0. The solar radiation contains about 50% invisible near-infrared & ultra violet light. Therefore, a perfectly selective glazing, which would all allow visible light pass through while blocking all of the invisible near-infrared & ultraviolet light, would have Ke of about 2.0.

iii) **Resistance to Heat Conduction (R-valve) :** It is a measure of resistance to heat flow that occurs because of temperature difference between the two sides of the windows. The inverse of R-value is termed as U-value.

Reflective Glass

This is an ordinary float glass with a metallic coat to reduce solar heat. Clear glass transmits most of the sunlight that shines upon it, and most of the solar heat as well; the metallic coated glass i.e. reflective glass has better shading coefficients because they reflect rather than absorb infrared energy. However, most of reflective glazing blocks day light more than solar heat.

Types of Coatings : There are two types of reflective glass, Pyroltic (Hard) coated and vacuum (soft) coated.

i) **Pyroltic :** It is a coating applied during glass manufacture. The coating is fused in to the glass at 1200ºC.

ii) **Vacuum Coated Glass :** It involves the deposition of metal particles on the glass surface by a chain reaction in a vacuum vessel. It is often called a soft coat; because the coating is more susceptible to damage than hard coat glass. Where toughening of product is required, the product must be toughened first & then vacuum coated. Vacuum coated products have better shading coefficient values than Pyroltic products.

Performance of Reflective Glass : The performance of reflective glass 6 mm of nominal thickness is given below:

Sl. No.	Parameter	Threshold Ratio in %age
1.	Visible Light - Transmittance (%) - Reflectance (%)	 15-46 12-24
2.	Total Solar Energy: - Transmittance (%) - Reflectance (%)	 16-24 8-12
3.	Ultra Violet Rays: - Transmittance (%)	 2-10
4.	U-Value - Summer - Winter	 0.58 0.45
5.	Shading Coefficient	0.25-0.35

Testing : The reflective glass shall be tested for the followings :

i) Physical/Field Test: In a true reflective glass, when a pointed pencil is placed, then tip of pencil (physical) & image should coincide.

ii) Laboratory Test: In the laboratory, the reflective glass shall be tested for the parameter specified in the table above.

2.03.00 **Glazing, Setting and Finish**

All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the Contractor.

All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant I.S. Codes, four glazing clips shall be provided per glass pan, except for large panes where 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 moulding 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.

Necessary glazing clips, putty, mastic cement etc. shall be supplied by the Contractor. The Contractor shall be responsible for damage of glass supplied by the Owner, during handling, transportation, fixing etc maximum wastage allowance shall be 5%.

After completion of glazing work, the Contractor shall remove all dirt stains, excess putty etc. clean the 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 EPDM 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 RATES

a) Rates shall be unit rates for supply and / or installation of different kinds of glass mentioned in the Schedule of Items.

b) No separate payment shall be made for glazing clips, mastic cement, putty, nails etc. for drilling holes in frames for inserting glazing clips.

c) No separate payment shall be made for cutting of glass to require size, edge finishing etc.

d) No separate payment shall be made for cleaning the glass after installation.

5.00.00 METHOD OF MEASUREMENT

All supply and / or installation of glass shall be measured for actual area of work done.

6.00.00 **IS CODES**

Following are some of the important I.S.Codes relevant to this Section;

IS : 3548 - Code of practice for glazing in building.

IS : 1083 - Code of practice for fixing and glazing metal doors, windows and ventilators.

IS : 14900 - Transparent Float glass- Specifications.

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SECTION-XXV

TECHNICAL SPECIFICATION
FOR
PAINTING, WHITE WASHING AND POLISHING ETC.

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SECTION-XXV

TECHNICAL SPECIFICATION FOR PAINTING, WHITE WASHING AND POLISHING ETC.

1.00.00 SCOPE

This specification covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces on wood work, masonry, masonry surface with lime punning or white cement putty, concrete plastering, plaster of Paris punning, 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 as shown on drawings, schedule or as directed by the Engineer.

Copper, bronze, chromium plate, nickel, stainless steel, aluminium and monel metal shall generally not be painted or finished except if otherwise specified.

The painting Contractor shall inspect the work of others prior to the application of paint. If surface to be finished cannot be put in suitable condition for painting by customary preparatory methods, the painting contractor shall notify the Engineer in writing or assume responsibility for and rectify unsatisfactory finishing those results.

Before commencing painting, the painting contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage, disfiguration or staining by other trades. He shall also undertake normal precautions to prevent damage, disfiguration or staining to work of other trades or other installations. Contractor shall keep record of number of coats of painting. Before applying second coat, the contractor shall obtain prior approval of Engineer in Charge

2.00.00 INSTALLATION

2.01.00 Materials

Materials shall be Grade-1 quality from 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 or one shade is obtained from the same

manufacturing batch. All paint shall be subject to analysis from random samples taken at site from painter's bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finishing coats to be applied.

All unspecified materials such as shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognised 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 Washing**

Preparation of Surface : Before new work is white washed, the surface shall be thoroughly brushed free from mortar droppings an foreign matters.

Preparation of Lime wash : The lime wash be prepared from fresh stone white lime (Natural or Dehradun quality) or fat lime, or a mixture of both as instructed by the Engineer, and shall conform to IS: 712 latest editions and shall be submitted to the Engineer for approval and approved sample shall be brought to site in unslaked condition. The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 40 gm of gum dissolved in hot water, shall be added to each 10 cubic decimeter of the cream. The approximate quantity of water to be added in making the cream will be 5 liters of water to one kg of lime.

Indigo (Neel) up to 3 gm per kg of lime dissolved in water, shall then be added and stirred well. Water shall then be added at the rate of about 5 liters per kg. of lime to produce a milky solution.

Application: The white wash shall be applied with moonj brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from the top downwards, another from the bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries.

Each coat shall be allowed to dry before the next coat is applied. Further each coat shall be inspected and approved by the Engineer-in-Charge before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on.

For new work, three or more coats shall be applied till the surface presents a smooth and uniform finish through which the plaster does not show. The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

Protective Measures : Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be white washed, shall be protected from being splashed upon. Splashing and droppings, if any shall be removed by the contractor at his own cost and the surfaces cleaned. Damages if any to furniture or fittings and fixtures shall be recoverable from the contractor.

Measurements : Length and breadth shall be measured correct to a cm. and area shall be calculated in sqm correct to two places of decimals.

Measurements for Jambs, Soffits and Fills etc. for openings shall be as described earlier.

Corrugated surfaces shall be measured flat as fixed and the area so measured shall be increased by the following percentages to allow for the girthed area.

Corrugated non-asbestos cement sheet	20%
Semi corrugated non-asbestos cement sheet	10%

Cornices and other such wall or ceiling features shall be measured along the girth and included in the measurements.

The number of coats of each treatment shall be stated. The item shall include removing nails, making good holes, cracks, patches etc exceeding 50 sq. cm. each with material similar in composition to the surface to be prepared.

The rate shall include all material and labour involved in all the operations described above.

b) **Colour Washing**

The mineral colours, not affected by lime, shall be added to white wash. Indigo (Neel) shall however, not be added. No colour wash shall be done until a sample of the colour wash of the required tint or shade has been got approved from the Engineer-in-Charge. The colour shall be of even tint or shade over the whole surface. If it is blotchy or otherwise badly applied, it shall be redone by the contractor.

For new work, the priming coat shall be of white wash with lime or with whiting as specified in the description of the item. Two or more coats, shall then be applied on the entire surface till it represents a smooth and uniform finish.

For old work, after the surface has been prepared (as described above) a coat of colour wash shall be applied over the patches and repairs. Then a single coat, or two or more coats of colour wash, as stipulated in the description of the item shall be applied over the entire surface. The colour washed surface shall present a uniform finish.

The finished dry surface shall not be powdery and shall not readily come off on the hand when rubbed.

Other specifications as described eallier.

c) **Dry Distemper**

Materials : Dry distemper of required colour (IS 427) and of approved brand and manufacture shall be used. The shade shall be got approved from the Engineer-in-Charge before application of the distemper. The dry distemper colour as required shall be stirred slowly in clean water using6 decilitres (0.6 litre) of water per kg of distemper or as specified by the makers. Warm water shall preferably be used. It shall be allowed to stand for at least 30 minutes (or if practicable over night) before use. The mixture shall be well stirred before and during use to maintain an even consistency.

Distemper shall not be mixed in larger quantity than is actually required for one day's work.

Preparation of Surface : Before new work is distempered, the surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand papered smooth.

New plastered surfaces shall be allowed to dry completely, before applying, distemper.

In the case of old work, all loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt, etc.

Pitting in plaster shall be made good with plaster of paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the resular coat of distemper is applied.

Priming Coat : A priming coat of whiting shall be applied over the prepared surface in case of new work, if so stipulated in the description of the item. No white washing coat shall be used as a priming coat for distemper.

The treated surface be allowed to dry before distemper coat is given.

Application : In the case of new work, the treatment shall consist of a priming coat of whiting followed by the application of two or more coats of distemper till the surface shows an even colour.

For old work, the surface prepared (as described before) shall be applied one or more coats of distemper till the surface attains an even colour.

The application of each coat shall be as follows :

The entire surface shall be coated with the mixture uniformly, with proper distemper brushes (ordinary white wash brushed shall not be allowed) in horizontal strokes followed immediately by vertical ones which together shall constitute one coat.

The subsequent coats shall be applied only after the previous coat has dried.

The finished surface shall be even and uniform and shall show no brush marks.

Enough distemper shall be mixed to finish one room at a time. The application of a coat in each room shall be finished in one operation and no work shall be started in any room, which cannot be completed the same day.

After each day's work, the brushes shall be washed in hot water and hang down to dry. Old brushes which are dirty or caked with distemper shall not be used.

The specifications in respect of scaffolding and protective measures shall be as described before.

d) **Oil Emulsion (Oil Bound) Washable Distemper**

Materials

Oil emulsion (Oil Bound) washable distemper (IS 428) of approved brand and manufactures shall be used. The primers where used as on new work shall be cement primer or distemper primer as described in the item. These shall be of the same manufacture as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for day's work shall be prepared.

The distemper and primer shall be brought by the contractor in sealed tins in sufficient quantities at a time to suffice for a fortnight's work, and the same shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty tins shall not be removed from the site of the work, till this item of work has been completed and passed by the Engineer-in-Charge.

Preparation of the Surface

For new work the surface shall be thoroughly cleaned of dust, old white or colour wash by washing & scrubbing. The surface shall then be allowed to dry for that at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

In the case of old work, all loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt etc.

Pitting in plaster shall be made good with plaster of paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

Application

Priming Coat : The priming coat shall be with distemper primer or cement primer, as required in the description of the item. The application of the distemper primer shall be as described before.

Note: If the wall surface plastered has not dried completely, cement primer shall be applied before distempering the walls. But if distempering is done after the wall surface is dried completely, distemper primer shall be applied.

Oil bound distemper is not recommended to be applied, within six months of the completion of wall plaster. However, newly plastered surface if required to be distempered before a period of six months shall be given a coat of alkali resistant priming Paint confirming to IS 109 and allowed to dry for atleast 48 hours before distempering is commenced.

For old work no primer coat is necessary.

Distemper Coat : For new work, after the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner (water or other liquid as stipulated as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical ones which together constitutes one coat.

The subsequent coats shall be applied in the same way. Two or more coats of distemper as are found necessary shall be applied over the primer coat to obtain an even shade.

A time interval of at least 24 hours shall be allowed between successive coats to permit proper drying of the preceding coat.

For old work the distemper shall be applied over the prepared surface in the same manner as in new work. One or more coats of distemper as are found necessary shall be applied to obtain an even and uniform shade.

15 cm double bristled distemper brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hang down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

The specifications in respect of scaffolding, protective measures shall be as described before.

e) **Cement Primer Coat**

Cement primer coat is used as a base coat on wall finish of cement, lime or lime cement plaster or on non-asbestos cement surfaces before oil emulsion distemper Paints are applied on them. The cement primer is composed of a medium and pigment which are resistant to the alkalies present in the cement, lime or lime cement in wall finish and provides a barrier for the protection of subsequent coats of oil emulsion distemper Paints.

Primer coat shall be preferably applied by brushing and not by spraying. Hurried priming shall be avoided particularly on absorbent surfaces. New plaster patches in old work should also be treated with cement primer before applying oil emulsion Paints etc.

Preparation of the Surface : The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any uneveness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

Application : The cement primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours, before oil emulsion Paint is applied.

The specifications in respect of scaffolding, protective measures shall be as described before.

f) **Cement Paint**

Material : The cement Paint shall be (confirming to IS 5410) of approved brand and manufacturer.

The cement Paint shall be brought to the site of work by the contractor in its original containers is sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the Contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of the work has been completed and permission obtained from the Engineer-in-Charge.

Preparation of the Surface : For new work, the surface shall be thoroughly cleaned of all mortar dropping, dirt dust, algae, grease and other foreign matter by brushing and washing. Pitting in plaster shall be made good and a coat of water proof cement Paint shall be applied over patches after wetting them thoroughly.

Preparation of Mix : Cement Paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement Paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement Paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement Paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously.

The lids of cement Paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement Paint rapidly becomes air set due to its hygroscopic qualities.

In case of cement Paint brought to in gunny bags, once the bag is opened, the contents should be consumed in full on the day of its opening. If the same is not likely to be consumed in full, the balance quantity should be transferred and preserved in an airtight container to avoid its exposure to atmosphere.

Application : The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The salutation shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun of the sun on the surface is avoided. The method of application of cement Paint shall be as per manufacturer's specification. The completed surface shall be watered after the days work.

The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted.

For new work, the surface shall be treated with three or more coats of water proof cement Paint as found necessary to get a uniform shade.

For old work, the treatment shall be with one or more coats as found necessary to get a uniform shade.

Precaution : Water proof cement Paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, Paints etc. It shall not be applied on gypsums, wood and metal surfaces.

If water proofing cement is required to be applied on existing surface, previously treated with white wash, colour wash etc., the surface shall be thoroughly cleaned by scrapping off all the white wash, colour wash etc. completely. Thereafter, a coat of cement primer shall be applied followed by two or more coat of water proof cement.

The specifications in respect of scaffolding and protective measures shall be as described before. The coefficient for cement paint on RCC Jalli shall be 2 x (for painting all over).

g) **Exterior Painting on Wall**

Material : The paint shall be (Textured exterior paint / Acrylic smooth exterior paint / premium acrylic smooth exterior paint) of approved brand and manufacture.

This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The material shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained form the Engineer-in-Charge.

Preparation of Surface : For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection before painting is commenced.

Application :

Base coat of water proofing cement paint – All specifications in respect of base coat of water proofing cement paint shall be as described before.

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with portable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the

manufacturer's instructions & directions of the Engineer-in-Charge shall be followed meticulously.

The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust.

Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.

The specifications in respect of scaffolding and protective measures shall be as describe before.

3.00.00 PAINTING

Materials

Paints, oils, varnishes etc. of approved brand and manufacture shall be used. Only ready mixed Paint (Exterior grade) as received from the manufacturer without any admixture shall be used.

If for any reason, thinning is necessary in case of ready mixed paint, the brand of thinner recommended by the manufacturer or as instructed by the Engineer-in-Charge shall be used.

Approved paints, oil or varnishes shall be brought to the site of work by the contractor in their original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empties shall not be removed from the site of the work, till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

Commencing Work

Painting shall not be started until the Engineer-in-Charge has inspect the items of work to be painted, satisfied himself about their proper quality and given his approval to commence the painting work. Painting of external surface should not be done in adverse weather condition like hail storm and dust storm.

Painting, except the priming coat, shall generally be taken in hand after practically finishing all other building work.

The rooms should be thoroughly swept out and the entire building cleaned up, at least one day in advance of the Paint work being started.

Preparation of Surface

The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

Application

Before pouring into smaller containers for use, the Paint shall be stirred thoroughly in its containers, when applying also, the Paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform.

The painting shall be laid on evenly and smoothly by means of crossing and laying off, the latter in the direction of the grains of wood. The crossing and laying off consists of covering the area over the Paint, brushing the surface hard for the first time over and then brushing alternately in opposite direction, to or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

Where so stipulated, the painting shall be done by spraying. Spray machine used may be (a) high pressure (small air aperture) type, or (b) a low pressure (large air gap) type, depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner.

Spraying should be done only when dry condition prevails. Each coat shall be allowed to dry out thoroughly and rubbed smooth before the next coat is applied. This should be facilitated by through ventilation. Each coat except the last coat, shall be lightly rubbed down with sand paper or fine pumice stone and cleaned off dust before the next coat is laid.

No left over Paint shall be put back into the stock tins. When not in use, the containers shall be kept properly closed.

No hair marks from the brush or clogging of Paint puddles in the corners of panels, angles of moulding etc. shall be left on the work.

In painting doors and windows, the putty round the glass panes must also be painted but care must be taken to see that no Paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out in painting. However, bottom edge of the shutters where the painting is not practically possible, need to be done nor any deduction on this account will be done but two coats of primer of approved make shall be done on the bottom edge before fixing the shutters.

On painting steel work, special care shall be taken while painting over bolts, nuts, rivets overlaps etc.

The additional specifications for primer and other coats of Paints shall be as according to the detailed specifications under the respective headings.

Brushes and Containers

After work, the brushes shall be completely cleaned of Paint and linseed oil by rinsing with turpentine. A brush in which Paint has dried up is ruined and shall on no account be used for painting work. The containers when not in use, shall be kept closed and free from air so that Paint dose not thicken and also shall be kept safe from dust. When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, so that they are clean, and can be used again.

Measurements

The length and breadth shall be measured correct to a cm. The area shall be calculated in the sqm. (correct to two places of decimal), except otherwise stated.

Small articles not exceeding 10 sq. decimeter (0.1 sqm) of painted surfaces where not in conjunction with similar painted work shall be enumerated.

Note: Components of trusses, compound girders, stanchions, lattices and similar work shall, however, be given in sqm. irrespective of the size or girth of members. Priming coat of painting shall be included in the work of fabrication.

In measuring painting, varnishing, oiling etc. of joinery and steel work etc. The coefficients as indicated in following tables shall be used to obtain the area payable. The coefficients shall be applied to the areas measured flat and not girthed.

Table 1
Equivalent Plain Areas of Uneven surface

Sl. No.	Description of Work	How measured	Multiplying Coefficients
I.	**Wood Work Doors, Windows etc.**		
1.	Panelled or framed and braced doors, windows etc.	Measured flat (not girthed including)	1.30 (for each side)
2.	Ledged and battened or ledged, battened and braced doors, windows etc.	Chowkhat or frame, Edges, chocks, cleats, etc. shall be deemed to be included in the item.	1.30 (for each side)
3.	Flush doors etc.	. --- do ---	1.20 (for each side)
4.	Part paneled and part glazed or gauzed doors, window etc. (Excluding painting of wire gauze portion)	. --- do ---	1.00 (for each side)
5.	Fully glazed or gauzed doors, windows etc. (Excluding painting of wire gauze portion)	. --- do ---	0.80 (for each side)
6.	Fully venetioned or louvered doors, windows etc.	. --- do ---	1.80 (for each side)
7.	Trellis (or Jaffri) work one way or two way	Measured flat overall, no deduction shall be made for open spaces, supporting members shall not be measured separately	2.00 (for painting all over)
8.	Carved or enriched work	Measured flat	2.00 (for each side)
9.	Weather boarding	Measured flat (not girthed supporting frame work) shall not be measured separately	1.20 (for each side)
10.	Wood single roofing	Measured flat (not girthed)	1.10 (for each side)
11.	Boarding with cover fillets and match boarding	Measured flat (not girthed)	1.05 (for each side)
12.	Tile and slate battening	Measured flat overall no deductions shall be made for open spaces	0.08 (for painting all over)

Sl. No.	Description of Work	How measured	Multiplying Coefficients
II.	**Steel Work Doors, Windows etc.**		
13.	Plane sheeted steel doors or windows	Measured flat (not girthed) including frame edges etc.	1.10 (for each side)
14.	Fully glazed or gauzed steel doors and windows (Excluding painting of wire gauze portion)	. --- do ---	0.50 (for each side)
15.	Part paneled and partly glazed or gauzed doors and windows etc. (Excluding painting of wire gauze portion)	. --- do ---	0.80 (for each side)
16.	Corrugated sheeted steel doors or windows	. --- do ---	1.25 (for each side)
17.	Collapsible gates	. --- do ---	1.50 (for painting all over)
18.	Rolling shutters of interlocked laths	Measured flat	1.10 (for each side)

Sl. No.	Description of Work	How measured	Multiplying Coefficients
III.	**General**		
19.	Expanded metal, hard drawn steel wire fabric of approved quality, grill works and gratings in guard bars, balustrades, railing partitions and MS Bars in windows frames.	Measured flat overall; no deduction shall be made for open spaces; supporting members shall not be measured separately	1.00 (for Paint all over)
20.	Open palisade fencing and gates including standards, braces, rails stays etc. in timber or steel	. --- do --- (See note no. 12)	1.00 (for Paint all over)
21.	Corrugated iron sheeting in roofs, side cladding etc.	. --- do --- Measured flat (not girthed)	1.14 (for each side)
22.	AC corrugated sheeting in roofs, side cladding etc.	. --- do ---	1.20 (for each side)
23.	AC semi corrugated sheeting in roofs, side cladding etc. or Nainital pattern using plane sheets	. --- do ---	1.10 (for each side)
24.	Wire gauze shutters including painting of wire gauze	. --- do ---	1.00 (for each side)

Explanatory Notes for Table 1

1. Measurement for doors windows etc., shall be taken flat (and not girthed) over all including chowkhuts or frames, where provided. Where Chowkhuts or frames are not provided, the shutter measurements shall be taken.

2. Where doors, windows etc., are of composite types, different portion shall be measured separately with their appropriate coefficients, the centre line of the common rail being taken as the dividing line between the two portions.

3. The coefficients for doors and windows shall apply irrespective of the size of frames and shutter members.

4. In case steel frames are used the area of doors, windows shutters shall be measured flat excluding frames.

5. When the two faces of a door, window etc. are to be treated with different specified finishes, measurable under separate items, the edges of frames and shutters shall be treated with the one or the other type of finish as ordered by the Engineer-in-Charge and measurement of this will be deemed to be included in the measurement of the face treated with that finish.

6. In the case where shutters are fixed on both faces of the frames, the measurement for he door frame and shutter on one face shall be taken in the manner already described, while the additional shutter on the other face will be measured for the shutter only excluding the frame.

7. Where shutters are provided with clearance at top or / and bottom each exceeding 15 cm height, such openings shall be deducted from the overall measurements and relevant coefficient shall be applied to obtain the area payable.

8. Collapsible gates shall be measured for width from outside to outside of gate in its expanded position and for height from bottom to top of channel vertical. No separate measurements shall be taken for the top and bottom guide rails rollers, fittings etc.

9. Coefficients for sliding doors shall be the same as for normal types of doors in the table. Measurements shall be taken outside to outside of shutters, and no separate measurements shall be taken for the painting guide rails, rollers, fittings etc.

10. Measurements of painting as above shall be deemed to include painting all iron fittings in the same or different shade for which no extra will be paid.

11. The measurements of guard bars, expanded metal, hard drawn steel wire fabric of approved quality, grill work and gratings, when fixed in frame work, painting of which is once measured else where shall be taken exclusive of the frames. In other cases the measurements shall be taken inclusive of the frames.

12. For painting open palisade fencing and gates etc., the height shall be measured from the bottom of the lowest rail, if the palisade do not go below it, (or from the lower end of the palisades, if they project below the lowest rail), upto the top of rails or palisades whichever are higher, but not up to the top standards when the letter are higher than the top rails or the palisades.

Width of moulded work of all other kinds, as in hand rails, cornices, architraves shall be measured by girth.

For trusses, compound girders, stanchions, lattice girders, and similar work, actual areas will be measured in sqm. and no extra shall be paid for painting on bolt heads, nuts, washers etc. even when they are picked out in a different tint to the adjacent work.

Painting of rain water, soil, waste, vent and water pipes etc. shall be measured in running metres of the particular diameter of the pipe concerned. Painting of specials such as bends, heads, branches, junctions, shoes, etc. shall be included in the length and no separate measurements shall be taken for these or for painting brackets, clamps etc.

Measurements of wall surfaces and wood and other work not referred to already shall be recorded as per actual.

Flag staffs, steel chimneys, aerial masts, spires and other such objects requiring special scaffolding shall be measured separately.

Precautions

All furnitures, fixtures, glazing, floors etc. shall be protected by covering and stains, smears, splashing, if any shall be removed and any damages done shall be made good by the contractor at his cost.

Rate
Rates shall include cost of all labour and materials involved in all the operations described above and in the particular specifications given under the several items

4.00.00 **PAINTING PRIMING COAT ON WOOD, IRON OR PLASTERED SURFACES**

Primer

The primer for wood work, iron work or plastered surface shall be as specified in the description of item.

Primer for plaster / wood work / Iron & Steel / Aluminium surfaces shall be as specified below.

Table-2

Sl. No	Surfaces	Primer to be used
1.	Wood work (hard and soft wood)	Pink conforming to IS 3536
2.	Resinour wood and plywood	Aluminium primer confirming to IS 3585
3.	(A) Aluminium and light alloys	Zinc chromate primer confirming to IS 104
	(B) Iron, Steel and Galvanized steel	Red Oxide Zinc chromate Primer confirming IS 2074
4.	Cement/Concrete/RCC/brickwork, Plastered surfaces, non-asbestos surfaces to receive Oil bound distemper or Paint finish.	Cement primer confirming to IS 109

The primer shall be ready mixed primer of approved brand and manufacture.

Where primer for wood work is specified to be mixed at site, it shall be prepared from a mixture of red lead, white lead and double boiled linseed oil in the ratio of 0.7 kg : 0.7 kg : 1 litre.

Where primer for steel work is specified to be mixed at site, it shall be prepared from a mixture of red lead, raw linseed oil and turpentine in the ratio of 2.8 kg :1 litre : 1 litre.

The specifications for the base vehicle and thinner for mixed on site primer shall be as follows:

i) **White Lead :** The white lead shall be pure and free from adulterants like barium sulphate and whiting. It shall confirm to IS 103.

ii) **Red Lead:** This shall be in powder form and shall be pure and free from adulterants like brick dust etc. It shall confirm to IS 102.

iii) **Raw Linseed Oil:** Raw linseed oil shall be lightly viscous bit clear and of yellowish colour with light brown tinge. Its specific gravity at a temperature of 30 degree C shall be between 0.923 and 0.928.

Note: The oil shall be mellow and sweet to the taste with very little small. The oil shall be of sufficiently matured quality. Oil turbid or thick, with acid and bitter taste and rancid odour and which remains sticky for a considerable time shall be rejected. The oil shall confirm in all respects to IS 75. The oil shall be of approved brand and manufacture.

iv) **Double Boiled Linseed Oil:** This shall be more viscous than the raw oil, have a deeper colour and specific gravity between 0.931 and 0.945 at a temperature of 30 degree C. It shall dry with a glossy surface. It shall confirm in all respects to IS 77. The oil shall be of approved brand and manufacture.

Turpentine : Mineral turpentine i.e. petroleum distillate which has the same rate of evaporation as vegetable turpentine (distillate product of oleoresin of conifers) shall be used. It shall have no grease or other residue when allowed to evaporate. It shall confirm to IS 533.

All the above materials shall be approved manufacture and brought to site in their original packing in sealed condition.

4.01.00 **Preparation of Surface**

4.01.01. **Wooden Surface :** The wood work to be painted shall be dry and free from moisture. The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material confirming to IS 345 with same shade as Paint shall be used where specified. The surface treated for knotting shall be dry before paint is applied. After obtaining approval of Engineer-in-Charge for wood work, the priming coat shall be applied before the woo work is fixed in position. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glazier's putty or wood putty. Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in stopping and the latter is therefore liable to crack.

4.01.02. **Iron and Steel Surface :** All rust and scales shall be removed by scrapping or by brushing with wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed.

All dust and dirt shall be thoroughly wiped away from the surface.

If the surface is wet, it shall be dried before priming coat is undertaken.

4.01.03. **Plastered Surface :** The surface shall ordinarily not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and where drying is satisfactory, painting shall then be taken in hand. Before primer is applied, holes and undulations shall be filled up with plaster of paris and rubbed smooth.

Application

The primer shall be applied with brushes, worked well into the surface and spread even and smooth. The painting shall be done by crossing and laying off as described before.

Treatment on Steel for Aggressive Environment

A second coat of ready mixed red oxide zinc chromate primer may be applied where considered necessary in aggressive environment such as near Industrial Establishment and Coastal regions where the steel members are prone to corrosion. The second coat (which shall be paid for separately) is to be applied after placing the member in position and just before applying Paint. The second coat of primer is not necessary in case of painting with synthetic enamel Paint as it is applied over and under coat of ordinary Paint.

Painting Priming Coat On Wood, Iron Or Plastered Surfaces

Synthetic Enamel

Paint, suitable for painting over G.S. sheets, of approved brand and manufacture and of the required shade shall be used. New or weathered G.S sheets shall be painted with a priming coat of one coat of redoxide zinc chromate Paint. Primer shall be applied before fixing sheets in place.

Preparation of Surface

Painting New Surface : The painting of new G.S. sheets shall not usually be done till the sheets have weathered for about a year. When new sheets are to be painted before they have weathered they shall be treated with a mordant solution prepared by mixing 38 gm of copper acetate in a litre of soft water or 13 gm hydrochloric acid in a solution of 13 gm each of copper chloride, copper nitrate and ammonium chloride dissolved in a litre of soft water. This quantity of solution is sufficient for about 235 sqm. to 280 sqm. of area and is applied for ensuring proper adhesion of Paint. The painting with the mordant solution will be paid for separately.

Before painting on new or weathered G.S. sheets, rust patches shall be completely cleaned with coarse emery paper and brush. All grease marks shall also be removed and surface washed and dried and rusted surface shall be touched with synthetic enamel paint of approved brand, manufacturer and shade.

Painting Old Surface : If the old Paint is firm and sound, it shall be cleaned and grease, smoke etc. The surface shall then be rubbed down with sand paper and dusted. Rusty patches shall be cleaned up and touched with synthetic enamel paint.

If the old Paint is blistered and flaked, it shall be completely removed as described before. Such removal shall be paid for separately and painting shall be treated as on new work.

Application

The number of coats to be applied shall be as in the description of item. In the case of C.G.S. sheets, the crowns of the corrugations shall be painted first and when these get dried the general coat shall be given to ensure uniform finish over the entire surface without the crowns showing signs of thinning.

The second or additional coats shall be applied when the previous coat has dried.

5.00.00 **PAINTING CAST IRON RAIN WATER, SOIL, WASTE AND VENT PIPES AND FITTINGS**

The primer shall be prepared on site or shall be of approved brand and manufacture as specified in the item.

Paint shall be anti-corrosive bitumastic Paint, aluminium Paint or other type of Paint as specified in the description of the item.

Painting New Surface

Preparation of Surface : The surface shall be prepared for priming coat as described earlier.

Application : The number of coat of painting over the priming coat shall be as stipulate in the description of the item. The application of Paint over priming coat shall be carried out as specified above.

Measurements : Measurements will be taken over the finished line of pipe including specials etc. in running metres, correct to a cm.

Pipes of different diameters of bore shall be measured and paid for separately.

Specials and fittings such as holder bat clamps, plugs etc. will not be measured separately.

Rate : The rate shall include the cost of all materials and labour involved in all the operations described above, including painting of all specials and fittings.

Painting on Old Surface

Preparation of Surface : If the old Paint is firm and sound, it shall be cleaned and grease, smoke etc. The surface shall then be rubbed down with sand paper and dusted. Rusty patches shall be cleaned up and touched with synthetic enamel paint.

If the old Paint is blistered and flaked, it shall be completely removed as described before. Such removal shall be paid for separately and painting shall be treated as on new work.

Application : The specifications for application shall be as described earlier.

Measurements : Measurements will be taken over the finished line of pipe including specials etc. in running metres, correct to a cm.

Pipes of different diameters of bore shall be measured and paid for separately.

Specials and fittings such as holder bat clamps, plugs etc. will not be measured separately.

Rate : The rate shall include the cost of all materials and labour involved in all the operations described above, including painting of all specials and fittings.

6.00.00 PAINTING WITH WOOD PRESERVATIVE

Oil type wood preservative of specified quality and approved make, confirming to IS 218 shall be used. Generally, it shall be creosote oil type-I or anthracene oil.

Painting on New Surface

Preparation of Surface : Painting shall be done only when the surface is perfectly dry to permit of good absorption. All dirt, dust or other foreign matter shall be removed from the surface to be painted. All roughness shall be sand papered and cleaned.

Application : The preservative shall be applied liberally with a stout brush and not daubed with rags or cotton waste. It shall be applied with a pencil brush at the joints of the wood work. The first coat shall be allowed at least 24 hours to soak in before the second (the final) coat is applied. The second coat shall be applied in the same manner as the first coat. The excess of preservative which does not soak into the wood shall be wiped off with a clean dry piece of cloth.

Painting on Old Surface

The work shall be done in the same manner as on new surface except that only one coat shall be done.

7.00.00 COAL TARRING

Coal tar of approved manufacture confirming to IS 290 shall be used. The tar, to every litre of which 200 gm of unslaked lime has been added, shall be heated till it begins to boil. It must then be taken off the fire and kerosene oil added to it slowly at the rate of one part of kerosene oil to six or more parts by volume and stirred thoroughly. The addition of lime is for preventing the tar from running.

Coal Tarring on New Surface

Preparation of Surface : This shall be done as specified in 4.01.00 except that sand papering is not necessary. Where iron work is to be painted it shall be free from scales and rust before painting.

Application : The mixture shall be applied as hot as possible with a brush. The second coat shall be applied only after the first coat has thoroughly dried up. Where possible, the article to be tarred, shall be dipped in the hot mixture for better results. The quantity of tar to be used for the first or second coat shall be not less than 0.16 and 0.12 litre per sqm respectively. Thinning with kerosene oil shall be suitable done to ensure this.

Coal Tarring on Old Surface

The work shall be done in the same manner as specified above (Coal Tarring on New Surface) except that only one coat using 0.12 litre per sqm. area shall be done.

8.00.00 **SPRAY PAINTING WITH FLAT WALL PAINT ON NEW SURFACE**

The work shall include a priming coat of 'Distempering Primer' or 'Cement Primer' as specified in the description of the item. Flat wall Paint shall normally be applied on walls 12 months after their completions, in which case Distemper primer will suffice. If the walls are to be painted earlier, the primer coat shall consist of cement primer.

The primer and the flat wall Paint shall be of approved brand and manufacture and of the required shade.

Preparation of the Surface : The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any uneveness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

Application

Priming Coat : The specified primer shall be painted or sprayed over the surface in an even and uniform layer.

Painting Coats : When the surface is dry, the spray painting with the wall Paint in uniform and even layers will be done to the required number of coats. Each coat shall be allowed to dry overnight and lightly rubbed with every fine grade of sand paper and loose particles brushed off before the next coat is sprayed.

Spraying should be done only when dry condition prevails. During spraying the spray gun shall be held perpendicular to the surface to be coated and shall be passed over the surface in a uniform sweeping motion. Different air pressures and fan adjustment shall be tried so as to obtain the best application. The air pressure shall not be kept too high as otherwise the Paint will fog up and will be wasted.

At the end of the job, the spray gun shall be cleaned thoroughly so as to be free from dirt. Incorrect adjustments shall be set right, as otherwise they will result in variable spray patterns, runs, sags and uneven coats.

If after the final coat of wall Paints, the surface obtained is not upto the mark, further one or more coats as required shall be given after rubbing down the surface and dusting off all loose particles to obtain a smooth and even finish.

If the primer or wall Paint gets thickened during the application, it shall be thinned suitably with the thinner recommended by the manufacture.

Adequate ventilation shall be provided to disperse spray fumes. Fitments and floor shall be protected from the spray.

9.00.00 SPRAY PAINTING WITH FLAT WALL PAINT ON OLD SURFACE

Where the old Paint is in sound condition, renewal shall be carried out as described below, otherwise the old Paint shall be completely stripped and spray painting shall be carried out as over new work. Such removal shall be paid for separately.

The flat wall Paint shall be of approved brand and manufacture and of required shade.

Preparation of Surface

The surface shall be washed to remove dust and dirt. A mild detergent solution like soap water shall be used for washing and surface shall also be rubbed down lightly with abrasive paper when dry. Any patches appearing on the surface shall first be touched up with a coat of Paint. These shall be allowed to dry and then rubbed down tightly.

Application

The paint shall then be applied with spraying machine in uniform and even layer. A second coat shall be applied if considered necessary by the Engineer-in-Charge but only after the first coat is complete dry and hard.

Spraying should be done only when dry condition prevails. During spraying the spray gun shall be held perpendicular to the surface to be coated and shall be passed over the surface in uniform sweeping motion. Different air pressures and fan adjustment shall be tried so as to obtain the best application. The air pressure shall not be kept too high as otherwise the Paint will fog up and will be wasted. At the end of the job, the spray gun shall be cleaned thoroughly so as to be free from dirt. Incorrect adjustments shall be set right, as otherwise they result in variable spray patterns, runs, sags and uneven coats.

10.00.00 WALL PAINTING WITH PLASTIC EMULSION PAINT

The plastic emulsion Paint is not suitable for application on external, wood and iron surface and surfaces which are liable to heavy condensation. These Paints are to be used on internal surfaces except wooden and steel.

Plastic emulsion Paint as per IS 5411 of approved brand and manufacture and of the required shade shall be used.

Painting on New Surface

The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, morter droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commended.

Application : The number of coats shall be as stipulated in the item. The Paint will be applied in the usual manner with brush, spray or roller. The Paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surface to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

Precautions

a) Old brushes if they are to be used with emulsion Paints, should be completely dried of turpentine or oil Paints by washing in warm soap water.

   Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the Paint from hardening on the brush.

b) In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.

c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

d) Washing of surfaces treated with emulsion Paints shall not be done within 3 to 4 weeks of application.

Painting on Old Surface

Preparation of Surface *:* This shall be done, generally as specified in 4.01.01 except that the surface before application of Paint shall be flattened well to get the proper flat velvety finish after painting.

Application : The number of coats to be applied shall be as in description of item. The number of coats shall be as stipulated in the item. The Paint will be applied in the usual manner with brush, spray or roller. The Paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surface to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

Except the above the thinning with water shall not normally be required.

11.00.00 PAINTING WITH SYNTHETIC ENAMEL PAINT

Synthetic Enamel Paint (confirming to IS 2933) of approved brand and manufacture and of the required colour shall be used for the top coat and an under coat of ordinary Paint of shade to match the top coat as recommended by the same manufacture as far the top coat shall be used.

Painting on New Surface

Preparation of Surface *:* Preparation of surface shall be as specified in 4.01.00 as the case may be.

Application : The number of coats including the undercoat shall be as stipulated in the item.

a) **Under Coat :** One coat of he specified ordinary Paint of shade suited to the shade of the top coat, shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.

b) **Top Coat:** Top coat of synthetic enamel Paint of desired shade shall be applied after the under coat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

Other details shall be as specified in 'EXTERIOR PAINTING ON WALL' as far as they applicable.

Painting on Old Surface

Preparation of Surface : Where the existing Paint is firm and sound it shall be cleaned of grease, smoke etc. and rubbed with sand paper to remove all loose particles dusted off. All patches and cracks shall then be treated with stopping and filler prepared with the specified Paint. The surface shall again be rubbed and made smooth and uniform.

If the old Paint is blistered and flaked it will be necessary to completely remove. Such removal shall be paid for separately and the painting shall be treated as on new surface.

Painting : The number of coats as stipulated in the item shall be applied with synthetic enamel Paint. Each coat shall be allowed to dry and rubbed down smooth with very fine wet abrasive paper, to get an even glossy surface. If however, the surface is not satisfactory additional coats as required shall be applied to get correct finish.

12.00.00 PAINTING WITH ALUMINIUM PAINT

Aluminium Paint shall be (confirming to IS 2339) of approved brand and manufacture. The Paint comes in compact dual container with the paste and the medium separately.

The two shall be mixed together to proper consistency before use.

Preparation of Surface

Steel Work (New Surfaces) : All rust and scales shall be removed by scraping or brushing with steel wire brushes and then smoothened with sand paper. The surface shall be thoroughly cleaned of dust.

C.G.S. Sheets (New Surfaces) : The preparation of surface shall be as specified in 'PAINTING SYNTHETIC ENAMEL PAINT OVER G.S. SHEETS on Painting New Surface'.

Steel Work or C.G.S. Sheets (Old Surfaces) : The specifications shall be as described in 'PAINTING SYNTHETIC ENAMEL PAINT OVER G.S. SHEETS on Painting Old Surface'.

Application

The number of coats to be applied shall be as given in the item. Each coat shall be allowed to dry for 24 hours and lightly rubbed down with fine grade sand paper and dusted off before the next coat is applied. The finished surface shall present an even and uniform appearance.

As aluminium paste is likely to settle in the container, care shall be taken to frequently stir the Paint during used. Also the Paint shall be applied and laid off quickly, as surface is otherwise not easily finished.

13.00.00 PAINTING WITH ACID PROOF PAINT

Acid proof Paint of approved brand and manufacture and of the required shade shall be used.

Preparation of surface and application shall be as specified under 11.00.00 for new/old surface as the case may be.

Other details shall be as specified in 3.00.00 as far as they applicable

14.00.00 PAINTING WITH ANTI-CORROSIVE BITUMASTIC PAINT

Ready mixed Paint (confirming to IS 158) shall be of approved brand and manufacture. It shall be black, lead free, acid-alkali-heat-water resistant.

Preparation of surface and application shall be as specified in 13.32 for Painting on new or old surfaces as the case may be.

The drying time between consecutive coats, however, shall be not less than 3 hours.

Other details shall be specified in 3.00.00 as far as applicable.

15.00.00 FLOOR PAINTING

Floor Paint of approved brand and manufacture and of the required colour shall be used.

Preparation of Surface

All dirt, grease shall be removed from the floor by wiping with rags, soaked in turpentine and scraping where necessary and then washing with warm water, containing caustic soda or washing soda in solution. The floor should then be rinsed thoroughly with water and dried. Cracks and holes shall then be filled with specified filler as recommended by the manufacture and rubbed smooth.

It should be noted that the painting with floor paints shall not be done over concrete surfaces less than two years old.

Old surface shall be prepared as specified in 'PAINTING WITH SYNTHETIC ENAMAL PAINT, Painting on Old Surface, Preparation of Surface'.

Application

The number of coats as in the description of the item shall be applied. Each coat shall be allowed to dry for not less than 24 hours before the next coat is applied. The flooring should not be brought into use for a week after final coat so that the painted surface can thoroughly harden.

16.00.00 **VARNISHING**

Ordinary copal varnish or superior quality spray varnish shall be used. The work includes sizing of transparent wood filler.

Varnish (confirming to IS 347 for the finishing and undercoats shall be of the approved manufacturer.

Varnishing on New Surfaces

Preparation of Surface : New wood work to be varnished shall have been finished smooth with a carpenter's plan. Knots shall be cut to a slight depth. Cracks and holes shall be cleaned of dust. The knots, cracks etc. shall then be filled in with wood putty made as follows:

On a piece of wood say 20 x 15 cm face and on the side where cross grains appear, a small quantity of glue size shall be poured and surface scraped with the edge of a fine carpenter's chisel. Very fine wood powder shall be mixed with the glue and the stiff paste thus formed shall be used for the filling.

The fillings when dry shall be rubbed down with a carpenter's file and then the entire surface shall be rubbed down perfectly smooth with medium grained and fine sand papers and wiped with dry clean cloth so that it presents uniform appearance. In no case shall sand papers be rubbed across the grains, as in this case even the finest marks will be visible when the varnishing is applied.

Sizing or Transparent Wood Filler Coat : The surface shall then be treated with either glue sizing or with transparent wood filler coat as stipulated in the description of item.

a) **Sizing :** When sizing is stipulated, an application of thin clean size shall be applied hot on the surface. When dry, the surface shall be rubbed down smooth with sand paper and cleaned. It shall then be given another application of glue size nearly cold. The sized wood work shall again be rubbed down smoothly with fine sand paper and cleaned. The surface shall be perfectly dry and all dust shall be removed not only from the surface but also from the edges and joints before varnishing is commenced. If the wood work is to be stained, the staining colour shall be mixed with the second coat of the size which must be applied evenly and quickly keeping the colour on the flow.

Any jointing up with work already dry will show badly. The object of application of the glue size is to seal the pores in wood to prevent absorption of the oil in the varnish.

Glue sizing is inadvisable on floors, table tops and other horizontal surfaces likely to carry wet household untensils which are likely to disturb the size coatings and thus expose bare wood.

Where glue sizing is omitted to be done the rate for the work shall be suitably reduced.

b) **Transparent Wood Filler Coat :** Where instead of glue sizing, transparent wood filler application is stipulated in the item, then the surface prepared as described earlier, shall be given as application of the application of the filler with brush or rag in such a way that the filler fills up all the pores and indentations and levels up the surface. It shall be allowed to dry for 24 hours. Then it shall be cut and rubbed with emery paper so that the surface of the wood is laid bare, with the filler only in the pores and crevices of the wood.

Application of Varnish : The number of coats to be applied shall be as stipulated in the description of the item.

The undercoat shall be with a flatting varnish. This dries hard and brittle and when cut and rubbed down to produce a smooth surface enhance the gloss of the finishing varnish. The top coat shall be given with stipulated brand of finishing varnish.

The varnish shall be applied liberally with a full brush and spread evenly with short light strokes to avoid frothing. If the work is vertical the varnish shall be crossed and recrossed and then laid off, letter being finished on the upstrokes so that varnish, as it sets, flows down and eliminates brush marks, the above process will constitute one coat. If the surface is horizontal, varnished shall be worked in every direction, with light quick strokes and finish in one definite direction so that it will set without showing brush marks, in handling and applying varnish care should be taken to avoid forming froth or air bubbles. Brushes and containers shall be kept scrupulously clean.

Rubbing down and flatting the surface shall be done after each coat except the final coat with fine sand paper.

The work shall be allowed to dry away from droughts and dump air. The finished surface shall then present a uniform appearance and fine glossy surface free from streaks, blister etc.

Any varnish left over in the small container shall not be poured back into the stock tin, as it will render the latter unfit for use.

Special fine haired varnishing brushes shall be used and not ordinary Paint brushes. Brushes shall be well worn and perfectly clean.

Other details shall be as specified in 3.00.00 as far as they are applicable.

Varnishing on Old Surface

Preparation of Old Surface : If the old varnished surface is firm and sound it shall be cleaned of grease and dirt with turpentine and then rubbed with wet sand paper until the surface is clean and smooth. It shall be dried and wiped clean with a soft cloth. Knots, holes and cracks shall be stopped as specified in ‘Varnishing on New Surfaces, Preparation of Surface’. The entire surface shall then be rubbed down smooth with sand paper and wiped clean.

If the old varnished surface is peeled or cracked then it will be necessary to remove the entire varnish and such removal shall be paid for separately outside the rate for varnishing. Future the varnishing itself will have to be done like new work and will be paid for as such.

Application : The specification shall be same as described in ‘Application of Varnish’ as far as applicable except that the coats to be applied will be with the stipulated quality of varnish for finishing coat.

Other details shall be as specified in 3.00.00 as far as they are applicable.

17.00.00 **FRENCH SPIRIT POLISHING**

Pure shellac confirming to IS 16 varying from pale orange to lemon yellow colour, free from resin or dirt shall be dissolved in methylated spirit at the rate of 140 gm of shellac to 1 litre of spirit. Suitable pigment shall be added to get the required shade. Ready made polish confirming to IS 348 can also be used.

Polishing New Surface

Preparation of Surface : The surface shall be cleaned. All unevenness shall be rubbed down smooth with sand paper and well dusted. Knots if visible shall be covered with a preparation of red lead and glue size laid on while hot. Holes and indentations on the surface shall be stopped with glazier's putty. The surface shall then be given a coat of wood filler made by mixing whiting (ground chalk) in methylated spirit at the rate of 1.5 Kg of whiting per litre of spirit. The surface shall again be rubbed down perfectly smooth with glass paper and wiped clean.

Application : The number of coats of polish to be applied shall be as described in the item.

A pad of wooden cloth covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with the polish and rubbed hard on the wood, in a series of overlapping circles applying the mixture sparingly but uniformly over the entire area to given an even level surface. A trace of linseed oil on the face of the pad facilitates this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cotton cloth slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

Other details shall be as specified in 3.00.00 as far as they are applicable.

Polishing Old Surface

Preparation of Surface : If the old polished surface is not much solid it shall be cleaned of grease and dirt by rubbing with turpentine and then rubbed with fine sand paper.

If the old polished surface is much soiled then it will be necessary to remove the entire polish and such removal shall be paid for separately outside the rate of polishing. Further the polishing itself will have to do done like new work and will be paid for as such.

Application : The specifications shall be same as described above and as far as applicable.

Other details shall be as specified in 3.00.00 as far as they are applicable.

18.00.00 **EPOXY COATING/PAINTING**

On the clean surface of concrete after properly drying of the following system is to be adopted as per manufacturers specification:

One coat of primer of following proportion to be applied over clean and dried concrete surface by brush application.

ARALDITE GY 250 - 100 Parts by weight

HARDENER HY 840 - 50 Parts by weight

Over the primer, the uneven surface of concrete should be filled with levelling putty as mentioned above. The cost of putty is included in the item rate without fixing prior limit to consumption of putty. Two top coats of the protective treatment to be applied over the prepared smooth surface in the following proportion.

ARALDITE GY 250 - 100 Parts by weight

HARDENER HY 830 - 45 Parts by weight

HARDENER BY 850 -15 Parts by weight

SILICA FLOUR - 20 Parts by weight

FLOW CONTROL - 2 Parts by weight
AGENT

Pigment may be added if desired by Engineer. The first top coat is applied over the primer and is left to reach a tack free state. At this stage, the final top coat is applied.

18.01.00 **Protection**

Furniture and other movable objects, equipments, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipments 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.

18.02.00 **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 spilled, splashed or splattered, including all equipment, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.

19.00.00 **ACCEPTANCE CRITERIA**

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.

20.00.00 **RATES**

Rates shall be unit rates for complete items described in the Schedule of Items. No extra payment will be made for preparation of surface before painting or for cleaning up after the work is complete.

21.00.00 **METHOD OF MEASUREMENT**

a) All structural steelwork whose any or all faces are to be painted shall be measured and paid according to Table-1.

b) Painting or whitewashing to concrete or masonry shall be measured and on the area painted. For measurement of openings whose jambs, sills, soffits etc. are to be painted the following procedure shall be followed:

i) For openings up to 0.5 sq.m. but not exceeding 3.0 sq.m. each deductions shall be made for half the area of openings and no additions shall be made for jambs, sills, etc.

ii) For openings exceeding 0.5 sq.m. but not exceeding 3.0 sq.m. each deductions shall be made for half the area of openings, and no additions shall be made for jambs, sills etc.

iii) For openings exceeding 3.0 sq.m. each, deductions shall be made for the whole area, and additions shall be made for the jambs, sills soffits, reveals etc.

c) For openings, pipes, sleeves etc. whose sides are not finished no deductions shall be made for openings etc. upto 0.1 sq.m. in area each and full deductions shall be made for all openings above 0.1 sq.m. in area each.

d) No extra shall be paid for painting etc. done around openings, sleeves, pipes, ducts, inserts, etc.

e) No extra payment shall be made for painting, etc. on wall features such as grooves, ducts, beads, projections, cornices, etc. unless give different finish or otherwise specified in the "Schedule of Items". The actual area of the features shall be girthed and included in the wall measurements.

f) For painting of uneven surfaces in doors, windows, ventilators, louvers, guard bars, balustrades, gratings, railings, gates, etc. equivalent plain areas shall be measured as given in Clause 17.2 (Table II) of IS:1200.

g) Corrugated surfaces shall be measured flat as fixed and not girthed. The quantities as measured shall be multiplied by the following factors to get equivalent plain area :

i) Corrugated steel sheets - shall be multiplied by 1.14.

ii) Corrugated asbestos sheets with large corrugations shall be multiplied by 1.20

iii) Semi-corrugated asbestos cement sheets shall be multiplied by 1.10.

iv) Any other non-standard corrugated surfaces shall be measured as decided by the Engineer.

h) For painting pipes for sanitary and plumbing work, measurement shall be made on actual work done in R.M. for different diameters. Measurements shall be along the central lines of pipes laid. No deductions or additions shall be made for valves, fittings, etc.

i) Unless specifically stated on the schedule of items, all painting, varnishing or polishing of wood shall be measured and paid on the area treated. For measurement of uneven surfaces, equivalent Main area shall be measured as per Clause 17.2 (Table II) of IS: 1200.

22.00.00 **I. S. CODE**

Important relevant IS Codes for this Sections are listed below :

IS: 348	:	Specification for French polish
IS: 427	:	Specification for Distemper, dry colour as required.
IS: 428	:	Specification for Distemper oil emulsion, colour as required.
IS: 1477 (I & II)	:	Code of Practice for painting of ferrous metal in buildings.
IS: 2338 (I & II)	:	Code of Practice for finishing of wood and wood based materials.
IS: 2339	:	Specification for Aluminium Paints for general purposes in dual containers.
IS: 2395	:	Code of Practice for painting concrete, masonry and plaster surface.
IS: 2932	:	Specification for enamel, synthetic, exterior, type-I.
IS: 5410	:	Specification for cement paint, colour as required.

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SECTION-XXVII

TECHNICAL SPECIFICATION
FOR
SHEET WORK IN ROOF AND SIDE WALL

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SECTION-XXVII

TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDE WALL

1.00.00 SCOPE

This specification covers the erection of asbestos, C.G.I., aluminium or other sheet plain /corrugated/trough covering to roof and side walls at various elevations and the fabrication and/or installation of asbestos, C.G.I or aluminium gutters, flashings etc., as shown on drawings and schedule of items.

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. If the materials are issued at site by the Owner, the Contractor shall at the time of issue, satisfy himself about the condition of issued sheets, gutters, etc. and no complaints shall be entertained later.

2.02.00 Workmanship

The workmanship shall be according to best construction practice to give a water tight finish to the satisfaction of the Engineer fixing of gutters and down pipes shall be according to IS:2527.

2.02.01 Asbestos Sheeting

Asbestos sheets of profiles as stated in the Schedule of Items, 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 centres 6 mm dia galvanised 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

This shall be of the thickness specified in the description of the item and shall conform to IS 277. The sheets shall be of 275 grade of coating unless otherwise specified in the description of item.

The sheet shall be free from cracks, split edges, twists, surface flaws etc. They shall be clean, bright and smooth. The galvanizing shall be non-injured and in perfect condition. The sheets shall not show signs of rust or white powdery deposit on the surface. The corrugations shall be uniform in depth and pitch and parallel with the side.

Purlins : Purlins of the specified material or M.S. rolled sections of requisite size shall be fixed over the principal rafters and the spacing will be as specified in the drawing.

Slope : Roof shall not be pitched at a flatter slope than 1 vertical to 5 horizontal or as specified in the drawing. The normal pitch adopted shall usually be 1 vertical to 3 horizontal.

Laying and Fixing : The sheets shall be laid and fixed in the manner described below, unless otherwise shown in the working drawings or directed by the Engineer-in-Charge.

The sheets shall be laid with a minimum lap of 15 cm at the ends and 2 ridges of corrugations at each side. The above minimum end lap of 15 cm shall apply to slopes of 1 vertical to 2 horizontal and steeper slopes. For flatter slopes the minimum permissible end lap shall be 20 cm. The minimum lap of sheets with ridge, hip and valley shall be 20 cm measured at right angles to the line of the ridges, hip and valley respectively. These sheets shall be cut to suit the dimensions or shapes of the roof, either along their length or their width or in a slant across their lines of corrugations at hips and valleys. They shall be cut carefully with a straight edge chisel to give a smooth and straight finish.

Lapping in C.G.I. sheets shall be painted with a coat of approved steel primer and two coats of painting with approved paint suitable for G.I. sheet, before the sheets are fixed in place.

Sheet shall not generally be fixed in to gables and parapets. They shall be bent up along their side edges close to the wall and junction shall be protected by suitable flashing or by a projecting drip course, the later to cover the junction by at least 7.5 cm.

The laying operation shall include all scaffolding work involved.

Sheets shall be fixed to the Purlins or other roof members such as hip or valley rafters etc. with galvanized J or L hook bolts and nuts, 8 mm diameter, with bitumen and G.I. limpet washers or with a limpet washers filled with white lead as directed by the Engineer-in-Charge. While J hooks are used for fixing sheets on angle iron Purlins, and L hooks are used for fixing the sheet to R.S. joists, timber or precast concrete Purlins. The length of the hook bolt shall be varied to suit the particular requirements.

The bolts shall be sufficiently long so that after fixing they project above the top of the nuts by not less than 10mm. The grip of J or L hook bolt on the side of the purlin shall not be less than 25 mm. There shall be a minimum of three hook bolts placed at the ridges of corrugations in each sheet on every purlin and their spacing shall not exceed 30 cm. Coach screws shall not be used for fixing sheets to purlins.

The galvanized coating on J or L hooks, and bolts shall be continuous and free from defects such as blisters, flux stains, drops, excessive projections or other imperfections which would impair serviceability.

The galvanized coating should conform to IS 1367 9pt. XIII). The mass of coating per square meter of the surface shall be as under:

Mass and Equivalent Thickness of coating

Minimum Mass (g/m²)	Average Thickness(µm)	Minimum Mass (g/m²)	Individual Thickness(µm)
375	54	300	43

Where slopes of roofs are less than 21.5 degrees (1 vertical to 2.5 horizontal) sheets shall be joined together at the side laps by galvanized iron bolts and nuts 25 x 6 mm size, each bolt provided with bitumen and a G.I. limpet washers or a G.I. limpet washers filled with white lead. As the overlap at the sides extends to two corrugations, these bolts shall be placed zigzag over the two overlapping corrugations, so that the ends of the overlapping sheets shall be drawn tightly to each other. The spacing of these seam bolts shall not exceed 60 cm along each of the staggered rows. Holes for all bolts shall be drilled and not punched in the ridges of the corrugations from the underside, while the sheets are on the ground.

Finish : The roof when completed shall be true to lines, and slopes and shall be leak proof.

Measurements : The length and breadth shall be measured correct to cm. Area shall be worked out in sq.m. correct to two places of decimal.

The specified area of roof covering shall be measured on the flat without allowance for laps and corrugations. Portion of roof covering overlapping the ridge or hip etc. shall be included in the measurements of the roof.

Roof with curved sheets shall be measured and paid separately. Measurements shall be taken on the flat and not girthed.

No deduction in measurement shall be made for opening up to 0.4sqm and nothing extra shall be allowed for forming such openings. For any opening exceeding 0.4 sqm in area, deduction in measurements for the full opening shall be made and in such cases the labour involved in making these openings shall be paid for separately. Cutting across corrugation shall be measured on the flat and not girthed. No additions shall be made for laps cut through.

Rate : The rate shall include the cost of all the materials and labour involved in all the operations described above including a coat of approved steel primer and two coats of approved steel paint on overlapping of C.G.I. sheets. This includes the cost the cost of roof sheets, galvanized iron J or L hooks, bolts and nuts, galvanized iron seam bolts and nuts, bituminous and galvanized iron limpet washers etc.

Ridges and Hips of Plain Galvanised Steel Sheets

Ridges and Hips : Ridges and hips of C.G.I. roof shall be covered with ridge and hip sections of plain G.S. sheet with a minimum lap of 20 cm on either side over the C.G.I. sheets. The end laps of the ridges and hips and between ridges and hips shall also be not less than 20 cm. The ridges and hips shall be of 60 cm overall width plain G.I. sheet, 0.6mm or 0.8 mm thick as given in the description of the item and shall be properly bent in shape.`

Fixing : Ridges shall be fixed to the purlins below with the same 8 mm dia G.I. hook bolts and nuts and bitumen and G.I. limpet washers which fix the sheets to the purlins.

Similarly, hips shall be fixed to the roof members below such as purlins, hip and valley rafters with the same 8 mm dia G.I. hook bolts and nuts and bitumen and G.I. limpet washers which fix the sheets to those roof members. At least one of the fixing bolts shall pass through the end laps of ridges and hips on either side. If this is not possible extra hook bolts shall be provided.

The end laps of ridges and hips shall be joined together with C.G.S sheet by galvanized iron seam bolts 25 x 6 mm size each with a bitumen and G.I. washer or white lead as directed by the Engineer-in-Charge. There shall be at least two such bolts in each end lap.

Surface of C.G.I. sheets of ridge and hip sections and roofing sheets which overlap each other shall be painted with a coat of approved primer and two coats of approved paint suitable for painting G.I. sheets before they are fixed in place.

Finish : The edges of the ridges and hips shall be straight from end to end and their surfaces should be plane and parallel to the general plane of the roof. The ridges and hips shall fit in squarely on the sheets.

Measurement : The measurements shall be taken for the finished work in length along the centre line of ridge or hip, as the case may be, correct to a cm. The laps in ridges and hips and between ridges and hips shall not be measured.

Rate : The rate shall include the cost of all labour and materials specified above, including painting, cost of seam bolts and any extra G.I. hook bolts, nuts and washers, required.

Valley and Flashing of Plain Galvanised Steel Sheets

Valley and Flashing : Valley shall be 90 cm wide overall plain G.I. sheet 1.6 mm thick or other size as specified in the item bent to shape and fixed. They shall lap with the C.G.I. sheets not less than 25 cm width on other side. The end laps of valley shall also be not less than 25 cm.

Valley sheets shall be laid over 25 mm thick wooden boarding if so required.

Flashing shall be of plain G.I. sheet of 40 cm overall width 1.25 mm thick or 1.00 mm thick as specified in the item bend to shape and fixed. They shall lap not less than 15 cm over the roofing sheets. The end laps between flashing pieces shall not less than 25 cm.

Laying and Fixing : Flashing and valley sheets shall be fixed to the roof members below, such as purlins and valley rafters with the same 8 mm dia G.I. hook bolts and nuts and bitumen and G.I. limpet washers which fix the sheets to those roof members.

At least one of the fixing bolts shall pass through the end laps of the valley pieces on other side. If this is not possible extra hook bolts shall be provided. The free end of flashing shall be fixed at least 5 cm inside masonry with the mortar of mix 1:3 (1cement: 3 coarse sand).

Surface of G.I. sheets under overlaps shall be painted with a coat of approved primer and two coats of approved paint suitable for painting G.I. sheets.

Finish : The edges of valley and flushing should be straight from end to end. The surface should be true and without bulges and depressions.

Measurements : The length of the valleys and flashing shall be measured for the finished work correct to a cm. The laps along the length of the valley or flashing pieces, including the portion embedded in masonry, shall not be measured.

Rates : The rate for valleys, shall be for all the labour and materials specified above, including painting, cost of seam bolts and the cost of requisite G.I. hook bolts, nuts and washers required over and above those needed for connecting the roof sheets to the roof members. The rate for valleys shall exclude the cost of boarding underneath which shall be paid for separately.

The rate for flashing shall be for all the labour and materials specified above, and shall include the cost of painting and mortar for fixing in wall.

Gutters Made of Plain Galvanised Steel Sheets

Gutters : Gutter shall be fabricated from plain G.I. sheets of thickness as specified in the item

Eaves gutters shall be of the shape and section specified in the description in the item. The overall width of the sheet referred to their in shall mean the peripheral width of the gutter including the rounded edges. The longitudinal edges shall be turned back to the extent of 12 mm and beaten to form rounded edges. The ends of the sheets at junction of pieces shall be hooked in to each other and beaten flush to avoid leakage.

Slope : Gutters shall be laid with a minimum slope of 1 in 120.

Laying and fixing : Gutters shall be supported on and fixed to M.S. flat iron brackets bent to shape and fixed to the requisite slope. The maximum spacing of brackets shall be 1.20 metres.

Where these brackets are to be fixed to the sides of rafters, they shall be of 40 x 3 mm section bend to shape and fixed rigidly to the sides of rafters with 3 nos. 10 mm dia bolts, nuts and washers. The brackets shall overlap rafter not less than 30 cm and the connecting bolts shall be at 12 cm centers.

Where the brackets are to be fixed to the purlins, the bracket shall consist of 50 x 3 mm M.S. flat iron bent to shape with one end turned at right angle and fixed to the purlin face with 2 nos. of 10 mm diameter bolts, nuts and washers. The bracket will be stiffened by provision of 50 x 3 mm M.S. flat whose over hung portion bent to right angle shape with its longer leg connected to the bracket with 2 nos. 6 mm dia M.S. bolts, nuts and washers and its shorter leg fixed to face of purlin with 1 no. 10 mm dia bolt, nut and washer. The overhang of the vertical portion of the bracket from the face of the purlin shall not exceed 22.5 cm with this arrangement. The spacing of the brackets shall not exceed 1.20 metres.

The gutter shall be fixed to the brackets with 2 nos. G.I. bolts and nuts 6 mm dia, each fitted with a pair of G.I. and bitumen washers. The connecting bolts shall be above the water line of the gutters.

For connection to down take pipes, a proper drop end or funnel shaped connecting piece shall be made out of G.I. sheet of the same thickness as the gutter and reverted to the gutter, the other end tailing in to the socket of the rain-water pipe. Wherever stop ends, angles etc., should be provided.

Finish : The gutters when fixed shall be true to line and slope and shall be leak proof.

Measurements : Measurements shall be taken for the finished work along the centre line of the top width of the gutter connection to a cm. The hooked lap portion in the junctions and gutter lengths shall not be measured. The number of brackets which are fixed to purlins with stiffener flats should be measured.

Rate : The rate shall include the cost of all labour and materials specified above, including all specials such as angles, junctions, drop ends or funnel shaped connecting pieces, stop ends etc., flat iron brackets and bolts and nuts required for fixing latter to the roof members. Brackets of 50 x 3 mm flats fixed to purlins with stiffener flats will be paid extra.

2.02.03 **Fiber Glass Reinforced Plastic Sheeting**

This shall be of thickness and profile as mentioned in the Schedule of Item. Colour and light transmittance shall be as mentioned in drawings and or schedules. 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 as mentioned in schedule of items. In all cases, the installation shall be completely watertight and able to withstand the designed wind-pressure as mentioned in Schedule.

2.02.04 **Precoated metal sheet**

Precoated metal sheeting for roof shall be of precoated cold rolled sheet of total coated thickness (TCT) 0.58 to 0.68 mm of approved manufacturer. The sheet shall be metallic hot deep coated with an alloy of 55% aluminium, 43% zinc and 1.55 silicon coating mass shall be 150 gms/sq.m. sheet shall be fixed with fastening clip and self tapping fastener. Ridge for slope roof shall be of similar material and shall be fixed with necessary self tapping screws as per manufacturer details.

Thermally insulated sandwiched metal cladding for external facade shall be of approved manufacturer. Sheeting shall Hi Rib 0.5 mm troughed sheeting manufactured from aluminium alloy high tensile steel (550Mpa) coated with fluro polymer (PV F2 or equivalent) and shall have life span sustenance against aggressive weathering action. Inner profiled sheet shall be with profile sheet of .6 mm thick (total coated thickness) permanently coated galvanised sheet.

Galvanised coating shall be not less than 120 gm/sq.m. and sandwiched insulation of 25 mm thick or as per design requirement shall be bonded mineral wool blanket or equivalent conforming to IS: 8183 (minimum density of 32/kg/cum for glass wool and 48/kg/cum for rock wool) having minimum coefficient of thermal conductivity of 0.49 m W/cm deg C (at 50 degree C) Cladding shall be fixed to supports/rails by nuts, bolts, hooks, washers self tapping screws of stainless steel Austentic grade) conforming to IS:1367 (part

14) including sealants, gaskets, PVC tape 0.25 mm thick, flashing, black synthetic rubber external trough filler and 25X3 mm aluminium earthling.

2.02.04 **Polycarbonate Sheeting Work**

Solid Polycarbonate sheet of minimum 4mm thick should be of UV resistant and high temperature resistant. Sheet should be of approved brand and quality, colour and transparency for ceiling/ roofing on plain, sloped, curved surfaces to any pitch or height including fixing purlins with polymer quoted galvanized self drilling, self tampering metal screws and fasteners and EPDM washers, rubber gasket with closing caps, adequate adhesive and sealants as per manufacturer's specification etc. complete but excluding the cost of purlins, rafters, trusses etc.(if any). Polycarbonate sheets shall be uniform pigmentation and thickness with out air pockets and shall conform to IS: 14443: 1997 and including cutting to required length and size including profile machine bending of sheets to achieve the desired profile by conforming minimum joints and laps as per drawing.

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 **RATES**

Rates shall be for unit rate for complete item described in the Schedule and shall include all wastages as mentioned earlier.

5.00.00 **METHOD OF MEASUREMENT**

a) No allowance shall be made for laps.

b) Roofing and side sheeting shall be measured for net area of work done. Corrugated sheeting shall be measured flat and not girthed. Openings less than 0.4 Sq.m shall not be deducted. Detailed stated earlier.

c) Special features like flashings, ridge pieces, caves, corner pieces, north-light curves etc. shall be measured for length of installation.

d) Gutter and down comers shall be measured for length along their centre lines and bends, junctions, shoes ends, etc. shall not be paid properly.

e) S-type asbestos louvers shall be measured for area of opening in which it is installed.

f) Curved asbestos roofing sheets shall be measured for area of curve.

g) Asbestos ventilators, roof lights shall be measured and paid under relevant items.

6.00.00 IS CODES

The following are some of the important IS Codes relevant to these sections:

IS : 3007	:	Code of practice for laying of asbestos cement sheets
IS : 2527	:	Code of practice for fixing rain water gutters and down pipes for roof drainage
IS : 1626	:	Specification for asbestos cement building pipes gutters and fittings
IS : 277	:	Specification for galvanised steel sheets (plain and corrugated)
IS : 1200 (PT.IX)	:	Method of measurements of building and civil engineering works: Part – 9 Roof covering (including cladding)
IS : 2633	:	Method of testing uniformity of coating on zinc coated articles.
IS : 3144	:	Method of test for mineral wool thermal insulation materials.
IS : 3346	:	Method of the determination of thermal conductivity of thermal insulation materials.
IS : 8183	:	Bonded mineral wool

VOLUME: II B

SECTION - D

SUB-SECTION – D5

METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

SPECIFICATION NO. PE-TS-999-600-C005

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

C 0 N T E N T

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METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

1.00.00 SCOPE

This section covers supplying and/or erecting and installing of all metal doors, windows, ventilators, louvers, glazed partitions, etc. The scope of work shall also include the assembly and erection of all doors, windows, louvers, glazed partitions, etc. Supplying and/or fixing of all door and window accessories and hardware are also included in the scope.

2.00.00 INSTALLATION

2.01.00 Materials

Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS: 1038 and IS: 1361 or as specified.

Steel sheets for frames, shutters, louver blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating doors, windows, partitions etc. shall be extruded sections conforming to IS:733 or IS:1285 or as manufactured by Indian Aluminium Company Limited or approved equivalent. Aluminium door, windows and ventilator shall be fabricated as per IS:1948 and IS:1949. The alloy used shall conform to IS Designation HE 9-WP of IS: 733.

Hardware and fixtures shall be as specified and the best quality from approved manufacturers shall only be used. The tenderer shall specifically state the particular manufacturer's materials he proposes to use. Improper alignment or faulty operation due to inadequate strength of hardware or fixture shall entirely be the Contractor's responsibility.

All hardware and fixtures shall be able to withstand repeated use. Door closures shall conform to IS: 3564 and shall be suitable for doors weighing 61-80 Kg. unless otherwise stated. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or shall be replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance Requirements and endurance test stated in IS: 3564 - Appendix-A. The Contractor shall submit samples of each type of hardware to the Engineer. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the Contractor towards end for incorporation in the job. The mastic for caulking shall be of best quality from a manufacturer approved by, the Engineer. In general, mastic for fixing of metals frames shall be as per IS: 1081 or as approved by the Engineer.

2.02.00 Fabrication

2.02.01 Steel Doors, Windows, Ventilators, louvers etc.

a) Door Frames

Frames shall be fabricated from 16 gage(G) sheets. They shall, be mortised, reinforced, drilled, and tapped for hinge lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Welded construction with mitered Corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose "T" masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be installed. Frames shall be brought to site with floor ties/weather bars installed in, place.

b) Double Plate Flush Door Shutters

Door shutters shall be 45 mm thick, completely flush design and shall comprise of the outer sheets or 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm on centres.

Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally as shown on drawing by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and heads, shall have proper level on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting-stile edges bevelled or rebated. Where shown on drawing, or called for in the schedule of items, the doors shall be sound deadened by filling the inside voids with mineral wool or other suitable approved materials.

Doors shall be mortised, reinforced, drilled, and tapped in shop for hinges, locks, and bolts. They shall also be reinforced for closers, push-plates, and other surface hardwares where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown drawing, provision shall be made for fixing glazing, vision panels, louvers etc. glazing mouldings shall be of 18 G steel or extruded aluminium sections and suitable for fixing 6 mm. glass. Louvers blades shall be V or Z shaped and made out of 16 G sheets.

c) Single Sheet Door Shutters

Single sheet doors shall be made from best quality 18 G mild steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with semi tubular edge and central stiffening rail, which shall convey the lock and other fixture. The frames shall be made from best quality, 16 G mild steel sheets.

Wherever required, provisions for fixing glass panes, louvers etc. shall be made.

The manufacturing shall be done as specified in 2.02.01 (b) “Double Plate Flush Door Shutters.”

d) Sliding Door

Sliding doors shall be either double plate or single plate Construction made out of 18 gauge steel sheets with adequate stiffeners. The contractor shall specify the weight of the door in his shop and submit the manufacturer's catalogue of the sliding gear he proposes to use. Where called for the Contractor shall make provision for openings to the door for monorail beams. Doors shall close positively to exclude rainwater from seeping in. When called for, sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions.

e) Door Threshold

Door threshold shall be provided. Doors without threshold shall have bottom tie of approved type.

f) Steel Windows, Sashes, and Ventilators etc.

These shall conform in all respects to IS: 1038 and IS: 1361 latest editions. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, and pivot arrangements for ventilators, etc. or as called for. All welds shall be dressed flush on all exposed and contact surfaces. Where composite unit openings are required the individual window units shall be joined together with requisite transoms and mullions. All windows shall be outside glazed, fixed with putty or metal glazing beads as specified. Where aluminium glazing beads are specified, they shall be extruded aluminium channel 9.5 mm x 9.5 mm x 1.6 mm (Indal Section No. 2209) unless otherwise shown on drawings. Aluminium beads shall be given one coat of zinc chromate primer before fixing to windows.

2.02.02 Aluminium Door, Windows, and Frames

Extruded sections shall have a minimum 3 mm wall thickness. All sections shall be approved by the Engineer before fabrication is taken up. Doors frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating of minimum 15 micron thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent Coating shall be applied to the sections before shipment from the factory.

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce an uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.03.00 Shop Coat or Paint

The shop Paint for steel doors, windows etc. shall be best lead or zinc chromate primer paint from, approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. that will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.

Where called for, all steel doors, windows, etc. shall be hot dip galvanized to give a coating weight of 1½ - 2 oz. per sqft. One coat zinc chromate primer coat shall then be applied as shop paint.

Portions of aluminium frame, which come in contact with masonry construction shall be (before shipment from workshop) protected with a heavy coat of alkali resistant paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer.

2.04.00 Handling & Storage of Fabricated Material

All metal doors, windows, etc. shall be packed and crated properly before dispatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.

When taking delivery of items supplied by Owner, the Contractor shall satisfy

himself that the items supplied are up to the specified standard. Any defect detected shall promptly be brought to the notice of the Engineer.

All metal doors, windows etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.

2.05.00 Assembly & Erection at Site

In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to IS: 1081. The Contractor shall assemble and install all steel doors, windows, sashes, fixed metal louvers, etc. including transoms and mullions for composite units in respective places, keening proper “Lines and levels”, and in approved workmanlike manner, to give trouble free and leak-proof installations. Installation shall be done according to instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Contractor shall take all precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Contractor and made good again as per original, after installation, without any extra charge.

After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good the same quality of paint used in shop coat.

All coupling mullions, transoms, frames, etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The Contractor shall bring to the site the cement in original sealed containers of manufacturer and shall apply it as per the instruction. For all frames supplied by either the owner or the Contractor, mastic shall be supplied by the Contractor and caulking done properly as per drawings, specifications and as per instructions of the Engineer.

Door shutters, partitions hardware fixtures etc. shall be fixed only after major equipments have been installed in rooms.

Wherever required, nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one metres from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.

2.06.0 Fire proof Door

Fire proof doors shall be provided at all fire exit points as specified and also to restrict the spread of fire within buildings whether from internal fire or from external fire. The construction details of door shall conform to the

requirements stipulated in IS:3614(Part-1). Doors shall comply with the testing requirement mentioned in IS:3614 (Part-2). The doors shall be approved by Tariff Advisory Committee and shall have minimum 2 hrs. fire rating.

Metal covered (on both sides) Doors having insulating core filled up with mineral wool shall be used at all fire exit points and shall open out side.

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 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

Specification for Wrought Aluminium and Aluminium Alloy bars, rods and sections (for general engineering purpose)	-	IS: 733
Specification for Wrought Aluminium and Aluminium Alloy, extruded round tube, hollow section (for general engineering purpose)	-	IS: 1285
Steel doors, windows, and ventilators	-	IS: 1038
Steel windows for industrial, building	-	IS: 1361
Aluminium doors windows, and ventilators	-	IS: 1948
Aluminium windows for industrial buildings	-	IS: 1949
Steel doorframes	-	IS: 4351
Code of practice for fixing and glazing of Metal (steel and aluminium) doors, windows and Ventilators.	-	IS: 1081
Specification for Fire-check Doors – Part 1: Plate, Metal covered and Rolling type	-	IS: 3614
Hot Rolled Steel Sections for Doors, Windows and Ventilators – Specification	-	IS: 7452

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

Rates shall be applicable of all elevation. Rates shall include preparation of working drawings (if required), supply of material, fixtures, gaskets, erection of unit, caulking and jamming of frames, including cutting/drilling/welding, grouting, grinding, making good of the structure for installing the unit etc. complete as per “Schedule of Items”.

Rates shall also include cost of surface preparation, application of primer, enamel painting or anodizing as applicable.

Rate for fire proof door is inclusive of providing insulation core, primer, shop painting (epoxy based), all hardware as specified in Schedule of items.

6.02.00 Measurement

Supply and installation of doors, windows, and ventilators shall be measured in Sqm or Kg as per BOQ item. If measured in sqm, it shall be for net outer to outer (excluding frame) area of doors, windows, and ventilators of each type used as described in "Schedule of Items". Frame for steel or 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

iii) 2 point handles - 1 No. per leaf

b) Top Hung Ventilators (Projecting Out)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Adjustable sliding fabrication assembles - 2 Nos. per leaf.

iii) 2 point handles - 1 No. per leaf.

c) Bottom Hung Ventilators (Projecting in)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Concealed side arms for opening adjustment. - 2 Nos. per leaf.

iii) Spring Catch - 1 No. per leaf.

ANNEXURE-A

D. ALUMINIUM WINDOW, VENTILATORS, ETC.
(As per IS-1948 latest editions)

a) Side Hung Windows

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) 300 mm peg stays - 1 No per leaf

iii) 2 point handles - 1 No per leaf

b) Top Hung Ventilators (Projecting out)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Adjustable sliding fabrication assembles - 2 Nos. per leaf

iii) 2 Point handles - 1 No. per leaf

c) Bottom Hung Ventilation & (Projecting In)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Concealed side arms for opening adjustment - 2 Nos. per leaf

iii) Spring Catch - 1 No. per leaf

VOLUME: II B

SECTION - D

SUB-SECTION – D7

ROLLING STEEL SHUTTERS AND GRILLS

SPECIFICATION NO. PE-TS-999-600-C007

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	I.S. CODES	5
5.00.00	RATES AND MEASUREMENTS	5

ROLLING STEEL SHUTTERS AND GRILLS

1.00.00 SCOPE

This Section covers the design and supply of materials, fabrication, delivery and erection of Rolling Shutters/Grills with motor drive and/or manual operation including all accessories as hereinafter specified.

2.00.00 INSTALLATION

2.01.00 Components

a) Slats for rolling shutters shall be made from tested bright cold rolled, annealed M.S. strips, not less than 0.9 mm thick for shutters upto 4.5 M wide and not less than 1.25 mm thick for shutters having width more than 4.5 M, wide and above, machine rolled at 75 mm rolling centers, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load.

b) Rolling grills shall be constructed out of 6mm rods at 35 mm on centers running horizontally flexible connected with vertical links spaced not more than 200 centers. Alternatively, rolling grills shall be made from perforated slats of approved design reinforced with 6mm dia rods.

c) End locks shall be heavy type M.C.I./C.I. and shall be provided at each end of alternate slats unless specified otherwise.

d) Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown on drawings, a flexible weather strip shall be applied to make tight contact with the floor.

e) Guides shall be of such depth as to retain the shutter under a wind pressure of 100 Kg/Sq.m.

f) Shafts shall be of steel pipe of sufficient size to carry the tensional load with a maximum deflection of 1/360th of span. Grease packed ball bearings or bushings shall be provided for smooth trouble free operation.

g) Hoods shall be formed of not less than 20 gauge steel, suitable reinforced to prevent sag.

h) Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides. Provision securing hand chain with pad-lock, provision for removable handle for hand cranks etc. shall be made as prescribed by the Engineer.

i) Power unit shall be suitable for 3 phase, 50 cycles, 400-volt A.C. power supply and be either floor or wall mounted unit. The motor shall be of sufficient capacity, to move the shutter in either direction at a speed of 0.3 metres per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building unless otherwise stated in drawing.

It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction.

j) Operating chains shall be of tested quality, heavily galvanized and with all ends rounded to assure smooth operation and hand protection.

k) Reduction gears shall be high strength grey cast iron, machine moulded from machine out patterns.

2.02.00 Manually Operated Shutters/Grills

Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 1.3 metres per second. In general, manually operated shutters shall be push pull type for opening up to 9 Sq. metre in area. Larger shutters shall, be either chain and gear operated or crank and gear operated. The crank handle shall be removable. All shutters shall be lockable from one or both sides as desired by the Engineer.

2.03.00 Power operated Shutters/Grills

These shall be operable from a push button station conveniently located beside the door. One emergency hand chain/crank operation shall also be provided for use in case of failure of the electric system. Where called for, externally mounted shutters shall be operated by control mechanism located inside the building.

2.04.00 Shop Coat

Shutters shall be painted with one coat of red lead or zinc chromate primer. Where specified, doors shall be galvanized and subsequently painted one coat of zinc chromate for adhesion of field coat.

2.05.00 Erection

Door shall be installed by the manufacturer or his authorized representative and all work shall be as per manufacturer's instructions. Any drilling or cutting to concrete, masonry etc. shall be made good after erection of shutters and all abrasion to shop coat shall be touched up. All electrical work shall be

in strict accordance with the latest Indian Electricity Rules.

3.00.00 ACCEPTANCE CRITERIA AND GUARANTEE

3.01.00 Shop Inspection

After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings.

3.02.00 Field Inspection

After installing the shutters, the Contractor shall test the performance of the shutter in the presence of the Engineer. The doors shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault free performance.

3.03.00 Guarantee

The Contractor shall give one year's guarantee for the successful operation of the shutters. This shall be supported by a separate and unilateral guarantee from the manufacturer of the shutters.

4.00.00 I.S. CODE

IS: 6248 - Metal rolling shutters and rolling grills.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates for rolling shutters and grill shall include the cost of the locks, guide channels, cost of drive as specified. In case of electrically operated rolling shutters, the rate shall also include the mounting of controls, wire and wiring from the nearest junction box, conduit and other electrical connections and cost of electric motor.

5.02.00 Measurement

Supply and installation of rolling shutter and grill shall be measured in Sqm in net outer to outer (including frame) area of each type used as described in “Schedule of Items”.

VOLUME: II B

SECTION - D

SUB-SECTION – D11

PAINTING, WHITEWASHING, POLISHING

SPECIFICATION NO. PE-TS-999-600-C011

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

C 0 N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
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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 to the latest IS standards. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.

a) White Wash/Colour Wash

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the engineer, and shall conform to IS: 712 latest editions. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 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 IS: 427. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacture. Only sufficient quantity of distemper required for a day's work shall be prepared.

c) Oil Bound Washable Distemper

Shall be of oil emulsion type containing suitable preservatives and shall conform to IS: 428. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for a day's work shall be prepared.

d) Waterproof Cement Paint

Shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agents and fungicides. The paint shall conform to IS: 5410.

e) Acrylic Emulsion Paint

Shall be water-based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigments and fungicide conforming to IS: 5411 (Part-1). It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with mild soap and water without any deterioration in colour, or without showing flaking, blistering, or peeling.

f) Synthetic Enamel Paint

Shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to give a smooth, hard, durable and glossy finish to all exterior and resist interior surfaces. White and pastel shades shall not yellowing and darkening with aging. The paint shall conform to IS: 2932 and IS: 2933.

g) Aluminium Paint

Shall be in two pack containers and shall resist weathering. The paint shall conform to IS: 2339.

h) Varnishing

Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age.

i) French Polish

Shall be made from best quality shellac, denatured spirit and other suitable alcohol soluble ingredients and made by a well known approved manufacturer. The material shall conform to IS: 348.

French polish shall not be used on bare wood it shall only be used as finishing coat on wood after the woods pretreated with a liquid wood filler conforming to IS: 345 is applied and rubbed out.

j) Bitumen paint (black bituminous anti-corrosive paint)

Bitumen based anti-corrosive paint conforming to IS: 158 shall be used.

2.00.02 Storage

The Contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement, & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent fire.

2.01.00 Preparation of surface

Before starting the work the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.

2.01.02 Wood

All surfaces shall be free from, dirt and loose or peeling paints. The surface shall be rubbed down smooth. All nails & screws shall be sunk below the surface and filled with putty after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum 2 coats of pure shellace coating applied thinly & extended 25 mm beyond the area. All large, loose, or resinous knots shall be removed and filled with sound wood. All work shall be done as per IS: 2338.

2.01.02 Masonry, Concrete, and Plastered Surface

Surface shall be free from all oil, grease, efflorescence, mildew, loose paint, or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from, the original surfaces, the resurfaces area shall be treated with minimum one coat of cement primer, which should be continued to the surrounding area for a distance of minimum 100 mm.

Surface with **Mildew or Efflorescence** shall be treated as below:

All mildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7g of copper carbonate dissolved in 80ml liquor ammonia and diluted to water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

2.01.03 Metal

The surface preparation shall be done in accordance with IS:1477(Part-1) 'Code of practice for painting of ferrous metals in building' and as directed by Engineer. All metal surfaces shall be absolutely clean, dry, and free from rust, scales, weld slag, flux deposit, wax, grease, dried soap films, foreign matters like cement mortar etc and free from existing loose red oxide zinc chromate primer and should be removed by means of wire brushes, hand scrappers, sand paper, emery cloth, emery papers, or by mechanical power tools etc. or as directed by Engineer. For exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanized iron surfaces shall be 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 IS: 1477 (Part I & 2). The total dry thickness of film should not be less than 120 Micron.

2.02.02 White Washing

The surface where white washing is to be applied shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before white washing.

One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied and in case the Engineer feels that one or more coats are required the Contractor shall do so without any extra cost to the Owner. No brush marks shall show on the finished surface.

2.02.03 Dry Distemper

New plastered surface shall be allowed to dry for at least two months. New lime or lime cement plastered surface shall be washed with a solution of 1 part Vinegar to 12 parts water or 1:50 sulphuric acid solution and for 24 hours after which the wall shall be thoroughly washed with clean water. For cement-plastered surface, the surface shall be washed with solution of 100 gms. of zinc sulphate to 1 litre of water and allowed to dry.

Dry distempering shall be done as per manufacturers instruction. In applying the distempers the brush, should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long, otherwise brush marks may result.

2.02.04 Oil bound washable distemper

The distemper shall be applied after surface is primed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per manufacturer's instruction.

2.02.05 Waterproof Cement Paint

Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours) the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

2.02.06 Acrylic Emulsion Paint

Paint shall be applied after providing one coat of cement primer solvent of approved quality and primer shall be conform to IS: 109. Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be done strictly as per manufacturer's specification.

2.02.07 Synthetic Enamel Paint

Shall be applied on properly primered surface. 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 I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 348	Specification for French polish
IS: 427	Specification for Distemper, dry colour as required.
IS: 428	Specification for Distemper oil emulsion, colour as required.
IS: 1477 (I & II)	Code of Practice for painting of ferrous metal in buildings.

IS: 2338 (I & II)	Code of Practice for finishing of wood and wood based materials.
IS: 2339	Specification for Aluminium, Paints for general purposes in dual containers.
IS: 2395	Code of Practice for painting concrete, masonry, and Plaster surface.
IS: 2932	Specification for enamel, exterior type-1.
IS: 5410	Specification for cement paint, colour as required.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be unit rates for complete items described in the "Schedule of Items".

Rate shall include cleaning, preparation of surface, supply and application of primer, painting and providing all protection and scaffolding required at site.

5.02.00 Measurements

Painting over the concrete/masonry/wooden surface shall be measured net (on the surface area on which it is applied) in Sqm.

No deduction shall be made for opening not exceeding 0.5 Sqm and ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sill of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.

Corrugated surfaces shall be measured flat and measured area shall be increased by 15%.

Painting of structural steel works shall be measured in M.T. of fabricated steel (as per section D-17 clause 6.02.00 i.e Mode of measurement of technical specification for fabrication of structural steel works) unless specified otherwise.

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SECTION - D

SUB-SECTION – D13

SHEET WORK IN ROOF AND SIDING

SPECIFICATION NO. PE-TS-999-600-C013

Maharatna Company

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

C 0 N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
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2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	5
4.00.00	I.S. CODES	5
5.00.00	RATES AND MEASUREMENTS	6

SHEET WORK IN ROOF AND SIDING

1.00.00 SCOPE

This section covers supply, cutting & fabrication and erection of corrugated/plain asbestos, corrugated galvanized iron, aluminum, permanently colour coated troughed zinc-aluminium alloy coated M.S. sheet or other sheet for covering to roof and sides at various elevations as specified.

2.00.00 INSTALLATION

2.01.00 Storage of Materials

All materials shall be stored by the Contractor in proper way to prevent all damage.

2.02.00 Workmanship

The workmanship shall be according to best construction practice to give a watertight finish to the satisfaction of the Engineer. Fixing of gutters and down pipes shall be according to IS: 2527.

2.02.01 Asbestos Sheeting

Asbestos sheets of profiles as specified shall be fixed with minimum 150 mm end lap and side laps as per manufacturer's specification. Hook bolts or J-bolts shall be 8 mm dia. at 305 mm centres. Six (6) mm dia. galvanized iron seam bolt and nut with G.I. flat washers and bitumen washers shall be used for stiching ridge cappings, corner pieces, ventilators, north light curves etc.

2.02.02 C.G.I. Sheeting and Aluminium Sheeting

Side laps shall be 2 corrugations for roof and one corrugation for side sheeting. End laps shall be minimum 150 mm for roof and 100 mm for side sheeting. In ridges and hips where plain sheets are used, the end laps shall be minimum 100 mm. Holes in C.G.I. sheets shall preferably be made on the ground. The sheets should be placed on purlins/trestles and holes punched in the ridge of the corrugation from the outside inward for obtaining proper seating of limpet washers. Sheets shall be secured to sheet framing by 8 mm dia. galvanised iron hooks or J-bolts and maximum spacing of the bolts shall be 305 mm. The length of the hook or J-bolts shall be to suit the sections of the bearers. Sheets shall also be bolted at the ends at every third corrugation with 6 mm dia. galvanized iron seam bolts and G.I. flat washers and bituminous washers.

2.02.03 Fibre Glass Reinforced Plastic Sheeting

This shall be of thickness and profile as specified. Colour and light transmittance shall be as mentioned. Where used in conjunction with C.G.I. or asbestos sheeting, the end and side laps and fixing device shall be same as used for general sheeting. Where used in lieu of glass, the fixing shall be by means of timber or metal glazing beads. In all cases, the installation shall be completely watertight and able to withstand the designed wind-pressure.

2.02.04 PERMANENT COLOUR COATED (SANDWICHED INSULATED) METAL CLADDING SYSTEM

i. Troughed zinc-aluminium alloy coated (both sides) M.S. sheet having 0.6mm minimum thickness (or high tensile steel sheet having minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used on external face (outer face) of cladding system. Weight of coating shall not be less than 150 gm/sq.m. The outer side (exposed face) shall be permanently colour coated with Polyfluro Vinyl Coating (PVF_2) of Dry Film Thickness (DFT) 20 microns (minimum) over primer. Inner side of external sheet shall be provided with suitable pre-coating of minimum 7 microns.

ii. Galvanised M.S. sheets of minimum 0.6mm thickness shall be used as inner liner (internal face) of cladding system. The exposed face shall be permanently colour coated with silicon modified polyester paint of DFT 20 microns (minimum) over primer. Inner face of external sheet shall be provided with suitable pre-coating of minimum 7 microns. The rate of galvanization shall not be less than 275 gm/sqm.

iii. The permanent colour coated sheet shall meet the general requirements of IS:14246 and shall conform to class 3 for the durability.

iv. Inner sheet shall be fixed directly to side runners and Z spacers made out of at least 2 mm thick galvanized steel sheet of grade 375 as per IS:277. Inner sheet shall be fixed at the rate not more than 1.50M centre to centre to hold the insulation and external sheeting. The fasteners shall be of high quality corrosion resistant grade of self tapping / self drilling type provided with suitable cap.

v. The insulation shall be of bonded mineral wool of minimum thickness 50mm conforming to IS:8183, having a density of 32 Kg/cu.m. for glass wool & 48 Kg/cu.m. for rock wool.

2.02.05 PERMANENT COLOUR COATED (NON-INSULATED) METAL CLADDING SYSTEM

i. Troughed zinc-aluminium alloy coated not less than 150 gm/sq.m M.S. sheets having 0.6 mm minimum thickness (or High tensile steel sheet having

minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used for the cladding system. The outer side (exposed face) shall be permanently colour coated with PVF_2 paint of minimum DFT 20 microns over primer and the inner side (internal face) shall be coated with same paint of minimum DFT 12 microns over primer. These shall be fixed directly to runners. The sheets shall meet the general requirement of IS:14246 and shall conform to class 3 for the durability.

ii. **FLASHING, CAPS, TRIM CLOSURES ETC.**

All flashings, trim closures caps etc. required for the metal cladding system shall be made out of plain sheets having same material and coating specification as mentioned above for the outer face of the sandwiched metal cladding.

3.00.00 ACCEPTANCE CRITERIA

The installations shall present a neat appearance and shall be checked for water tightness. The following shall be checked:

a) Side and end laps

b) Absence of cracks, holes or damages in sheet

c) Spacing of bolts

d) Provision of double washers (G.I. and asbestos or bituminous washers)

e) Proper installation of flashing.

4.00.00 I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 3007	:	Code of practice for laying of asbestos cement sheets.
IS: 2527	:	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
IS: 1626	:	Specification for asbestos cement building pipes, gutters and fittings.
IS: 277	:	Specification for galvanized steel sheets (plain and corrugated).

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be unit rate for complete item described in "Schedule of Items" and shall include all wastage.

5.02.00 Measurement

Sheeting work in roof & sides shall be measured in Sq.M. for net area of the work done. Profiled sheeting shall be measured flat and not girthed. Opening less than 0.40 Sqm shall not be deducted. No extra shall be paid for extra labour in cutting and for wastage etc. No payment shall be made for laps, flashings, sealing, fasteners etc. in sheeting works.

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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 under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard specification, any other standard practice, as may be specified by the Engineer shall be followed:

IS : 226 - Structural steel (Standard Quality)

IS : 800 - Code of Practice for general construction in steel.

IS : 806 - Code of practice for use of steel tubes in general building construction.

IS : 808 - Rolled steel beams, channels, and angle sections

IS : 813 - Scheme of symbols for welding

IS : 814 - Covered electrodes for metal arc welding of structural steel

IS : 815 - Classification and coding of covered electrodes for metal arc welding of structural steels.

IS : 816 - Code of practice for use of metal arc welding for general construction in mild steel

IS : 817 - Code of practice for training and testing metal arc welders

IS : 818 - Code of practice for safety and health requirements in electric and gas welding and cutting operations

IS : 822 - Code of practice for inspection of welds

IS : 919 - Recommendations for limits and fits for Engineering
IS : 961 - Structural Steel (High Tensile)

IS : 1148 - Rivet bars for structural purposes

IS : 1149 - High tensile rivet bars for structural purposes

IS : 1161 - Steel Tubes for structural purposes

IS : 1200 - Method of measurement of steelwork and ironwork (Part 8)

IS : 1239 - Mild Steel Tubes

IS : 1363 - Black hexagon bolts, nuts and lock nuts (dia. 6 to 30 mm) and black hexagon screws (dia 6 to 24 mm)

IS : 1364 - Precision and semi-precision hexagon bolts, screws, nuts and l locknuts (dia, range 6 to 39 mm)

IS : 1367 - Technical supply conditions for threaded fasteners

IS : 1442 - Covered electrodes for the metal are welding of high tensile structural steel

IS : 1608 - Method for tensile testing of steel products other than sheet strip, wire and tube

IS : 1730 - Dimensions for steel plate, sheet, and strip for structural and general engineering purposes.

IS : 1731 - Dimensions for steel flats for structural and general engineering purposes

IS : 1852 - Rolling and cutting tolerances for hot-rolled steel products

IS : 1977 - Structural steel (ordinary quality) St-42-0

IS : 2062 - Steel for General Structural Purposes

IS : 2074 - Ready mixed paint, red oxide Zinc chromate priming

IS : 2595 - Code of Practice for Radiographic Testing

IS : 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and Steel

IS : 2633 - Method for testing uniformity of coating on Zinc Coated Articles

IS : 3757 - High strength structural bolts

IS : 4759 - Specifications for Hot-Dip Zinc Coatings on Structural Steel and other allied products

IS : 7205 - Safety Code for Erection of Structural Steelwork

IS : 7215 - Tolerances for fabrication of steel structures

IS : 7280 - Bare wire electrodes for submerged arc welding of structural steels.

IS : 9595 - Recommendations for metal arc welding of carbon and carbon manganese steels.

2.04.00 Conformity with Designs

The contractor shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer keeping in view the maximum Utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract.

2.05.00 Materials to be used

2.05.01 General

All steel materials required for the work will be supplied by the contractor unless otherwise specified elsewhere in the contract. The materials shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance. All materials shall be of tested quality only unless otherwise permitted by the Engineer and/or Consultant. If desired by the Engineer, Test Certificates in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Engineer, a random sample shall be tested at an approved laboratory from each lot of 50 tones or less of any particular section.

The arc welding electrodes shall be of approved reputed manufacture and conforming to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and amperage (Polarity in case of D.C. supply) for which the electrodes are suitable.

2.05.02 Steel

All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable:

a) IS : 2062 - Steel for general structural purposes

b) IS : 961 - Structural steel High Tensile

c) IS : 1977 - Structural steel (Ordinary quality) St-42-0

In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable.

2.05.03 Rivet Steel

All rivet steel used in construction within the purview of this Specification shall comply with one of the following Indian Standard Specifications as may be applicable:

a) IS : 1148 - Rivet Bars for structural purpose

b) IS : 1149 - High tensile rivet bars for structural purposes. Where high tensile steel is specified for rivets, steps shall be taken to ensure that the rivets are so manufactured that they can be driven and heads formed satisfactorily without the physical properties of steel being impaired.

2.05.04 Electrodes

All electrodes to be used under the Contract shall be of approved reputed manufacture, low hydrogen electrode and shall comply with any of the following Indian Standard Specifications as may be applicable

a) IS : 814 - Covered electrodes for metal arc welding of structural steel

b) IS *:* 815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel

c) IS : 1442 - Covered electrodes for the metal arc welding of high tensile structural steel

d) IS : 7280 - Bare wire electrodes for submerged arc welding of

structural steels

2.05.05 Bolts and Nuts

All bolts and nuts shall conform to the requirements of Indian Standard Specification IS: 1367 - Technical Supply Conditions for Threaded Fasteners.

Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable.

a) Mild Steel

All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm² and a minimum elongation of 23 per cent on a gauge length of 5.6 _/A, where "A" is the cross sectional area of the test specimen

i) IS: 1367: Technical supply conditions for threaded fasteners

ii) IS: 1608: Method for tensile testing of steel products other than sheet, strip, wire and tube

b) High Tensile Steel

The material used for the manufacture of high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS: 1367 or as approved by the Engineer.

2.05.06 Washers

Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract:

a) IS : 2062 - Steel for general structural purposes

b) IS : 961 - Structural Steel (High Tensile Quality)

c) IS : 1977 - Structural steel (Ordinary Quality) St-42-0

d) IS : 6649 - Hardened washers

2.05.07 Paints

Paints to be used for shop coat of fabricated steel under the purview of this

contract shall conform to the Indian Standard Specification IS: 2074 - Ready mixed Paint, Red oxide Zinc Chromate Priming.

2.06.00 Coal Bin

2.06.01 Shape of bins shall be circular, polygonal, square, or rectangular in plan. Bottom hopper portion may have 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 IS: 9178 (Pt.l & 11) shall be followed as general guidance. The bins shall be fabricated and erected in segments.

2.06.03 The Coal bins shall be made of mild steel plates joined together with full strength butt weld and provided with stiffeners at regular interval. Stiffeners shall be provided on the external face and it may be welded with external face.

2.06.04 Bending of plates and rolled sections to the required shape for fabrication shall be done by plate bending machine or cold bending process Without resorting to heating, hammering, angle smithy and black smithy process.

2.06.05 Poking hole (manual or pneumatic) and striking plate shall be provided to facilitate coal flow. Poking holes shall have circular MS pipe and cover cap as detailed in the drawing.

2.07.00 New Erection Marks

2.07.01 Additional structures involving new erection marks may be required to be added at any stage of work.

2.07.02 All such new erection marks shall be detailed and included in marking schemes and fabrication carded out thereafter.

2.07.03 All such new erection marks shall be considered under item of original fabrication work. As a result of additional structures becoming necessary if the work is delayed beyond the time schedule stipulated, the Engineer shall give suitable extension of time provided he is satisfied about the reasonableness of the delay involved. However, no claim for extra payments or revision of rates due to delay shall be entertained.

2.08.00 ELECTRO FORGED STEEL GRATINGS

2.08.01 Factory made fabricated electro forged gratings unit with steel conforming to IS: 2062 shall be supplied, fabricated, transported, erected and aligned in floorings, platforms, drain and trench covers, walkways, passages, staircases with edge binding strips and anti skid nosing in treads etc.

2.08.02 All grating units shall be rectangular in pattern and electro forged. The size and the spacing of the bearing bars and cross bars shall be as detailed in fabrication drawings. The contractor shall submit the grating design for different spans and load intensities along with fabrication drawings. The depth of the grating unit shall be 40 mm, unless specified otherwise.

2.08.03 The gratings shall be made up in panel units designed to coincide with the span of the structural steel framing or openings as indicated in the design/ scope drawings. Maximum possible standardization of the grating panel sizes shall be tried and designed.

2.08.04 The grating unit shall be accurately fabricated and finished, free from wraps, twists, or any defects that would impair their strength, serviceability, and appearance.

2.08.05 Grating work shall include cut outs and clearance opening for all columns, pipes, ducts, conduits or any other installation penetrating through the grating work. Such cut outs and clearances shall be treated as specified in subsequent clauses.

2.08.06 The gratings shall be notched, trimmed and neatly finished around flanges and webs of the columns, moment connections, cap plates, and such other components of the steel structures encountered during the placement of the gratings. In all such cases, the trimming shall be done to follow the profile of the components encountered. After trimming, the binding strip shall be provided on the grating to suit the profile so obtained.

2.08.07 Opening in gratings for pipes or ducts that are 150mm in size or diameter or larger shall be provided with steel bar toe plates of not less than 5mm thickness and appropriate width, set flush with the bottom of the bearing bars.

2.08.08 Penetrations in gratings that are more than 50mm but less than 150mm in size or diameter shall be welded with plates of size shown in the detailed drawings set flush with the bottom of the grating panel.

2.08.09 Unless otherwise indicated on the drawings, grating units at all penetrations shall be made up in split section, accurately fitted and neatly finished to provide for proper assembly and erection at the job site.

2.08.10 Grating units shall be provided with all necessary clips, bolts, nuts and lock washers required for proper assembly and rigid installation and fastening to abutting units supporting structural steel framing members.

2.08.11 The gratings shall be of reputed make and manufacturer, as approved by Engineer. The unit rate quoted by him for this item shall be inclusive of transport of gratings to the project site, all taxes, duties etc. He shall also provide all facilities and access to the Engineer or his representative to carry out inspection during all stages of manufacturing of gratings.

2.08.12 Maximum deviation in linear dimension from the approved dimension shall not exceed 12mm.

2.08.13 All fabricated grating section and accessories shall be blast cleaned to near white metal surface (Sa 2½) followed by either of the following two:

(a) Two coats of red lead primer and two coats of black enamel finish paint.

(b) Hot dipped galvanization at 610 gm/sq.m.

in the shop prior to erection at site, as the approved drawing.

2.08.14 Prior to finishing all surfaces shall be cleaned, free from rust, mill scale, grease, oil, or any other foreign matter by blast cleaning. BS: 4232 shall be followed for blast cleaning.

2.08.15 Primer can be applied by spray guns or by brushes, however the finish paint shall necessarily be applied by means of spray guns. The applied coatings shall be uniform, free from voids and streaks; drilled or punched holes shall be touched up prior to erection or assembly.

2.09.00 GALVANIZATION OF GRATINGS

2.09.01 Purity of Zinc to be used-for galvanizing shall be 99.5% as per IS: 2 15

2.09.02 After the shop work is complete, the structural material shall be punched with erection mark and be hot double dip galvanized. Before galvanizing the steel section shall be thoroughly blast cleaned to near white metal surface (Sa 2½).

2.09.03 The weight of the zinc coating shall be at least 610 gm/m² - unless noted otherwise.

2.09.04 The galvanized surface shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be cleaned and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter that is loosely attached to the steel, blistered surface, flaking or peeling off etc. The presence of any of

these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

2.09.05 There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized steel member shall withstand minimum four one minute dips in copper sulphate solution as per IS: 2633.

2.09.06 When the steel section is removed from the galvanizing kettle, excess spelter shall be removed by 'bumping'. The processes known as 'wiping' or 'scrapping' shall not be used for this purpose.

2.09.07 Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications or lack of quality control in any manner in the galvanizing plant, shall render the entire, production in the relevant shift liable to rejection.

2.09.08 All structural steel shall be treated with sodium dichromate or an approved equivalent solution after galvanizing; so as to prevent white storage stains.

2.09.09 If the galvanizing of any member is damaged, the Engineer shall be shown of the extent of damage, if so directed the galvanizing may have to the redone in the similar manner as stated above at no extra cost to the Owner.

2.10.00 STAINLESS STEEL HOPPERS (As per BOQ item)

2.10.01 Material

In case SS Hopper is to be fabricated & erected as per BOQ item with SS415M, following specification shall be followed.
Stainless steel hopper of grade SS 415M as manufactured by SAIL or equivalent shall be provided in the lower portion of bunker hopper. SS 4 15M having the following chemical composition shall be used.

Material	%	Remarks
Carbon	10.03%	Max.
Silicon	1.60%	Max.
Manganese	0.80% to 1.50%	
Phosphorous	0.03%	Max.
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 I.S. and international specification as well as stipulations contained herein. Fabrication drawings shall be prepared by the contractor on the basis of the design / scope drawings furnished by Engineer. The fabrication and erection works shall be done as per the approved fabrication drawings.

2.10.03 Fabrication Drawings

a) Fabrication drawing shall give the cutting plan for each hopper plate. Such, cutting plan shall be based on the size of the Stainless Steel plate available at store. In order to reduce the wastage and ensure the maximum utilization of stainless steel plate, the cutting plan shall take in the consideration of the reverse curvature and place the various elements of hopper plate in opposite fashion to reduce the end wastage. Similarly the hopper plate element having different radii shall be placed one inside the other, to optimize the stainless steel plate use. Such optimization may also 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 IS: 5206 or by inert gas arc welding as per IS: 2811. Shielding gas shall be Argon + Hydrogen mixture or Argon + Oxygen mixture. However, Argon + Oxygen mixture shall be preferred. Carbon-di-oxide mixture shall be avoided. 308L and 315L electrodes/fillers shall be used for the welding of Stainless Steel to Stainless Steel and Stainless Steel to Mild Steel respectively. However, the welding process and the type of the electrodes to be used for welding shall be as per welding procedure, as approved by the Engineer. On the basis of the welding procedure, the Contractor shall conduct qualification test.

2.10.06 Bending

The stainless steel plates shall be subjected to cold forming and bending in order to get the desired shape and profile.

2.10.07 Welding sequence

The type of electrodes, welding sequence, preheat and interpass temperature and post weld heat treatment shall be as approved by the Engineer.

2.10.08 Acceptance Criteria of Fabricated Structures

The acceptance of the fabricated structure work shall depend upon correct dimensions and alignment, absence of distortion in the structure, satisfactory results from the inspection and testing of the welded structure joints and the

test specimens, general workmanship being good meeting the tolerance requirements given in IS: 7215.

2.11.00 BEARINGS

2.11.01 PTFE (Poly tetra fluorethylene) slide bearing

a) General

The bearings shall consist of upper and lower units. The upper unit shall include a sole plate with mirror finish stainless steel facing bonded to the bottom surface of the sole plate. The lower unit shall consist of a relevant laminated elastomers pad surfaced with PTFE. A rigid confining medium substructure bonds the PTFE to the pad. When the upper and lower units are mated the stainless steel slides on the PTFE surface with an extremely low coefficient of friction. These bearings shall be designed as per the performance requirements. The bearing shall be of reputed make and manufacturer as approved by Engineer, for required vertical loads, as per the construction drawings and for a maximum displacement of ± 50 mm.

b) Material

PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/cm². In order to prevent cold flow in the PTFE surface it shall be rigidly bonded by a special high temperature resistant adhesive to the stainless steel sub-strata. The stainless steel surface, which slides against the PTFE, is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of the stainless steel shall be between 1.0 to 1.5mm.

The resilient bearing pad shall consist of multiple layers of lightweight fabric impregnated with a high quality elastomer compound vulcanized into slabs of uniform standard thickness as per the requirement. This shall withstand vertical (compressive) load not less than 500 kg/cm² and shear loads upto 40 kg/cm².

c) Installation

The seating area for PTFE bearing shall be prepared accurately level and furnished with a thin layer of epoxy resin mortar. The bearing will be placed on this layer while it is still workable and the bearing is levelled. The bearing should not be displaced as the beam is lowered into position. When the mortar and adhesive are fully set and the beam slightly above the top of the bearing. The upper surface of the bearing shall then be coated with sufficient thickness of epoxy resin mortar so that when the beam is lowered on to the temporary supports it comes into full contact

with the mortar and some is squeezed out. The surplus shall be troweled off and after the mortar is fully set the temporary supports removed.

2.12.00 Storage of material

2.12.01 General

All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged, shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed and the cost incurred thereof shall be realised from the Contractor. The Contractor shall maintain upto date accounts in respect of receipt, use, and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks.

2.12.02 Steel

The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground section wise and lengthwise so that they can be easily inspected, measured, and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather.

2.12.03 Electrodes

The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating.

2.12.04 Bolts, Nuts and Washers

Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length, and quality.

2.12.05 Paints

Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.

2.13.00 Quality Control

The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall co-operate with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor.

Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work.

The quality control procedure shall cover but not be limited to the following items of work

a) Steel: Quality manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.

b) Rivets, Bolts, Nuts & Washers : Manufacturer's certificate, dimension checks, material testing.

c) Electrodes : Manufacturer's certificate, thickness and quality of flux coating.

d) Welders : Qualifying Tests

e) Welding sets : Performance Tests

f) Welds : Inspection, X-ray, Ultrasonic tests

g) Paints : Manufacturer's certificate, physical inspection reports

h) Galvanizing : Tests in accordance with IS 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products.

2.14.00 Standard dimensions, forms and weights

The dimensions, forms, weights and tolerances of all rolled shapes rivets, bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards.

2.15.00 Fabrication Drawings

The contractor shall within thirty (30) days after the award of the Contract submit to the Engineer the Schedule of Fabrication and erection of structural Steelworks, for approval. Within one week after receipt of approval on design of any steel structure (part or full) based on the approved design. As decided by the Engineer, six (6) copies each of some or all of the detailed fabrication drawings will have to be submitted for approval.

The sequence of preparation of fabrication drawings shall match with the approved fabrication and erection schedule. The above-mentioned approval for fabrication drawings will be accorded only towards the general conformity with the design requirements as well as specifications. The approval of drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents.

The fabrication drawings shall include but not limited to the following:

a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.

b) Dimensional drawings of base plates, foundation bolts location etc.

c) Comparison sheets to show that the proposed alternative section, if any, is as strong as the original sections shown on the Design Drawings.

d) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.

e) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof.

These drawings shall give all the necessary information for the fabrication, erection, and painting of the steelwork in accordance with the provisions of this Specification. Fabrication drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Fabrication drawings shall give complete information necessary for fabrication of the various components of the steelwork,

including the location, type, size, and extent of welds. These shall also clearly distinguish between shop and field rivets, bolts, and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the fabrication drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked up stresses and distortion. Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification. IS: 813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length.

The Contractor shall be responsible for and shall carry out at his cost any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him, whether such drawings or other particulars have been duly approved or not in accordance with the Contract.

3.00.00 WORKMANSHIP

3.01.00 Fabrication

3.01.01 General

All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS: 800 - Code of Practice for general construction in steel and other relevant Indian Standards or equivalent.

3.01.02 Straightening Material

Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification on IS: 1552 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600°C.

3.01.03 Cutting

Shearing, cropping, or sawing shall affect cutting. Use of a mechanically controlled gas-cutting torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Engineer.

To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges, occasional notches or gouges not more than 4 mm deep will be permitted. Gouges greater than 4 mm that remain from cutting shall be removed by grinding. All re-entrant corners shall be shaped notch free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion.

3.01.04 Planning of edges

Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer.

3.01.05 Clearances

The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams web shall be not more than 3 mm at each end, but where for practical reasons greater clearance is necessary, suitably designed cheatings shall be provided.

3.02.00 Riveted and bolted construction

3.02.01 Holes

Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of rivet or bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the rivet or bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the rivet or black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of BS as specified in IS: 919. Parts to be connected shall be firmly held together by

tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

Holes for rivets or bolts shall not be formed by gas cutting process.

3.02.02 Assembly

All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the rivets or bolts shall be reamed. Poor matching of holes shall be cause for rejection .The component parts shall be so assembled that they are neither twisted not otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained.

Rivets shall ordinarily be hot driven, in which case their finished heads shall be approximately hemispherical in shape and shall be of uniform size throughout the work for rivets of the same size full, neatly finished and concentric with he holes. Rivets shall be heated uniformly to a temperature not exceeding 1 125°C they shall not be driven after their temperature has fallen below 540°C.

Rivets shall be driven by power riveters, of either compression or manually operated type, employing pneumatic, hydraulic or electric power. Hand driven rivets shall not be allowed unless in exceptional cases specifically approved by the Engineer. After driving, rivets shall be tight, shall completely fill the holes and their heads shall be in full contact with the surface. In case of countersunk rivets, the countersinking shall be fully filled by the rivet, any proudness of the countersunk head being dressed off flush, if required.

Riveted members shall have all parts firmly drawn and held together before and during riveting and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole.

All loose, burnt, or otherwise defective rivets shall be cut out and replaced and special care shall be taken to inspect all single riveted connections. Special care shall also be taken in heating and driving long rivets. The Contractor shall prove the quality of riveting by cutting some rivets chosen at random by the Engineer. No extra payment will be made to the Contractor for such cutting and replacing. Riveting work, for any particular section or group, will be considered satisfactory when at least 90% of the corresponding cut rivets is found to be sound. If the ratio is below 75%, all the rivets in the particular section or group shall be cut, removed and replaced and tested again at the

Contractor's expense. For cases between 75% and 90% the engineer shall have the option to instruct cutting and replacing any number of further rivets at the Contractor's cost as he deems necessary.

Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if shown on drawing or directed by the Engineer.

Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project trough the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer one spring washer or lock nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified on the Drawings.

3.03.00 Welded Construction

3.03.01 General

Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS: 817.

3.03.02 Preparation of material

Surface to be welded shall be free from loose scale, slag, rust, grease, paint, and any other foreign material except that mill scale, which withstands vigorous wire brushing, may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch.

3.03.03 Assembling

Parts to be fillet welded shall be brought in, as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces, which are not completely sealed by, welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2°).

The work shall be positioned for flat welding whenever practicable.

3.03.04 Welding Sequence

In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shod splicing not more than three sub-sections, each made in accordance with this paragraph.

When required by the Engineer, welded assemblies shall be stress relieved by heat-treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Engineer.

3.03.05 Welding technique

All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 m thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross-section. Groove welds made with the use of the backing of the same material, as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness.

Groove welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the contract.
To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to the relevant Indian Standards.

3.03. 12 Temperature

No welding shall normally be done on parent material at a temperature below (-) 5°C. However, if welding is to undertaken at low temperature, adequate precautions as recommended in relevant Indian Standard shall be taken. When

the parent material is less than 40 mm thick and the temperature is between (-) 5°C and 0°C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is hand warm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20°C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard.

3.03. 13 Peening

Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool, peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening.

3.03. 14 Equipment

These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufacturers of electrodes or as may be approved by the engineer.

3.04.00 Finish

Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butted over the whole section with a clearance not exceeding 0.1 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc; after welding/riveting together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles of channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 1.0 mm.

3.05.00 Slab bases and caps

Bases and caps fabricated out of steel slabs, except when cut material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face, which is to be grouted direct to a foundation, need not be machined if such face is true and parallel to the upper face.

To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.

3. 12.00 Lacing bars

The ends of lacing bars shall be neat and free from burns.

3. 13.00 Separators

Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.

3.14.00 Bearing Plates

Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.

3.15.00 Floor Grating

All grating units shall be rectangular in pattern and of pressure locked assembly. The size and spacing of bearing bars and cross bars shall be as approved in detailed drawings. Alternatively diamond pattern grating if approved may be used.

The grating shall be made in panel units designed to span as indicated in structural steel framing drawing or as directed by the Engineer.

The grating units shall be finished free from warps, twists, or any other defects. Grating work shall include cutouts and clearance openings for all columns, pipes, ducts, conduits etc. The gratings shall be notched, trimmed, and neatly finished around components of the steel structures encountered. Binding strip shall be provided on the grating to suit the profile. Openings in gratings shall be provided with steel bar toe plates of not less than 5 mm thickness and 100 mm width.

Unless otherwise indicated on drawings, all penetrations of grating units shall be made up in split section, accurately fitted, and neatly finished. Grating units shall be provided with all necessary clips, bolts, lock washers etc. for proper assembly and installation on supporting steel members. Maximum deviation in linear dimension shall not exceed 12 mm.

3.10.00 Chequered Plates

Minimum thickness of chequered plate floorings, covers etc. shall be 6 mm O/P. Chequered plate shall be accurately cut to the required sizes and shapes and the cut edges properly ground. Stiffeners shall be provided wherever required from design consideration.

3.11.00 Architectural Clearances

Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances.

3.11.00 Shop connections

a) All shop connections shall be otherwise riveted or welded as specified on the Drawings.

b) Heads of rivets on surfaces carrying brick walls shall be flattened to 10 mm thick projection.

c) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the contractor will have to make the desired changes at no extra cost to the exchequer.

3.13.00 Castings

Steel castings shall be annealed.

3.14.00 Shop erection

The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before dispatch. The parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in such a way as will facilitate the check of interchange ability.

3.15.00 Shop painting

3.15.01 General

Unless otherwise specified, steelwork, which will be concealed by interior building finish, need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer.

After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other methods of loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by the solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by trough sweeping with a fibre brush.

3.15.02 Inaccessible parts

Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, Positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

3.15.03 Contact surfaces

Contact surface shall be cleaned in accordance with sub-clause 3.13.1 before assembly.

3.15.04 Finished surfaces

Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

3.15.05 Surfaces adjacent to field welds

Unless otherwise provided for, surfaces within 50 of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

3.16.00 Galvanizing

3.16.01 General

Structural steelwork for switchyard or other structures as may be specified in the contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS: 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.

3.16.02 Surface Preparation

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

3.16.03 Procedure

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS: 4759 - Specification for Hot-dip zinc coatings on Structural Steel & other allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after leaving been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surfaces during transport, handling, and

erection. Damages, if occur, shall be made good in accordance or as directed by the Engineer.

4.00.00 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

4.01.00 Inspection

Unless specified otherwise, inspection to all, work shall be made by the or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification.

The Contractor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract. The Contractor shall guarantee compliance with the provisions of this Specification.

4.02.00 Testing and Acceptance Criteria

4.02.01 General

The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own Cost. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.

4.02.02 Steel

All steel supplied by, the Contractor shall conform, to the relevant Indian Standards. Except otherwise mentioned in the contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T or less of any particular section for tests to conform to relevant Indian Standards. Cost of all tests shall be born by the contractor.

All material shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance.

4.02.02 Welding

a) The weld surface shall be cleaned with steel wire brush to remove spatter metal, slag etc. and 100% of welds shall be inspected visually for size, length of weldment and external defects. Weld gauges shall be used for checking weld sizes. The surface shall be clean with regular beads and free from slags, cracks, blow-holes etc.

b) Non-destructive examination shall be carried out to determine soundness of weldments as follows:

   i) 10% at random on fillet-joints.

   ii) 100% on all butt-joints.

c) Should the ND tests indicate defects like improper root penetration, extensive blowholes, slag intrusion etc., such welds shall be back gauged, joints prepared again and rewelded. All defects shall be rectified by the Contractor at no extra costs.

d) All electrodes shall be procured from approved reputed manufacturers with test certificates. The correct grade and size of electrode, which has not deteriorated in storage, shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tones of welded fabrication, the Engineer may ask for 1(one) test-destructive or non-destructive including X -ray, ultrasonic test or similar, the cost of which shall be borne by the Contractor.

4.02.04 Rivets, bolts, nuts and washers

All rivets, bolts, nuts, and washers shall be procured from M/s. Guest Keen William Ltd. or equivalent and shall confirm to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards. Cost of all such testing shall have to be borne by the Contractor. In addition to testing the rivets by hammer, 2% (two per cent) of the rivets done shall have to be cut off by chisels to ascertain the fit, quality of material and workmanship. The removal of the cut rivets and re-installing new rivets shall be done by the Contractor at his own cost.

4.02.05 Shop painting

All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of the relevant Indian Standards.

4.02. 12 Galvanizing

All galvanizing shall be uniform and of standard quality when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and 15: 4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products.

4.03.00 Tolerance

The tolerances on the dimensions of individual rolled steel components shall be as specified in IS: 1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures shall be as specified in IS: 721 - Tolerances for Fabrication of Steel Structures.

4.04.00 Acceptance

Should any structure or part of a structure be found not to comply with any of the provisions of this specification, the same shall be liable to rejection. No Structure or part of the structure once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check some of the tests at an appropriate laboratory at the contractors cost.

When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue acceptance certificate, upon receipt of which, the items will be shop painted, packed and dispatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract.

4.05.00 Delivery of materials

4.05.01 General

The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. The Owner may prescribe or control the sequence of delivery of materials, at his own discretion.

4.05.02 Marking

Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection.

4.05.03 Shipping

Shipping shall be strictly in accordance with the sequence stipulated in the agreed Programme. Contractor shall dispatch the materials to the e worksite securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All parts shall be adequately braced to prevent damage in transit.

Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following:

a) Name and address of the consignee

b) Name and address of the consignor

c) Gross weight of the package in tonnes and its dimensions

d) Identification marks and/or number of the package

e) Custom registration number, if required

All markings shall be carried out with such materials as would ensure quick drying and indelibility.

Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers.

Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially -

a) Name of the Contractor

b) Number and date of the Contract

c) Name of the office placing the contract

d) Nomenclature of stores

e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawings and the quantity of each.

The shipping dimensions of each packing shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads.

After delivery of the materials at site, all packing materials shall automatically become the property of the Owner.

Notwithstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the Contractor at no additional cost to the Owner. When facilities exist, all shipments shall be covered by approved Insurance Policy for transit at the cost of the Contractor.

The contractor shall ship the complete materials or part on board a vessel belonging to an agency approved by the Owner or on rail and/or road transport as directed. The Contractor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no case will the Owner be liable to pay any warehouse, wharfage, demurrage and other charges.

If, however, the Owner has to make payment of any of the above-mentioned charges, the amount paid will be deducted from the bills of the Contractor.

Necessary 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 upto maximum extent and minimise the wastage/scrap. Quantity of wastage/scrap of material should be limited to the percentage mentioned elsewhere in the conditions of tender/ contract specifications.

6.01.15 The bidder's rates for re-erection of erection marks after additions to, alterations in and/or modifications shall be inclusive of all operations mentioned in technical specification for the calculated weight of the rectified/modified erection mark rejected at site. This shall not include the weight of temporarily dismantled/supported members, connected member. All the operations mentioned above for restoring such members shall be carried out at no extra cost. The work of erection of any erection mark which has not been dismantled but have been modified/rectified before erection shall not be paid under this item but shall be paid under relevant item of fabrication and erection of steel work of Schedule of items for the modified weight.

6.01.16 The bidder's rates for PTFE shall include design, supply, transportation of the complete assembly with guides and dust protection cover and installation of bearings in position drilling, bolting, erecting aligning etc. along with any taxes, duties thereon etc.

6.01.17 The bidder's rates for Stainless Steel hopper (if specified) shall include fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, all other operations mentioned in the technical specification. The rates shall also include for erection scheme, alignment, making cutting plan, cutting, jointing, bending, rolling, grinding, drilling, bolting, assembly, edge preparation, welding including pre-heating, post-heating, testing of welders, inspection of welds, inspection and testing, protection against damage in transit, stability of structures, installation of temporary structures etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus / waste steel materials including cut pieces/waste steel, provision of additional butt / weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work.

6.01.18 The 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 ISMB, ISMC, ISA, flats, round bars, square bars and pipes, length shall be taken as per distance between planes normal to the axis of the member passing through the extreme points of the section.

6.02.04 Gussets plates in trusses, and bracings, brackets plates, stiffeners, and skew cuts if any in plates for butt welds, the area shall be assumed as the minimum circumscribed rectangle. However deduction for any notch/skew cut shall be made as mentioned in clause no-6.02.06.

6.02.05 For bunker wall plates, the minimum-circumscribing rectangle of the individual plate/pieces out of which these wall plates are assembled by butt-welding, shall be measured. Care shall be taken to ensure maximum utilization of cut-pieces generated by providing extra butt joints (for which no extra payment shall be made).

6.02.06 For all other plates, where the area of any notch/skew cut in the plate is less than 0.05 sq.m. the area of the plate shall be assumed as that of the minimum circumscribing rectangle for the purpose of measurement and calculation of area for the purpose of payment. However, if the area of any notch/skew cuts in a plate is more than 0.05 sq.m, the area of notch/skew cut shall be deducted from assumed minimum circumscribing rectangular area for the purpose of payment.

6.02.07 No deduction shall be made for the hole in the members, if the area of individual hole is less than 0.05 sq.m. The weight shall be calculated by deducting the area of holes, if area of individual hole is more than 0.05 sq.m.

6.02.08 All cut-pieces and scrap generated due to cutting of holes, skew-cuts of plates, gussets, brackets, stiffeners, etc. shall be stacked separately and handed over to the project stores without being considered for material accounting as the circumscribing rectangle has been considered for payment.

6.02.09 The splice plate shown in the fabrication drawing or approved by the Engineer shall only be measured for payment.

6.02.10 The weight of permanent bolts, washers and nuts and welds shall not be included in the weights of the members. No extra payment shall be made for

welding/bolting.

6.02.11 The bolts and nuts required for erection purpose shall not be paid for and may be taken away by the Contractor after final welding for members. Erection boltholes left after removal of erection bolts shall be suitably plugged with welds.

6.02.12 The measurement for the item of application of inorganic primer including blast cleaning of steel surfaces shall be based on the weight on which the zinc silicate primer is applied, after blast cleaning in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works.

6.02.13 The measurement for the item of application of finish primer system shall be based on the weight on which the epoxy based finish primer is applied in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works.

6.02.14 The measurement for the item of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor, and accepted by the Engineer. Nothing extra shall be payable for making cutouts, notches, openings of any profile, trimming profiles etc. in the grating units.

6.02.15 The measurement for the item of hot dipped galvanization of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal of gratings galvanized by the Contractor and accepted by the Engineer.

6.02.16 The measurement for the item of permanent bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules.

6.02.17 The measurement for the item of High Strength Structural bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules.

6.02.18 The measurement for the item of the work of dismantling, additions, alterations, reerection etc. shall be as given below

6.02.19 For dismantling, the unmodified weight of the actually dismantled erection marks shall only be measured.

6.02.20 For the work of addition to, alteration in and / or modification of 'erection

marks' either in erected position or in the fabrication yard, measurement of weight for payment purpose shall be calculated as the arithmetic sum of weight of steel cut and removed from the erection mark, weight of steel reutilised out of such cut and removed pieces and weight of additional new steel pieces added to the erection mark.

6.02.21 For re-erection the weight of the modified erection mark shall only be measured.

6.02.22 The weight shall be measured nearest to kg. and shall be arrived in a manner similar to the measurement for the item of fabrication, erection, alignment and welding of structural steel.

6.02.23 The measurement for the item of PTFE bearings shall be based on the load carrying capacity of PTFE in MT, corrected to third place of decimal, supplied by the contractor and as accepted by the Engineer and as per the approved bearing schedule, for the total vertical load carrying capacity, for all bearings.

6.02.24 The measurement for the item of stainless steel hopper shall be based on the actual finished weight of hopper weight in Kgs, corrected to second place of decimal. The hopper weight shall be arrived by multiplying of the inner surface area of the hopper with the unit weight of the hopper plate.

6.02.25 The measurement for the item of flexible open-ended bellows straps of neoprene shall be based in running meter, corrected to second place of decimal. Bellow Straps shall be supplied as per the requirement of the approved drawings. The measurement shall be done for the inner circumference of the bunker on which neoprene has been fixed and for the length supplied by the Contractor 'and as accepted by the Engineer.

6.02.26 The measurement for the item of Stainless Steel Hand Railing shall be based on finished weight of handrail in Kgs corrected to second place of decimal. The weight shall also include the weight of Stainless Steel fasteners, Stainless Steel beading, Stainless Steel cleats etc. The weight shall be the finished weight of Hand Rail, as accepted by the Engineer.

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SECTION - D
(PART I)

SUB-SECTION – D 18

ERECTION OF STRUCTURAL STEELWORK

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

C 0 N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	GENERAL	3
3.00.00	WORKMANSHIP	6
4.00.00	TESTING AND ACCEPTANCE CRITERIA	12
5.00.00	INFORMATION TO BE SUBMITTED	16

SUB-SECTION – D 18

ERECTION OF STRUCTURAL STEELWORK

1.00.00 SCOPE

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at site, installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Contractor, unless otherwise specified in the Contract, shall include but not be limited to the following:

a) The Contractor shall provide all construction and transport equipment, tools, tackle, consumables, materials, labour, and supervision required for erection of the structural steelwork.

b) Receiving, unloading, checking, and moving to storage yard at Site including prompt attendance to all insurance matters as necessary for all fabricated steel materials arriving at Site. The Contractor shall pay all demurrage and/or wharfage charges etc. on account of default on his part.

c) Transportation of all fabricated structural steel materials from Site storage yard, handling, rigging, assembling, riveting, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer. If necessary suitable temporary approach roads to be built for transportation of fabricated steel structures.

d) Checking center 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, leveling, riveting, bolting, welding and securely fixing the fabricated steel structures including floor gratings, chequered plates etc. in accordance with the Drawings or as directed by the Engineer.

f) Painting of the erected steel structures.

g) All minor modifications of the fabricated steel structures as directed by the

Engineer including but not limited to the following:

i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.

ii) Cutting, chipping, filling, grinding, etc. if required for preparation and finishing of site connections.

iii) Reaming of holes for use of higher size rivet or bolt if required.

iv) Refabrication of parts damaged beyond repair during transport and handling or refabrication of parts, which are incorrectly fabricated.

v) Fabrication of parts omitted during fabrication by error, or subsequently found necessary.

vi) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.

vii) Carry out tests in accordance with this specification.

2.02.00 Work by Others

No work under this Specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Codes and Standards

All work under this Specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specification and codes of Practice of equivalent:

IS: 800 - Code of practice for general construction in steel.

IS: 456 - Code of practice for main or reinforced concrete.

2.04.00 Conformity with Designs

The Contractor will erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification and the sequence and the design criteria laid down by the Engineer. All work shall conform to the provisions of this specification and /or instructions of the engineer. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specifications and/or the instructions o the Engineer.

2.05.00 Material

2.05.01 General

All fabricated steel structures and connection materials shall be supplied by the Contractor to the site. The Contractor shall take delivery from railway wagons or trucks at site, and unload the materials and perform all formalities like checking of materials and attend to insurance matters in accordance with Sub-Clause 2.01.00 and as specified hereinbefore.

2.05.02 Materials to conform to Indian standards

All materials required to be supplied by the Contractor under this contract shall conform to the relevant Indian Standard specifications.

2.06.00 Storage of Materials

2.06.01 General

All material shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site, failing which, the engineer shall be at liberty to get the materials removed by agency and the cost incurred thereof shall be realised from the Contractor's dues.

2.06.02 Yard

The Contractor will have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other raw steel materials such as structural sections and plates as required. The yard shall have facilities like drainage, lighting, and suitable access for large cranes, trailers, and other heavy equipments. The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved Programme of work.

The Tenderer must visit the site prior to submission of his tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc. all of which shall be carried out by the Contractor at his own cost as directed by the Engineer.

2.06.03 Covered Store

All field connection materials, paints, cement etc. shall be stored on well

designed racks and platforms off the ground in a properly covered store building to be built at the cost of the Contractor.

2.07.00 Quality Control

The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the Following items of work :

i) Erection: Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.

ii) Grouting: Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency, and strength of grout.

iii) Painting: Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

2.08.00 Taking Delivery

The Contractor shall take delivery of fabricated structural steel and necessary connection materials from railhead/trucks as may be necessary and as directed by the Engineer. He shall check, unload; transport the materials to his stores for proper storing at his own cost. The Contractor shall submit claims to insurance or other authorities and pursue the same in case of loss or damage during transit and handling and all loss thereof shall be borne by him.

The Contractor shall also take all precautions against damage of the materials in his custody after taking delivery and till the same are erected in place and accepted. The Contractor shall salvage, collect, and deliver all the packing materials to the Owner free of charge.

3.00.00 WORKMANSHIP

3.01.00 Erection

3.01.01 Plant and Equipment

The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be thoroughly verified. They shall be efficient, dependable, in good working condition and shall have the approval of the Engineer.

3.01.02 Method and sequence of erection

The method and sequence of erection shall have the prior approval of the Engineer. The Contractor shall arrange for most economical method and sequence available to him consistent with the drawings and specifications and other relevant stipulations of the contract.

3.01.03 Temporary Bracing

Unless adequate bracing is included as a part of the permanent framing, the erector during erecrtion shall install, free of cost to the Owne, temporary guys and bracings where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations.

If additional temporary guys are required to resist wind or seismic forces acting upon components of the finished structure installed by others during the course of the erection of the steel framing, arrangement for their installation by the erector shall be made free of cost to the Owner.

The requirement of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned, and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer.

The temporary guys, braces, false work, and cribbing shall not be the property of the Owner and they may be removed immediately upon completion of the steel erection.

3.01.04 Temporary Floors for Buildings

It shall be the responsibility of the Contractor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or bylaws of state, Municipal or other local authorities.

3.01.05 Setting Out

Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Engineer. For heavy columns, etc. the Contractor shall set proper screed bars to maintain proper level. No extra payment shall be made for this.

Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance under this Specification.
No permanent field connections by riveting, bolting or shall be carried out until proper alignment and plumbing has been attained.

3.01.06 Field Riveting

All rivets shall be heated and driven with pneumatic tools. Hand passing or "throwing" of rivets are desirable. Any other method of conveying hot rivets from the furnace to the driving point must be approved by the engineer. No-cold rivets shall be driven. All other requirements of riveting including quality and acceptance criteria shall be in accordance with the relevant portions of the Specification for Fabrication of Structural Steelwork of the Project.

3.01.07 Field Bolting

All relevant Portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following:

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other, defects that would prevent solid seating of the parts. Contact surfaces within friction type joints shall be free of oil, paint, lacquer, or galvanizing.

All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods.

a) Turn-of-nut Method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the Joint are brought into good contact with each other. 'Snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table-I with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation

there shall be no rotation of the part not turned by the wrench.

TABLE-I

Bolts length not exceeding 8 times dia or 200 mm	Bolt length exceeding 8 times dia or 200 mm	Remarks
1/2 turn	2/3 turn	Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation-30° over or under.

Bolts may be installed without hardened washers when tightening is done by the turn -of-nut -method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have the outer face of the match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque Wrench Tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques specified in TABLE-II (See Note below the Table). Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

TABLE-II

Nominal Bolt Diameter (mm) of IS:1367	Torque to be applied (Kg.M) for bolt class 8.8
20	59.94
22	81.63
24	103.73

Note: The above torque values are approximate for providing tensions of 14.

7 T for 20 mm dia.; and 21.2 T for 24 mm dia. bolts under moderately lubricated condition. The torque wrench shall be calibrated at least once daily to find out the actual torque required to produce the above required tension in the bolt by placing it in a tension indicating device. These torques shall be applied for tightening the bolts on that day with the particular wrench.

In either of the above two methods, if required, for bolt entering and wrench operation clearances, tightening may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds. Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this sub clause.

3.01.08 Field Welding

All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints.

3.01.09 Holes, Cutting and Fitting

No cutting of sections, flanges, webs, cleats, rivets, bolts, welds etc. shall be done unless specifically approved and /or instructed by the Engineer.

The erector shall not cut, drill, or otherwise alter the work of other trades, unless such work is clearly specified in the Contract or directed by the Engineer. Wherever such work is obtain specified the Contractor shall obtain complete information as to size, location and number of alterations prior to carrying out any work. The Contractor shall not be entitled for any payment on account of any such work.

3.02.00 Drifting

Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes as necessary to make connections. Reaming, that weakens the member

or makes it impossible to fill the holes properly or to adjust accurately after reaming, shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited.

3.03.00 Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced)

Grouting shall be carried out with Ordinary Cement grout as described below:

The mix shall be one (1) part cement and one (1) part sand and just enough water to make it workable. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water and any accumulated water shall be removed. These shall be placed under expert supervision, taking care to avoid air locks. Edges shall be finished properly. If the thickness of grout is 25 mm or more, two (2) parts of 6 mm down graded stone chips may be added to the above noted cement-sand grout mix, if required, by the Engineer or shown on the drawings.

No grouting shall be carried out until a sufficient number of bottom lengths of stanchions have been properly lined, leveled, and plumbed and sufficient floor beams are tied in position.

Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned.

If required by the Engineer, certain admixtures like aluminium powder, “ironite” or equivalent, may be required to be added to the grout to enhance certain desirable properties of the grout. Approved non-shrink pre-mixed grout having required flowability and compressive strength may also be used with Engineer's approval.

3.04.00 Painting after Erection

Field painting shall only be done after the structure is erected, levelled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. Normally, final painting shall be done only after the floor slabs are concreted and masonry walls are built. However, touch up painting, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the Contractor free of cost to the Owner. The materials and specification for such painting in the field shall be in accordance with the requirements of the specification for fabrication of structural

steelwork applicable for the project.

Painting shall not be done in frosty or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust.

All field rivets, bolts, welds, and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces, which will be in contact after site assembling, shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet.

Surface, which will be inaccessible after field assembly shall receive the full, specified protective treatment before Bolts and fabricated steel members who are galvanized or otherwise treated and steel members to be encased shall not be painted.

The final painting shall be of tow coats of Synthetics Enamel painting or Aluminium paint of approved manufacture as per the approved "Schedule of Painting". The shades shall also be as per the approved schedule. Synthetic enamel paint shall conform to IS: 2932.

3.05.00 Final cleaning up

Upon completion of erection and before final acceptance of the work by the Engineer, the contractor shall remove free of cost all false work, rubbish and all Temporary Works resulting in connection with the performance of his work.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 General

Loading tests shall be carried out on erected structures, if required by the Engineer, to check adequacy of fabrication and/or erection. Any structure or a part thereof found to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member as per the Contract and no payment towards the cost of the dismantled portion and any connected work shall be made to the contractor. In course of dismantling, if any damage is done to any other parts of the structure or to any fixtures, the same shall be made good free of cost by the Contractor, to the satisfaction of the Engineer. The Cost of the tests specified hereinafter shall be borne by the Owner; but if the structure fails to pass the tests, the cost of the tests shall be recovered from the Contractor. Any extra claim due to loss of time, idle labour, etc. arising out of these testing operations shall not be entertained, however, only reasonable and appropriate time extensions will be allowed.

The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing and the tests shall be conducted as indicated in the following sub-clauses 4.01.01, 4.01.02 and 4.01.03. The method of testing and application of loading shall be as approved by the Engineer.

4.01.01 Stiffness Test

In this test, the structure or member shall be subjected, addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after this second test is not less than 90 per cent of the maximum increase in strain or deflection recorded during the second test.

4.01.02 Strength Test

The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours.

In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on the removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load.

4.01.03 Structure of same design

Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first application of the test load, particular note shall be taken of the strain or deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours. This information is required as a basis of comparison in any check test carried out on samples of the structure.

When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 time the specified live load, in a manner and to an extent prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the maximum strain or deflection recorded at similar load in the test on the prototype.

4.01.04 Repair for subsequent test and use after strength tests

An actual structure which has passed the "Strength Test" as specified in Sub-clause 4.1.2 hereinbefore and is subsequently to be erected for use, shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in Sub-clause 4.01.01 hereinbefore.

4.02.00 Tolerances

Some variation is to be expected in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications for fabrication of structural steel work applicable to this Project and as specified below: The specified tolerance is mainly for welded erection. In case of bolted erection, no tolerance is desired so that all prefabricated bolt holes are matched on erection.

I. For Buildings Containing Cranes

Component	Description	Variation Allowed
1.	2.	3.
Main columns	a) shifting of column axis at foundation level with respect to building line	
	i) In longitudinal direction	i) ± 3.0 mm
	ii) In lateral direction	ii) ± 3.0 mm
	b) Deviation of both major column axis from vertical between foundation and	

	other member connection levels:	
	i) For a column upto and including 10M height	i) ± 3.5 mm from true vertical
	ii) For a column greater than 10M but less than 40M height	ii) ± 3.5 mm from true vertical for any 10 M length measured between connection levels, but not more than ±7 mm per 30m length.
	c) For adjacent pairs of columns across the width of the building prior to placing of truss	± 9.0 mm on true span.
	d) For any individual column deviation of any bearing or resting level from levels shown on drawings.	± 3.0 mm
	e) For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating	3.0 mm
Trusses	a) Deviation at centre of span of upper chord member from vertical plane running through centre of bottom chord.	1/1500 of the span or greater than 10mm whichever is the least.
Trusses	b) Lateral displacement of top chord at center of span from vertical plane running through center of supports.	1/250 of depth of truss or 20 mm which ever is the - least.
Crane Cirders	a) Difference in levels of crane rail measured between adjacent columns.	2.0 mm.
	b) Deviation to crane rail-gauge	± 3.0 mm

	c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermite welding.	1.0 mm.
	d) Deviation of crane rail axis from centre line of web.	± 3.5 mm
Setting of Expansion gaps	At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30°C. The coefficient of expansion or contraction shall be taken as 0.000012 per °C per unit length.	

iv) For Building without Cranes

The maximum tolerances for line and level of the steel work shall be ±3.0 mm on any part of the structure. The structure shall not be Out of Plumb more than 3.5 mm on each lox section of height and not more than 7.0 mm per 30 m section.

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

4.03.00 Acceptance

Structures and members have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.01.00, 4.01.01, 4.01.02, 4.01.03 and 4.01.04 and other applicable provisions of this specification and are within the limits of tolerances specified in Sub-clause 4.02.00 and/or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfillment of the provisions of this contract.

5.00.00 INFORMATION TO BE SUBMITTED

5.01.00 Before Tender

5.01.01 Tentative Programme

The Tenderer shall submit a tentative programme based on the information available in the Tender Document and visit to site indicating the structure-wise erection schedule proposed to be maintained by the Contractor to complete the job in time in accordance with the Contract.

5.01.02 Constructional Plant and Equipment, Tools, Temporary works & manpower A detailed list Of all constructional plant and equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tenderer which he will be able to employ on the job to maintain the progress of work in accordance with the Contract shall be submitted along with the Tender. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.

5.01.03 Erection Yard

A site plan showing the layout and location of the erection yard proposed to be established by the tenderer shall also be attached with the tender indicating the storage space for fabricated steel materials, site-fabrication and repair shop, covered stores, offices, locations of erection equipments and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the Contractor shall comply with the same without any claim whatsoever.

5.02.00 After award of the Contract

After award of the contract, the Contractor shall submit the following:

5.02.01 Detailed Programme

The Contractor shall submit a detailed erection programme within a month of the award of the Contract for completion of the work in time in accordance with the Contract. This will show the target programme, with details of erection proposed to be carried out in each fortnight, details of major equipment required, and an assessment of required strength of various categories of workers in a proforma approved by the Engineer.

5.02.02 Fortnightly Progress Report

The Contractor shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and all details of actual achievements against the target programme specified in Sub-clause 5.02.01 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the Contractor shall also furnish details of fabricated materials in hand at site and the strength of his workers.

VOLUME I

Geotechnical Investigation report of 5X800MW Yadadri thermal Power station at Veerlapalem, Telangana state for ISG scope consists of three volumes as per details given below:

VOLUME –I – Methodology, Analysis & Recommendations

VOLUME – II – Bore logs, Trial pits, Field permeability test Double Packer and laboratory tests results

VOLUME – III – Plate load tests,Cyclic plate load tests,Electrical resistivity tests ,Cross hole, shear tests, Pressuremeter tests.

This Volume consists of Methodology, Analysis and Recommendations for proposed the power plant.

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FOR
5X800MW YADADRI THERMAL POWER STATION
NALGONDA DISTRICT,
TELANGANA STATE

NOBLE GEO-STRUCTS PROJECT NO. S 16022

Aug 19, 2016

INTRODUCTION

Noble Geo-Structs is pleased to submit Geotechnical Investigation Report for 5x800MW Yadadri Thermal Power Station, Nalgonda District, Telangana State. Geotechnical Investigation work was awarded by M/s Bharat Heavy Electricals Limited; Chennai through quotation no. NGS/Q/15/52 dated 02/07/2015.
Vide PO no:BHEL PSSR SC 1588/28th August 2015

The purpose of this report is to describe the subsurface conditions observed at the Fourty eightborings drilled for this study, analyze and evaluate the test data, and provide recommendations with respect to:

- chemical nature of the sub-soil and
- strength and stability of strata for deciding the founding level.

PROJECT DESCRIPTION

The project involves Soil Investigation & Topographical survey for 5x800MW Yadadri Thermal Power Station at Veerlapalem village, Dameracherla Mandal, Nalgonda District, Telangana State.
Site Location: 7km from the NH-5, Veerlapalemvillage, Dameracherla Mandal, Nalgonda district, Telengana State.

Co=ordinates: N=16^{0}42’20.40, E= 79^{0}34’41.56

The nearest town to the site is Miryalaguda at a distance of 30km which is easily accessible from the TelenganaState capital Hyderabad by road. The nearest railway station is Vishnupuram at 6.50km from the project site. The nearest airport is Vijayawada at 130km from the site.

SCOPE OF WORK

Specifications of the work include drilling Two Hundred and eleven bore holes at stipulated locations, tests (in-situ and ex situ) on soil, rock and ground water samples, interpretation of test data and test results and preparation of a geotechnical report.

Field Work

Field work consists of Two Hundred and eleven boreholes at stipulated locations (Table No 1),collecting disturbed, undisturbed soil samples and rock samples at salient locations, conducting standard penetration test (SPT).

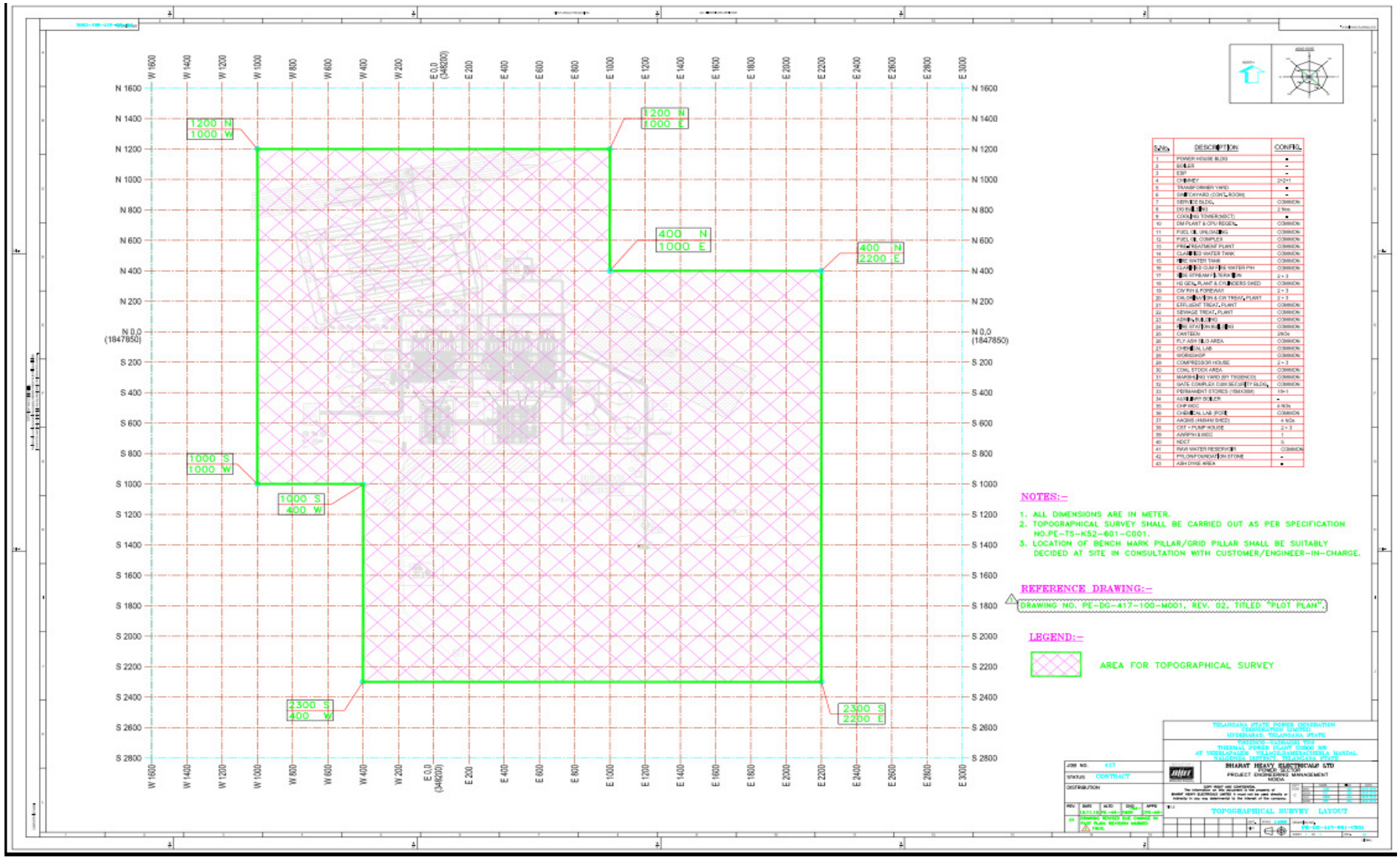
Drilling at the stipulated boreholes was planned up to a sufficient depth of the rock level to determine the competent strata for foundation design. Minimum diameter of the boreholes was 150mm and boring was carried out in accordance with the provisions of IS 1892 upto the termination depth.

Field Tests

The Field Work involves following activities and the co-ordinates with levels are given in the corresponding tables as mentioned:

a) Visual identification of soil samples
b) Standard Penetration Test
c) Plate load test (Table No 8)
d) Cyclic plate load test (Table No 3)
e) Electrical Resistivity Test (Table No 10)
f) Pressure Meter Test (Table No 4)
g) Cross hole Shear wave Test (Table No 2)

Project :5x800MW Yadadri Thermal Power Station at Veerlapalem, Telangana State.
Noble Geo-Structs Project No. S 16022
August 19, 2016



Project :5x800MW Yadadri Thermal Power Station at Veerlapalem, Telangana State.
Noble Geo-Structs Project No. S 16022
August 19, 2016

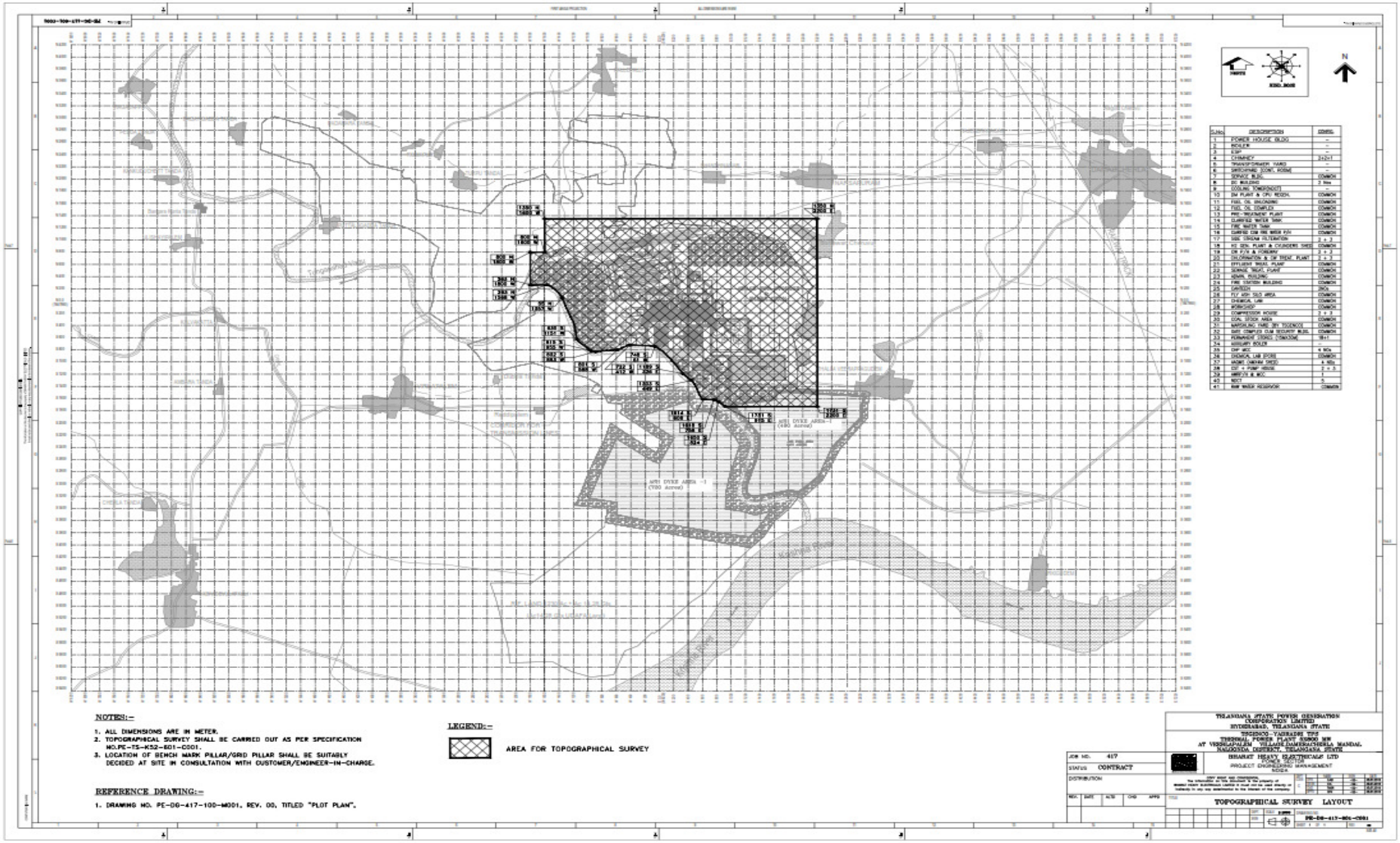


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Table No 1 Borehole details:

Sr no	Structure type	Bore/Test no	Northing	Easting	Ground level (G.L.) in terms of RL(+)	Water Table below (G.L.)	Termination depth (m)
1	Wagon Tippler,Track Hopper and Tunnels	IBH 1	1008	-127	95.15	-	20.0
2		IBH 2	952	-116	90.23	-	10.0
3		IBH 3	930	-552	96.46	-	15.0
4		IBH 4	913	-186	89.66	-	20.0
5		IBH 5	888	-427	90.23	-	15.0
6	Coal Stock Yard with Conveyors and JNTs	IBH 6	769	-114	86.87	-	10.0
7		IBH 7	714	-155	86.80	-	10.0
8		IBH 8	720	-72	87.96	3.00	10.0
9		IBH 9	659	-361	86.59	-	10.0
10		IBH 10	649	-172	92.75	-	10.0
11		IBH 11	633	99	92.02	-	10.0
12		IBH 12	624	-729	88.71	-	10.0
13		IBH 13	597	-650	87.75	-	10.0
14		IBH 14	545	-26	88.24	-	15.0
15		IBH 15	544	-321	85.50	-	10.0
16		IBH 16	526	-198	88.32	4.00	10.0
17		IBH 17	510	125	88.49	3.00	10.0
18		IBH 18	69	142	87.16	3.00	10.0
19		IBH 19	439	-209	84.24	-	10.0
20		IBH 20	437	-705	88.62	-	10.0
21		IBH 21	419	-11	86.33	3.90	15.0
22		IBH 22	401	225	86.27	3.50	10.0
23		IBH 23	395	-415	86.00	-	10.0
24		IBH 24	385	152	87.05	-	10.0
25		IBH 25	341	-672	89.27	4.10	10.0

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Sr no	Structure type	Bore/Test no	Northing	Easting	Ground level (G.L.) in terms of RL(+)	Water Table below (G.L.)	Termination depth (m)
26	Coal Stock Yard with Conveyors and JNTs	IBH 26	329	314	85.60	-	10.0
27		IBH 27	329	314	83.70	3.60	10.0
28		IBH 28	288	249	84.30	-	10.0
29		IBH 29	288	249	87.25	3.10	10.0
30		IBH 30	242	176	84.15	-	10.0
31		IBH 31	242	176	87.57	3.90	10.0
32		IBH 32	216	-648	88.01	-	10.0
33		IBH 33	193	57	84.77	-	10.0
34		IBH 34	193	-57	83.94	3.85	10.0
35		IBH 35	119	-548	85.80	-	10.0
36		IBH 36	116	-417	84.08	-	10.0
37		IBH 37	74	-615	86.24	-	10.0
38	CHP & AHP Structures in Power Block Area	IBH 38	69	142	84.12	-	10.0
39		IBH 39	20	249	80.58	4.00	10.0
40		IBH 40	13	-139	79.66	5.00	10.0
41		IBH 41	-158	0	78.01	3.00	10.0
42		IBH 42	-158	431	82.62	4.00	10.0
43		IBH 43	-1578	-38	77.28	-	10.0
44		IBH 44	-144	867	87.38	4.00	10.0
45		IBH 45	167	-154	77.89	5.50	10.0
46		IBH 46	-1558	-94	79.11	3.50	10.0
47		IBH 47	-166	579	84.96	-	10.0
48		IBH 48	-2110	140	77.53	2.90	10.0

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Field tests details are enlisted below:

Table No 2 PLATE LOAD TEST

Sr no	Structure type	Bore/Test no	Northing	Easting	Ground level (G.L.) in terms of RL(+)
1	Coal Stock Yard with Conveyors and JNTs	IPLT 1	744	-364	88.20
2		IPLT 2	518	271	88.03
3		IPLT 3	508	-490	86.21
4		IPLT 4	305	-228	84.72
5	CHP & AHP Structures in Power Block Area	IPLT 5	0	143	82.40
6		IPLT 6	1607	-62	78.09
7		IPLT7	-207	192	81.67
8		IPLT8	-198	261	80.97

Table No 3 CYCLIC PLATE LOAD TEST

Sr no	Structure type	Bore/Test no	Northing	Easting	Ground level (G.L.) in terms of RL(+)
1	Coal Stock Yard with Conveyors and JNTs	ICPLT 1	608	-705	88.33
2	CHP & AHP Structures in Power Block Area	ICPLT2	-158	328	81.08
3		ICPLT3	-158	-36	77.78

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Table No 4 ELECTRICAL RESISTIVITY TEST

Sr no	Structure type	Bore/Test no	Northing	Easting	Ground level (G.L.) in terms of RL(+)
1	Coal Stock Yard with Conveyors and JNTs	IERT 1	808	-111	87.05
2		IERT 2	793	-231	89.59
3		IERT 3	482	279	87.66
4		IERT 4	396	-709	88.89
5	CHP & AHP Structures in Power Block Area	IERT 5	54	-139	82.13
6		IERT 6	20	301	81.04
7		IERT 7	-23	208	80.27
8		IERT 8	101	199	79.03
9		IERT 9	1591	110	80.75
10		IERT 10	232	184	81.91

Table No 5 PRESSUREMETER TEST

Sr no	Structure type	Bore/Test no	Northing	Easting	Ground level (G.L.) in terms of RL(+)
1	Wagon Tippler,Track Hopper and Tunnels	IPMT 1	1027	-155	97.76
2		IPMT 2	969	-338	95.29
3		IPMT 3	834	-611	91.41
4	Coal Stock Yard with Conveyors and JNTs	IPMT 4	409	-2	86.16

Table No 6 CROSS HOLE SHEAR WAVE TEST

Sr no	Structure type	Bore/Test no	Northing	Easting	Ground level (G.L.) in terms of RL(+)
1	Coal Stock Yard with Conveyors and JNTs	ICST 1	639	-753	88.89
2		ICST 2	613	-874	88.27

INVESTIGATION METHODOLOGY AND SUB-SOIL CHARACTERISTICS

Subsurface Exploration

The subsurface condition was evaluated through Fourty eighttest boreholes to the required depth. The borings were drilled using Calyx machine at the stipulated locations. The boring depths were measured from the existing grade at the time of our field activities. The object of site exploration is to provide reliable, specific and detailed information about the soil and rock conditions for foundation design.

Field Investigation

Drilling

Core drilling was completed using rotary type boring machine with diamond bits. Casing of 150mm diameter was advanced up to the firm strata as per IS 1892-1979. In order to extract maximum possible information and to prevent the loss of valuable sub-surface data obtained during the drilling of rock core (NX size) indexing and storing of the cores obtained was done as specified by IS 4078.

Sampling in soils

Undisturbed soil samples

Cohesive soil samples were obtained using thin wall tube samplers, as per IS: 2132 in such a manner that moisture content and structure of soil did not alter. The sampler was slightly oiled from outside to reduce friction. It was then attached to the boring rod, lowered to the bottom of the hole and pressed into the soil. The sampler tubes were serially numbered immediately on their recovery.

Disturbed soil sample

Cohesionless soil samples were obtained from boreholes at each 1 m interval or at the change of strata whichever occurs earlier and stored as per procedure laid down by IS: 1892-1979. The samples were stored in polythene bags and numbered appropriately for proper identification. These samples were used for grain size analysis and chemical analysis.

Standard Penetration Test on Soil

The standard penetration tests were conducted inside exploratory bore holes at depths shown in bore logs as per the procedure stipulated in IS: 2131 - 1981. The disturbed soil sample from tube was carefully stored to carry out further tests. The values of standard penetration blows, N values, at various borehole locations were indicated in the respective bore logs. SPT ‘N’ values were co-related with relative density of non-cohesive stratum and with consistency of cohesive stratum. Co-relations are tabulated in Annexures“General Notes” Table 1 and Table 2.

Sampling in rock

Rock cores

When rock was encountered, size of borehole was changed to NX (76mm) diameters. Double tube and NX sized bits were used for rotary drilling and recovering rock cores, conforming to IS 6926. Recovered rock cores were numbered serially and preserved in good quality sturdy wooden core boxes. Rock Core Recovery and Rock Quality Designation (RQD) were computed for every run length drilled. Rock samples were selected based on the probable founding elevation of the proposed structure.

Rock classification in terms of weathering and state of fractures and strength is carried out as in Annexures“General Notes” Table 3.

Static Plate Load Test:(Reaction Method)

The test is conducted as per IS 1888 – 1982.

The plate load test is carried out at desired pit location. A rigid, 25 mm thick steel plate of 450mm x 450 mm is firmly seated at the center of the pit. The loads on the test plate are applied by reaction loading method to avoid fluctuations, impact, eccentricity etc. The loading frame fabricated on ground for this purpose, has the weight of 1 T. The hydraulic jack has an attached pressure gauge, which is carefully calibrated. A steel ball is placed at the central point of the jack and the frame, to ensure vertical application of the load. The pressures are applied in suitable increments. The pressure is increased to the next higher intensity of pressure step when no appreciable settlement is noted under the applied intensity of pressure over considerable time interval. The settlement, of the test plate is measured with reference to an independent steel slotted angle, anchored in the ground. The settlements are measured using dial gauges having least count of 0.01 mm i.e. measuring to the accuracy of 0.01 mm.

After completion of the test load Vs settlement curve is plotted to the arithmetic scale. From the curves safe bearing capacity is read corresponding to the settlement of plate (Sp) which is calculated for the assumed footing settlement using the following formula.

$$S_p = S_f \left[\frac{B_p}{B_f} X \frac{(B_f + 30)}{(B_p + 30)} \right]^2$$

Where:

S_p = Settlement of plate (mm)

S_f = Settlement of footing (mm)

B_p = Width of plate (cm), and

B_f = Width of footing (cm

For different size of footing settlement of plate is calculated. Corresponding to the calculated settlement of plate the safe bearing capacity is obtained from the load Vs settlement graph.

Cyclic plate load test (Reaction Method)

The cyclic plate load test is carried out at desired at the test depth. A rigid, 25 mm thick steel plate of 450 mm x 450 mm or of desired size is firmly seated at the center of the pit. The loads on the test plate are applied by reaction loading method to avoid fluctuations, impact, eccentricity etc. The loading frame fabricated on ground for this purpose, has the weight of 1 T. The hydraulic jack has an attached pressure gauge, which is carefully calibrated. A steel ball is placed at the central point of the jack and the frame, to ensure vertical application of the load. The pressures are applied in suitable increments. The pressure is increased to the next higher intensity of pressure step when no appreciable settlement is noted under the applied intensity of pressure over considerable time interval. The settlement, of the test plate is measured with reference to an independent steel slotted angle, anchored in the ground. The settlements are measured using dial gauges having least count of 0.01 mm i.e. measuring to the accuracy of 0.01 mm.

Packer Permeability Test

After completion of boring packer's permeability test was carried out as per the IS Method.The water is allowed in the tube well at the pressure intervals of 2 kg/cm2, 4 kg/cm2 and 6 kg/cm2 noted the water meter readings at t = 0, 5, 10 and 15 minutes time interval. Then again water meter mediator was noted at the reduced pressure of 4 and 2 kg/cm2. Finally water intake for the every 15 minutes interval is calculated. Then average intake is evaluated. Based on these observations the daily recharging possible is calculated.From all the three methods of recharging, it is concluded that all the methods are within reasonable limits of variance.

Electrical Resistivity Test (Wenner's Method)

The test was conducted as per IS 1892 & IS 3043The electrical resistivity method is based on the measurement and recording of change in the mean resistivity or apparent specific resistance of various soils. The resistivity is usually defined as the resistance between opposite phases of a unit cube of the material. By the determination of vertical and lateral variations in this resistance it is possible, within certain limitations, to infer the stratification and lateral extent of subsurfacedeposits. Several methods involving different electrode arrangement have been developed for making field resistivity measurements. Among these are the Wanner, Schlumberger, and Lee Methods. Schlumberger method is commonly utilized for most European surveys. This method is also accepted in India.

P	=	2 * 3.142*DE/I
Wherein		
P	=	Mean resistivity Ohm-m
D	=	Distance between the electrodes (cm)
E	=	Potential drop between inner electrode (V)
I	=	Current flowing between outer electrode (A)

Pressure meter test

Pressure meter test shall be carried out at 1m, 3m, 5m, 7m, 9m, 12m, 15m, 18m and 20m depths in all types of strata.The purpose of the pressure meter tests is to determine rock strength parameters.Deformation modulus, E parameter shall be obtained from the tests.The pressure meter and its associated equipment is of electronic type and the size of the pressure meter probe corresponds to NX size of borehole. The pressure meter is capable of applying 350kg/cm^2 radial pressure without distress. The pressure meter equipment is suitable for the rock strata and depth to be tested.The test was conducted in at various depth(s) indicated as directed by the Consultant. The probe was introduced through boreholes advanced by conventional rotary drillings.

After placing the probe at the required elevation, pressure was applied in more than 6 equal pressure increments up to failure point or till the specified maximum pressure of 350 Kg/cm^2 is reached. In a standard test, readings of volume change in relation to the time were taken at 60 seconds after pressure increase for each pressure step.The volume changes at 60 seconds versus pressure is plotted to give the in situ stress-strain curve.

Cross hole shear wave test

The cross hole shear wave test was conducted as per IS 13372 part 1 & 2.This test shall be generally carried out in accordance with IS: 13372to establish the dynamic elastic properties of soil and rock. In thistest, the seismic waves are to be picked up in two adjacent receiverboreholes. The spacing of boreholes shall be determined so as toobtain good results. The boreholes shall be uncased in the portioncarrying the geophones. However it should be kept filled with wateror drilling mud in order to ensure perfect contact between the borehole wall and the geophone. In case of cased hole preferably alow velocity material such as a high impact PVC should be used forcasing and it is essential that it should be well grouted behind inorder to make an intimate contact with the soil.

The charge shall beinstalled within the depth as specified and the waves shall be pickedup from the geophones installed at required depths in receiverboreholes. Knowing the travel time from shot hole to receiver holeand corresponding distance, the velocity of the waves is determinedwhich enables to estimate dynamic elastic modulus, shear modulusand Poisson's ratio. In each receiver borehole multiple geophonesshall be provided at 2m interval (with starting depth as 3m belowground level) to cover the depth and various strata as specified.Intensity of the waves shall be recorded by multiple channelseismograph.

Laboratory Work

The laboratory work scope included analysis of the soil, rock and groundwater samples from the fieldwork for the following parameters:

A)Soil

1. Grain size analysis (GSA)
   a) Sieve analysis
   b) Hydrometer analysis
2. Specific gravity
3. Dry Density
4. Natural Moisture Content
5. Atterberg Limits
   a) Liquid Limit
   b) Plastic Limit
   c) Shrinkage Limit

B) Rock

1. Density
2. Water absorption
3. Specific Gravity
4. Porosity
5. Unconfined Compression Test
6. Point Load Index
7. Modulus of Elasticity
8. Slake Durability Index
9. Hardness test
10. Soundness test

C) Chemical analysis of soil

Chemical analysis test of soil samples including sulphate (SO_3), Chloride and pH

D) Chemical analysis of water

Chemical analysis test of water samples including sulphate (SO_3), Chloride, and pH

E) Foundation Recommendation

1 Depth of foundation
2 Type of foundation
3 Net safe bearing capacity

Laboratory Tests

Tests on Soil samples:

The soil samples collected from boreholes were analyzed for their physical and engineering properties as described below:

Grain Size Analysis

A quantitative determination of the particle size distribution in the soil was made by wet sieve analysis and sedimentation analysis using hydrometer. Procedure laid down by IS: 2720 Part – IV was followed. The particle sizes were designated according to the scale given in IS: 1498 (Table -1).

Particle size distribution

Classification (Identified by behavior)	Denseness	Size of particles in mm
Gravel	Coarse	80 to 20
	Fine	20 to 4.75
Sand	Coarse	4.75 to 2
	Medium	2 to 0.425
	Fine	0.425 to 0.075
Silt & Clay		Less than 0.075

Specific Gravity

Specific gravity of soil was determined by the density bottle method. This test is determined as per test procedure laid in IS: 2720 (Part III/Section 1).

Natural Moisture Content

Natural moisture content was determined by using the oven drying method. This test was carried out as per IS: 2720 (Part - II).

Dry Density

Dry Density was carried out in accordance with the water displacement method stated in IS 2720 (Part V) and was determined for undisturbed samples only.

Atterberg Limits

To understand the plasticity and shrinkage characteristic of the soils, liquid limit, plastic limit and shrinkage limits were determined. Liquid limit is the moisture content at which soil passes from plastic stage to liquid state, as determined by the liquid limit test. Plastic Limit is the moisture content at which the soil becomes too dry to be in a plastic condition, as determined by the Plastic Limit Test. Reduction of moisture content by drying below

Shrinkage Limit is not accompanied by decrease in volume; instead air enters the voids of the system and material becomes partially or fully unsaturated. Liquid Limit and Plastic Limit are determined as per IS: 2720 Part - V and Shrinkage Limit as per IS: 2720 Part VI.

Tests on Rock samples:

Density

Density was determined as per IS 13030.

Water Absorption

Water Absorption was determined as per procedure laid in IS: 1124.

Specific Gravity

Specific gravity was determined as per procedure laid in IS: 1124.

Porosity

Porosity was determined as per test procedure laid in IS: 1122.

Unconfined Compression test

Unconfined Compression test was determined as per test procedure laid in IS: 9143.

Point Load Index

Point Load Index was determined as per test procedure laid in IS: 8764 (1998).

Modulus of Elasticity

Modulus of Elasticity wasdetermined as per test procedure laid in IS: 9221 (1979).

Slake Durability Index

Slake Durability Index was determined as per test procedure laid in IS: 10050 (1981).

Chemical Analysis:

Tests on Soil

Chloride Content, Sulphate content and pH value were determined as per test procedure laid in IS: 2720 (Part XXVI and Part XXVII).

Tests on Water

Chloride Content, Sulphate content, and pH value were determined as per test procedure laid in IS: 3025 (Part XXVI and Part XXXII).

GEOLOGICAL REPORT

GEOLOGY OF THE STUDIED SECTION:

The proposed site for Thermal Power Plant lies over Stage Nandyal shale of Kundair Series in Kurnool System. The Kurnool have been sub-divided into four series, composed mainly of limestones with sub-ordinate shale and sandstones. Outcrops of Kurnool rocks, sometimes called PALNAD SERIES, are developed in Palnad, in the north-east of the Cuddapah basin, stretching on both sides of the Krishna river. They lie unconformably on the Cuddapahs.

GENERAL DESCRIPTION OF ENCOUNTERED ROCK:

Sandstone:

Sandstone is the abundant rock type encountered within the area of interest. It is essentiallycomposed of quartz with decomposed and altered feldspar and mica as minor constituents;rare dark minerals are not uncommon. Depending on the intensity of weathering the bodycolor of the rock varies from light grey to brownish grey. The rock is dominantly fine tomedium grained, some are very fine; apparently massive and medium spaced bedded.Sometimes thick to moderately thick beds are very thinly inter banded and a few instancesshows sets of cross bedding. Grains are mostly sub rounded-to-rounded. Frequently thesandstone contains extremely fine-grained shale clasts of variable sizes and also stringersand layers of it. The orientation of such clasts is dominantly bed parallel. A general trend offining -up sequence is observed. In general the sandstone is matrix supported, moderately to medium hard, moderately strong (at fresh end), medium to tightly compacted and moderately porous with medium low specific gravity. Depending on weathering the strength parameters also reduced a great extent.

Shale :

The color of the shale varies depending on degree of weathering though remains reddish brown. Grain size of the rock varies from extremely fine to fine grains contains good amount of silt / very sand size grains particularly at the gradual transition from sandstone to shale. It is very thinly laminated but not cleaved. The shale frequently contains stringers of sand / silt and less frequently clasts of sandstone / siltstone. Mineralogical composition of shale is not identified due to its extreme fine (shale) nature. The rock is soft, densely compacted and depending on degree of weathering it may be weak, usually strong to very strong. Preferably and easily split along the almost horizontal to very low angle (<5°) lamination planes. Weathered shale easily breaks under finger pressure or even disintegrates into rock particles when kept in water and at dry conditions the surface of the shale is marked with sun-cracks. Compositionally shale is homogeneous and structurally isotropic but intervention with silt / sand is dominant at some depths. Porosity of the shale is very low and the specific gravity is medium.

Limestone:

The color of the limestone varies depending on degree of weathering though remains white in colour.Limestone consist essentially of calcium carbonate with some magnesium carbonate and quartz grains. The average chemical analysis shows 92% of CaCo3 and MgCo3 together, and 5% SiO3 the proportion of magnsium carbonate is small except in magnesium and dolometic limestones.

Limestones are bedded rock often containing many fossile ; they are readily scratched with a knife , effervesce on the addition of cold dilute hydrochloric acid (except dolomite). They are formed both chemically and organically.

Calcium carbonate is present in the form of crystals (aragonite and calcite) and as amorphouse calcium carbonate , and also as the hard parts of organisms (fossils) such as shells and calcareous skeletons, on their broken fragments.Thus consolidated shells isa limestones by virtue of the calcium carbonate of which the shells are made. Onthe other hand chemically deposited calcium carbonate builds limestone under conditions where water of high alkalinity has restricted circulation as in a shallow sea or lake. Impurities commonly present in limestone include clay, silica in colloidal form or as quartz grains on the other hand detrital grains. Though usually grey or white in colour the rock may be tinted by iron compounds or finely devided carbon or by bitumen.

Quartzite

It is formed by contact or hydrothermal metamorphism. It is composed of quartz grains so firmly cemented that when broken, it fractures through the grains instead of around them.

The colour of the rock varies according to the nature of the impurities, pure impurieties, pure quartzite is white.Quartzite is quite resistant action. It is used for paving blocks and for manufacturing of silica bricks.

GEOLOGY OF TELANGANA

Nalgonda area bounded by latitudes 16°45' ;17°12 and longitudes 79°00' ; 80°00 E over an area of about 5000 sq.km. The area forms a part of the Eastern Dharwar Craton and comprises mainly rocks of older Metamorphics, Peninsular Gneissic Complex and minor schist belts occurring as linear NNW-SSE trending belt at Medavaram (16°57'30"; 79°40'35", 56 P/9). The hornblende schist and amphibolites (older metamorphics), which are the oldest rocks, occur as rafts, enclaves and discontinuous linear bands within the Gneissic Complex. The Gneissic Complex is represented by migmatites, granites, granodiorite, tonalite-trondhjemite suite of rocks and hornblende-biotite schists. The schist belts comprise metabasalt, metarhyolite and banded haematite quartzite. These are intruded by younger granites, basic dykes and quartz pegmatite veins and the rocks of the Gneissic Complex are unconformably overlain by the sedimentary rocks of the CuddapahSupergroup and Kurnool Group in the southeastern part of the area.

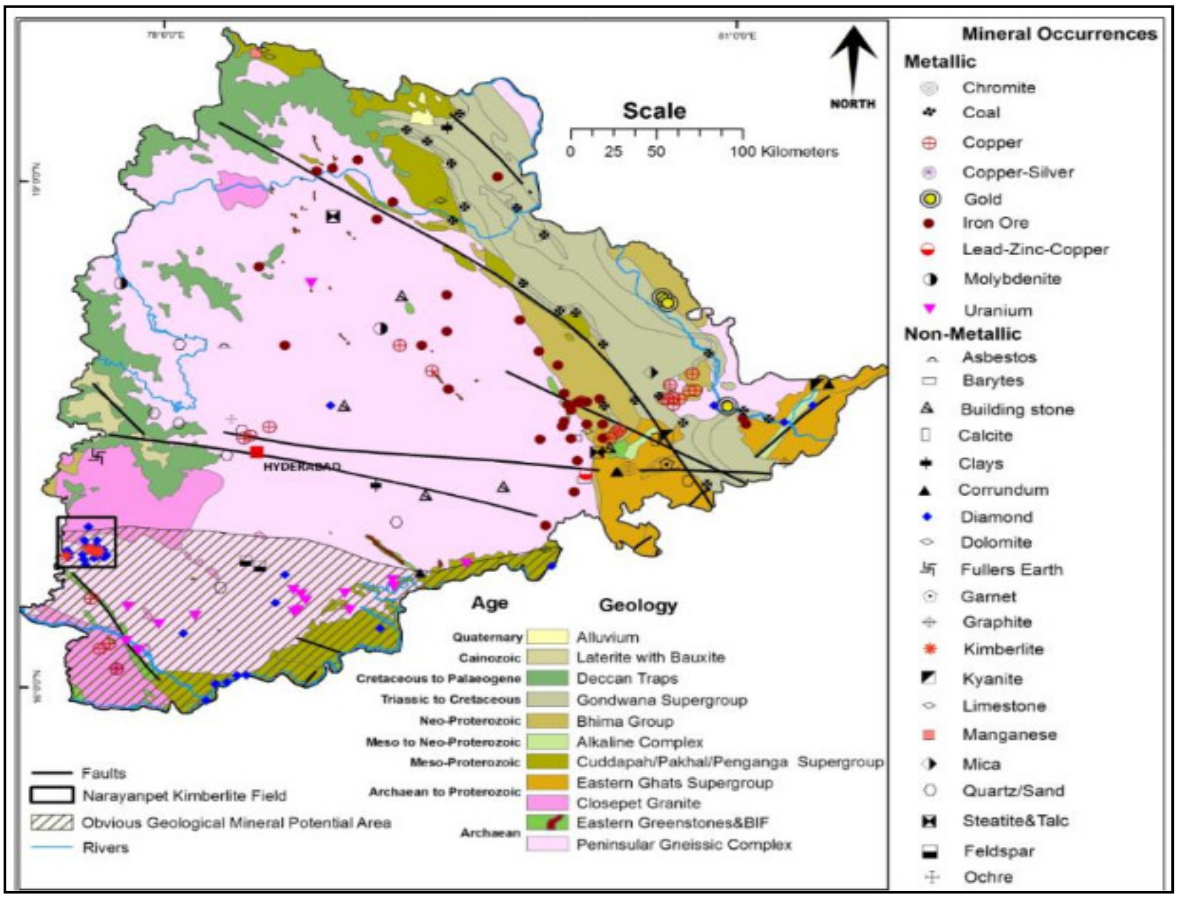

Fig. 1 Gelogical map showing mineral occurrence in Telangana Site

Table 1.Relation between Soil Properties and Penetration Resistance on Basis of Standard Penetration Test for Sand/Non Plastic Silt According to Geotechnique journal Vol XXXVI No.3, Sept. 1986.

Relative Density	Penetration Value	Relative Density I_D %
Very Loose	0 to 4	0-15
Loose	4 to 10	15-35
Medium	10 to 30	35-65
Dense	30 to 50	65-85
Very Dense	50 and above	85-100

Table 2. Relation Between soil properties and Penetration resistance on basis of Standard Penetration Test for Clay / Plastic Silt.

Consistency	Number. of Blows (SPT)
Very Soft	0 to 2
Soft	2 to 4
Medium	4 to 8
Stiff	8 to 15
Very Stiff	15 to 30
Hard	30 and above

Table 3 Rock quality in terms of Weathering Grades of Rock Mass According to I.S. 4464.

Terms	Description	Grade	Interpretation
Fresh	No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces.	I	*CR > 60%*
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. Weathering may discolour all the rock material.	II	CR between 40% to 60%
Moderately Weathered	Less than half of the rock material is decomposed or disintegrated to a soil. Fresh or discoloured rock is present either as a continuous framework or as core stones.	III	CR between 25% to 40%
Highly Weathered	More than half of the rock material is decomposed or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as core stones.	IV	CR between 11% to 25%
Completely Weathered	All rock material is decomposed and / or disintegrated to soil. The original mass structure is still largely intact.	V	CR between Zero to 10%
Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI	CR = Zero % But N > 50

It should be understood that all grades of weathering may not be seen in a given rock mass and that in some cases a particular grade may be present to a very small extent. Distribution

of the various weathering grades of rock material in the rock mass may be related to the porosity of the material and the presence of open discontinuities of all types in the rock mass.

Table 4 Ground Water Limits According to IS 456 - 2000

Test	Value
pH	6 to 8
Cl ppm	500
SO_3 ppm	400

Table 5.Chemical Content Limits for soils According to IS 456 - 2000

Test	Value
pH	6.5 to 8.30
Cl %	0.2
SO_3 %	0.04
Salinity %	3.30

CHEMICAL TESTS:

Chemical tests were performed on few soil and water samples for determining the pH value, Sulphate, Chloride, carbonate content etc. The results are given in a tabular form below:

Chemical Analysis of soil

BH. No.	Depth	Total Carbonates (as CaCO3)	Sulphate (as SO4)	Sulphite (as SO3)	Chloride (as Cl)	Nitrate (as NO3)	Nitrite (as NO2)	p H Value (By Digital p H Meter)	Turbidity (as N T U)	Total Organic matter
		ppm	ppm	ppm	ppm	ppm	ppm	6.50 – 8.30	max 1000	ppm
IBH 1	5.80	167	37	30.83	128	0.041	0.030	7.81	361	59
IBH 10	5.10	156	31	25.83	123	0.047	0.035	7.9	370	60
IBH 12	5.00	159	50	41.67	135	0.051	0.038	7.7	377	62
IBH 26	3.60	152	31	25.83	117	0.027	0.020	7.45	347	51
IBH 44	4.00	162	39	32.50	122	0.038	0.028	7.5	344	49

Nature of the Sample Water

Results of Analysis	*Water IBH 45*	Depth (m): 1.00
Sulphate (as SO4)	0.034	%
Chloride (as Cl)	0.16	%
p H Value (By Digital p H Meter)	7.4	**6.50 – 8.30**

It is seen that the values are within permissible limits (as per IS:456-2000) and so no special cement will be required for foundation concrete. either ordinary Portland cement or Portland slag cement or Portland Pozzolana cement can be used for concreting.

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Sr. No.	IBH No.	Depth (m)	Core Piece No.	Water Absorption or Moisture content (%)	Specific Gravity	Hardness (Moh's scale)	Soundness %	Porosity (%)	Dry Density (g/cc)	Slake Durability (I_d)	Point Load Index at in situ water content (MPa)	Point Load Index at saturated water content (MPa)	Deformability or Evalue (Mpa) at in situ water content	Deformability or Evalue (Mpa) at saturated water content	UCS (MPa) at in situ water content	UCS (MPa) at saturated condition	Core Description
1	1	3.00 to 3.75	7	0.31	2.61			1.15	2.58								Quartzite
2	1	11.25 to 12.00	38				15					5					Quartzite
3	2	2.25 to 3.00	7	1.20	2.56			1.17	2.53								Quartzite
4	3	5.25 to 6.00	13				7							1.43E+04		118	Quartzite
5	3	6.75 to7.50	17								2						Limestone
6	4	9.75 to 10.50	31	0.48	2.63		4	1.14	2.60								Limestone
7	5	3.00 to 3.75	17			4					2						Limestone
8	5	6.00 to 6.75	30									4				107	Quartzite
1	6	3.75 to 4.50	16				5						1.46E+04			19	Quartzite
2	7	3.00 to 3.75	16								3						Quartzite
3	8	3.75 to 4.50	7			7					4						Quartzite
4	9	3.00 to 3.75	5							15							Limestone
5	9	8.25 to 9.00	13			7	10										Quartzite
6	10	1.50 to 2.25	10	0.41	2.72			1.10	2.69								Quartzite
7	10	4.50 to 5.25	37									2					Quartzite
8	11	6.00 to 6.75	25	0.74	2.56			1.17	2.53								Quartzite
9	11	7.50 to 8.25	31			7									21		Quartzite
10	12	7.50 to 8.25	29	0.27	2.56			1.17	2.53								Quartzite
11	12	9.00 to 9.75	35				7					5				115	Quartzite
12	13	0.75 to 1.50	10				11			20	1						Limestone
13	13	9.75 to 10.50	31			3				19							Limestone
14	13	9.75 to 10.50	31							22						79	Limestone
15	14	5.25 to 6.00	26	4.17	2.53			1.23	2.40								Limestone
16	14	9.00 to 9.75	49											1.60E+04	83		Limestone
17	14	9.00 to 9.75	49			3									32		Limestone
18	15	3.75 to 4.50	25				10							1.60E+04	86		Limestone
19	15	4.50 to 5.25	19	0.32	2.51			1.20	2.48								Limestone
20	15	6.00 to 6.75	39			6						4					Quartzite
21	16	2.25 to 3.00	5							15			1.43E+04		88		Quartzite
22	17	6.75 to 7.50	24	0.99	2.56			1.17	2.53								Quartzite
23	17	9.00 to 9.75	35							20							Quartzite
24	18	4.50 to 5.25	10										1.67E+04		154		Quartzite
25	18	6.00 to 6.75	31			3	7				2						Limestone
26	19	3.75 to 4.50	21											1.25E+05		77	Limestone
27	19	3.00 to 3.75	15	0.41	2.55			1.18	2.52								Limestone
28	20	3.75 to 4.50	6										1.15E+04		71		Limestone
29	20	7.50 to 8.25	10	2.38	2.53			1.23	2.40								Limestone
30	21	5.25 to 6.00	21											9.67E+04		75	Quartzite

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Sr. No.	IBH No.	Depth (m)	Core Piece No.	Water Absorption or Moisture content (%)	Specific Gravity	Hardness (Moh's scale)	Soundness %	Porosity (%)	Dry Density (g/cc)	Slake Durability (I_d)	Point Load Index at in situ water content (MPa)	Point Load Index at saturated water content (MPa)	Deformability or Evalue (Mpa) at in situ water content	Deformability or Evalue (Mpa) at saturated water content	UCS (MPa) at in situ water content	UCS (MPa) at saturated condition	Core Description
31	22	2.25 to 3.00	6										1.09E+04		29		Quartzite
32	22	4.50 to 5.25	12			7	11										Quartzite
33	23	8.25 to 9.00	30			3										113	Limestone
34	23	6.75 to 7.50	21	1.12	2.57		12	1.17	2.54								Limestone
35	24	1.50 to 2.25	3							22							Quartzite
36	24	2.25 to 3.00	9	0.32	2.60			1.16	2.57								Quartzite
37	25	0.75 to 1.50	5			7					2						Quartzite
38	25	6.00 to 6.75	25	0.34	2.57		9	1.17	2.54								Limestone
39	26	5.25 to 6.00	13			6											Quartzite
40	26	9.00 to 9.75	33											1.62E+04		143	Quartzite
41	27	4.50 to 5.25	13	0.50	2.59			1.26	2.36						22		Limestone
42	27	5.25 to 6.00	17			3						2					Limestone
43	27	4.50 to 5.25	13									5					Limestone
44	28	3.00 to 3.75	9	1.74	2.58		14	1.20	2.46								Quartzite
45	29	5.25 to 6.00	33			6					9						Quartzite
46	29	6.00 to 6.75	38				13								56		Quartzite
47	30	3.00 to 3.75	9			3				18							Limestone
48	30	4.50 to 5.25	18	0.30	2.50			1.20	2.47								Quartzite
49	31	4.50 to 5.25	20	0.47	2.54			1.40	2.11								Limestone
50	31	3.75 to 4.50	16									5		1.43E+04		115	Limestone
51	32	3.75 to 4.50	12	0.33	2.58			1.16	2.55								Quartzite
52	32	5.25 to 6.00	16							18						32	Quartzite
53	33	1.50 to 2.25	4			7						4	6.00E+04			91	Quartzite
54	34	5.25 to 6.00	26	0.29	2.60		12	1.15	2.57						86		Quartzite
55	34	1.50 to 2.25	7			6						1					Quartzite
56	35	2.25 to 3.00	8													115	Quartzite
57	35	0.75 to 1.50	2				13				2						Quartzite
58	36	4.50 to 5.25	9			6									103		Quartzite
59	36	2.25 to 3.00	6	0.44	2.67			1.12	2.64					1.16E+04		28	Quartzite
60	37	3.75 to 4.50	19	0.48	2.57			1.27	2.34								Quartzite
61	37	4.50 to 5.25	25			3									35		Quartzite
62	38	1.50 to 2.25	14	0.67	2.62		2	1.15	2.59	20		2					Quartzite
63	39	3.75 to 4.50	15				4			18	3						Quartzite
64	40	4.50 to 6.00	43			6				22							Quartzite
65	40	9.00 to 10.00	70										1.57E+04		120		Shale
66	41	3.00 to 3.75	16				4						1.33E+05		197		Quartzite
67	42	2.25 to 3.00	30			7				15					8		Limestone
68	43	3.00 to 3.75	12	0.41	2.55			1.18	2.52					1.20E+05		28	Limestone
69	44	0.00 to 0.75	3				9			19				1.46E+05		80	Quartzite
70	45	6.00 to 6.75	66							15							Quartzite
71	45	9.00 to 10.00	88			4	8				3						Shale
72	46	8.25 to 9.00	20			7							7.00E+04		63		Limestone
73	47	6.00 to 7.50	71	0.60	2.59			1.16	2.56	16	8			1.54E+04		65	Shale
74	48	3.00 to 3.75	13	0.76	2.60			1.16	2.57								Limestone

Based on the bore log details and laboratory test results of soil & rock samples, it has been observed that the entire project area is having more or less same profile and following design parameters are obtained to arrive Net safe bearing capacity of isolated and raft footings.

Design parameters (ISG area)

Areas covered – Wagon Tippler,Track Hopper and Tunnels, Coal Stock Yard with Conveyors and JNTs, CHP & AHP Structures in Power Block Area

GENERALIZED PROFILE OF VARIOUS SOIL/ROCK LAYERS ENCOUNTERED AT SITE

Stratum I

It consists of dense sandy silt with completely weathered rock from existing ground level to 1.00m.The Standard penetration tests conducted in this stratum show generally refusal but the lowest value being 81. The DS samples collected show the following properties

Non plastic characteristics.

Grain size

Gravel: 4.21%

Sand: 47.17%

Silt + clay : 48.63%

Atterberg limits: Non plastic in nature

Specific gravity: 2.66

Stratum II

It consists of Highly to moderately weathered light grey fine grained rock from 2.0m to 7.50m. The core recovery varies from 4% to 58% and RQD in the range of Nil to 48%

The following tests were carried out and the average values are given below:

Water absorption (%): 0.71

Specific Gravity: 2.59

Hardness (MOH's Scale): 8

Soundness (%): 8

Porosity (%): 1.17

Dry density (g/cc): 2.54

Slake Durability (%): 18.39

Point Load Index (Mpa, in- situ): 2.62

Point Load Index (Mpa, 7days saturation): 3.54

Deformability (Mpa, in- situ): 7.72E+04

Deformability (Mpa, 7days saturation):6.32E+04

UUCS (Mpa, in- situ): 84.61

UCS (Mpa, 7days saturation): 83.18

Stratum III

It consists of Slightly weathered to Fresh fine grained rock from 4.50m to 20.0m. The core recovery varies from 24% to 89% and RQD in the range of Nil to 74%

The following tests were carried out and the average values are given below:

Water absorption (%) : 0.6

Specific Gravity: 2.59

Hardness (MOH's Scale): 6

Soundness (%): 6

Porosity (%): 1.16

Dry density (g/cc): 2.56

Slake Durability (%): 17.75

Point Load Index (Mpa, in- situ): 4.5

Deformability (Mpa, in- situ): 4.29E+04

Deformability (Mpa, 7days saturation):1.54E+04

UCS (Mpa, in- situ) : 91.4

UCS (Mpa, 7days saturation): 65.3

Design parameters (ISG area)

Areas covered – Wagon Tippler,Track Hopper and Tunnels, Coal Stock Yard with Conveyors and JNTs, CHP & AHP Strutures in Power Block Area

Sub soil Profile for ISG area

Ground Level (GL): varies

Stratum	Description	Depth (m)	Thickness of layer (m)	SPT N value	CR (%)	RQD (%)
I	Sandy silt	GL to 1.0 m	1.0	81		
II	Highly weathered fine grained rock having UCS value 500 kg/sqcm upto 3.5m depth below ground level.	1.0 to 3.5 m	2.5		21 to 58	Nil to 26
III	Moderately weathered to fresh fine grained rock having UCS value 700 kg/sqcm below 3.5m depth below ground level.	3.5 m to 11.0 m	7.5	-	21 to 89	NIL to 74

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Safe Bearing Capacity Calculations

SAFE BEARING CAPACITY IS EVALUATED FROM SHEAR FAILURE CRITERION.

				soil	
		square		**s**	
c=			=	**0**	t/sqm
∅=	ANGLE OF SHEARING RESISTANCE	r	=	**30**	degrees
D_f=	DEPTH OF FOUNDATION		=	**1**	m
r =	SATURATED DENSITY		=	**1.00**	t/m^3
f_s=	FACTOR OF SAFETY		=	**2.5**	
W'=	WATER TABLE CORRECTION		=	**0.5**	
α	inclination angle		=	**0**	
q=	OVER BURDEN PRESSURE	=r*Df	=	**1.00**	t/m^2
B=	WIDTH OF FOUNDATION		=	**10**	m
L=	LENGTH OF FOUNDATION		=		
$\sqrt{N_\phi}$=	$\tan(\pi/4 + \phi/2)$		=	1.7320508	
N_c=			=	30.14	
N_q=	BEARING CAPACITY FACTORS		=	18.4	
N_γ=	BEARING CAPACITY FACTORS		=	22.4	
S_c=	SHAPE FACTOR		=	1.3	
S_q=	SHAPE FACTOR	=1+(B/L)*0.2	=	1.2	
S_γ=	SHAPE FACTOR	=1-0.4*(B/L)	=	0.8	

	dc	dq	dg	ic	iq	ig
	1.03	1.017321	1.017321	1	1	1

q_{ult}= $cN_c s_c d_c i_c + q(N_q - 1) s_q d_q i_q + 0.5 B\gamma N_\gamma s_\gamma d_\gamma i_\gamma W'$ =

$cN_c s_c d_c i_c$		0	30.14	1.3	1.03	1		0
$q(N_q - 1) s_q d_q i_q$		1.00	17.4	1.2	1.01732	1		21.24165
$0.5 B\gamma N_\gamma s_\gamma d_\gamma i_\gamma$	W'	0.5	10	1.00	22.4	0.8	0.5	45.57596
		1.017321	1					66.81761

		q_{ult}=	66.82	T/sqm
	WITH FS = 2.5	q_{ns} safe=	**26.727044**	
q_{ns} safe=	Net Safe Bearing Capcity		**20.00**	T/sqm

SETTLEMENT ANALYSIS

Schmertmann's method of settlement calculations is presented.

$$s = C_1 * C_2 * \Delta P \sum_{i=1}^{n} \frac{Izi * \Delta zi}{\Sigma E}$$

s=	settlement,cms	=			
B=	Width of foundation			10	m
d'o=	Depth upto foundation level	=		1	m
γ_o=	Density upto foundation level	=		1.00	t/m^3
σ'_o=	insitu overburden pressure at foundation level	=		1	t/m^2
C_1=	**embedment factor**	**=**			
C_1=	$1-0.5*\sigma_o/(\Delta p)$	> or = 0.5			0.975
				0.975	
t=	time in years	=		**50**	years
C_2=	**long term settlement factor**	**=**			
C_2=	$1+.2 \log_{10}(t / 0.1)$				1.540
Δp=	**net foundation pressure**	**=**		**20.0**	**t/m^2**
Δ zi=	**thickness of ith layer**	**=**			
Δz_1=	thickness of 1st layer	=		5	m
Δz_2=	thickness of 2nd layer	=		5	m
Δz_3=	thickness of 3rd layer	=		5	m
Δz_4=	thickness of4th layer	=		5	m
Ezi=	**Modulus of elasticity of ith layer**				
Ez_1=	Modulus of elasticity of 1st layer	=		2538597.8	t/m^2
Ez_2=	Modulus of elasticity of 2nd layer	=		3170000	t/m^2
Ez_3=	Modulus of elasticity of 3rd layer	=		3170000	t/m^2
Ez_4=	Modulus of elasticity of 4th layer	=		3170000	t/m^2
Izi=	**Influence factor in ith layer**	**=**			
d'o=	Depth upto B/2 below foundation level	=		5	m
γ_1=	Density from foundation level to B/2 below the foundation level	=		**1.00**	**t/m^3**
$\sigma' v_p$=	insitu vertical stress at B/2 below the foundation level	=		6.00	
Iz =	Influence factor at *b/2 level* below the foundation				
Iz =	$0.5+0.1*\sqrt{(\Delta p / \sigma' v_p)}$	=			0.68

0

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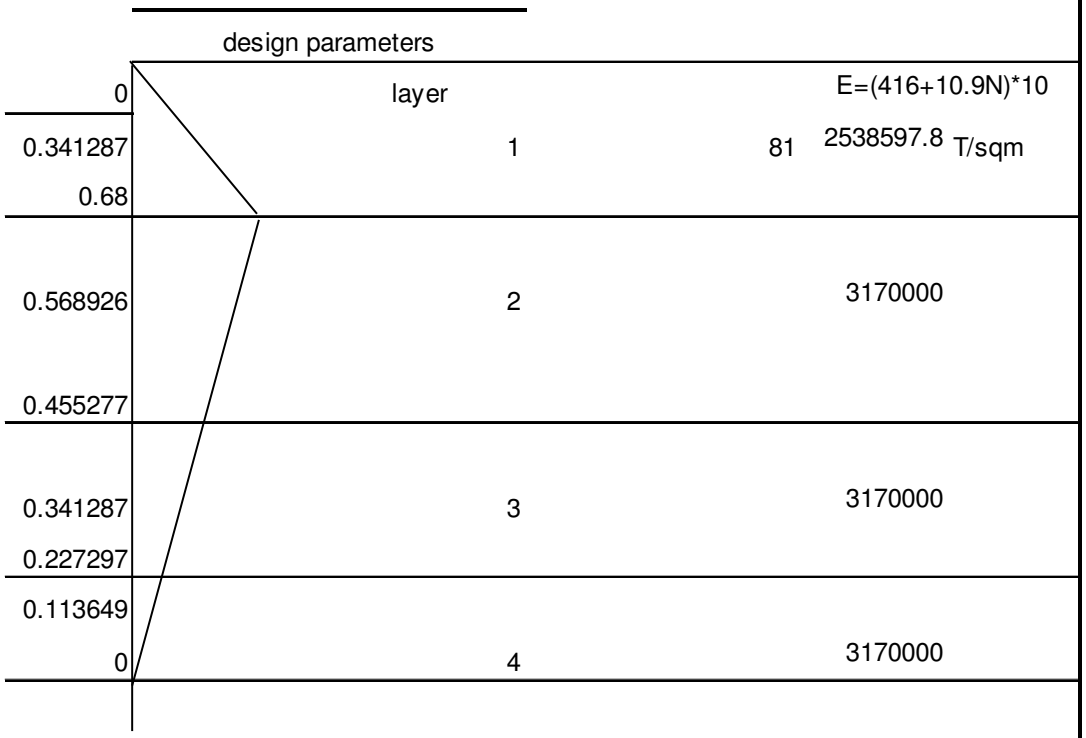

layer	Izi	Δzi	Ei	Iz*Δ zi/Ezi
1	0.341287	500	2538597.8	6.722E-05
2	0.568926	500	3170000	8.974E-05
3	0.341287	500	3170000	5.383E-05
4	0.113649	500	3170000	1.793E-05
			n	**0.0002108**

$s = C_1 * C_2 * \Delta P * \sum_{i=1}^{n} \frac{izi*\Delta zi}{Ezi}$

s=	0.975	1.540	20.0	0.0002108	0.0063291 cm

Depth correction factors 0.97 Rigidity factor 0.8 **0.06** mm

SBC for 0.06 mm settlement = 20.00 T/sqm

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Settlement analysis by IS 8009 (Part 1) figure 9				
Standard penetration	N	=	81	
Effective overburden pressure		=	1	kg/cm^2
Correction factor		=	1	as per IS 2131 fig 1
Corrected N value		=	81	
Settlement for $1kg/cm^2$		=	5	mm
Water table correction factor		=	0.5	as per IS 8009 (Part 1) fig. 9 and clause 9.1.4
Settlement for $20t/m^2$		=	5	mm
Immediate settlement		=	0.06	mm
Total settlement		=	5.06	mm
Depth factor		=	0.97	
Rigidity factor		=	0.8	
Corrected Total settlement		=	3.93	mm for 20 t/m^2

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SAMPLE CALCULATION OF BEARING CAPACITY ISG SCOPE STRUCTURES

BEARING CAPACITY CALCULATION BASED ON CORE STRENGTH OF ROCK MASS

As per IS 12070:1987, Clause 6

For rock mass with favourable characteristics:

1 rock surface is parallel to the base of the foundation
2 load has no tangential component
3 rock mass has no open discontinuities

$$q_s = q_o * N_j$$

q_s = safe bearing pressure (gross)

q_o = average uniaxial compressive strength of rock cores

N_j = empirical coefficient depending on the spacing of discontinuities

$$N_j = \frac{3+S/B_t}{10\sqrt{(1+300\,\delta/S)}}$$

assumed FOS = 3

δ	=	thickness of discontinuities	=	1	cm
S	=	spacing of discontinuities	=	30	cm
B_t	=	footing width considered	=	1000	cm
N_j	=	(3+30/1000)/ (10*SQRT(1+300*1/30))	=	0.0914	

Relationship valid for rock mass with:

1 spacing of discontinuities greater than 0.3m = 30cm
2 aperture (opening) of discontinuities less than 10mm
(15mm filled with soil or rock debris)
3 foundation width greater than 0.3m = 30cm

Considerations for correction factors:				
1	Submergence =		c_1	0.5
2	Cavity =		c_2	0.5
3	Slope =		c_3	0.5

.....(clause 9.2)

Sl. No	Depth of footing below EGL (m)	UCS (q_o) (kg/cm^2)	$q_s = q_o * N_j$ (kg/cm^2)	Net safe bearing capacity ($q_{ns}=qs*c_1*c_2*c_3$) (kg/cm^2)	Net safe bearing capacity, q_{ns} (t/m^2)
1	1				NA
2	2	500	45.68	5.71	57
3	3	500	45.68	5.71	57
4	4	700	63.95	7.99	80
5	5	900	82.22	10.28	103
6	5m and above	900	82.22	10.28	103

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BEARING CAPACITY CALCULATION BASED ON RMR METHOD FOR ROCK STRATA IN ISG SCOPE AREA

Depth (M)			UCS Mpa	Rating for Comp. Strength	RQD (%)			Rating Drilling Quality	Spacing of Discon tinuity m	Rating for Spacing	Oreintation of Discon tinuity	Rating for Oreintation	Condition of Discon tinuity	Rating for Condition	Ground water Condition	Rating for Ground water	RMR Value	SBC T/m2
				1				2		3		4		5		6	Col (1+2+3+4+5+6)	
	To					To												
1.0	-	2.0	50	4	0	-	25	3	0.06 - 0.2	8	Fair	-7	slickened	10			25	66
2.0	-	3.0	50	4	0	-	25	3	0.06 - 0.2	8	Fair	-7	slickened	10	wet	7	25	66
3.0	-	4.0	70	7	0	-	25	3	0.06 - 0.2	8	Fair	-7	slickened	10			28	80
4.0	-	5.0	90	7	0	-	25	3	0.06 - 0.2	8	Fair	-7	slickened	10			28	80
5.0	-	>5	90	7	0	-	25	3	0.06 - 0.2	8	Fair	-7	slickened	10			28	80

RECOMMENDATIONS FOR NET SAFE BEARING CAPACITY

Recommended net safe bearing capacity for Isolated and raft footings for all areas

GL: varies

S. No.	Depth of foundation below EGL (m)	Recommended Net safe bearing capacity (T/m2)
1	1	20
2	2	50
3	3	55
4	4	80
5	5 m or below	80

Note: In case any soil/loose pocket is observed at the founding level, the same shall be removed and filled with PCC up to the required founding level.

Suitability of the soil for construction of roads and embankments:

Suitability of the soil for construction of roads and embankments ,their stable slopes for shallow and deep excavations, active andpassive earth pressures, earth pressure at rest are furnished.

For $\phi = 30$

$K_a = \tan^2(45-\phi/2) = 0.928$

$K_p = \tan^2(45+\phi/2) = 1.072$

$K_0 = 1-\sin\phi = 0.500$

For $\phi = 45$

$K_a = \tan^2(45-\phi/2) = 0.828$

$K_p = \tan^2(45+\phi/2) = 1.172$

$K_0 = 1-\sin\phi = 0.293$

Sand is suitable with factor of safety 1.5

Suitability of locally available soils at site for filling and backfilling purposes:

On an average basis, soil hasgravel content 5.09%, sand, 54.20%, silt 16.51% and clay 24.20%. The Atterberg Limits shows soil to be non plastic in nature. The Specific gravity is 2.67. The soil is non swelling and chemically non reactive. Hence it is suitable for backfilling purpose.

Identification of any other potential geotechnical problems and their remedial measures are as follows:

- Limestones shall have soluble cavities. Piping is to be checked for water retaining structures.
- Limestone shall be friable at high temperature. Stability of rock as high temperature is not assumed.
- Necessary buffer layer over limestone is to be designed and provided. A bentonite cake is one of the useful provisions.
- Shale has a tendency to soften on exposure to alternate wetting and drying.

Protective measures based on chemical nature of soil and groundwater:

Protective measures based on chemical nature of soil and groundwater with due regard to the potential deleterious effects on concrete, steel and other building materials etc.

- The aggressive chemicals especially sulphates are within the permissible limits of 0.20%. The aggressive chemicals are within the permissible limits as per IS 456-2000. Hence no precautions in the form of extra cover or anticorrosive treatment to the reinforcement are necessary. The type of cement to be used for the concreting is Ordinary Portland Cement (OPC).
- Hence, no protective measures are required.

Suitability of quartzite as aggregate:

Hard rock encountered at the site is quartzite. It can be used as an aggregate in

a) Road construction
b) Concreting in construction field

because of the following reasons:

i. Density is more than 2.5 gm/cc
ii. Water absorption is less than 1%.
iii. Specific gravity is greater than 2.5
iv. Hardness is about 6-7
v. Soundness is less than 12%
vi. Rock has good unconfined Compressive Strength
vii. Good CBR values

Suitability of soil/weathered rock as back filling material

i. Specific gravity is 2.66
ii. It is non plastic in nature.
iii. It is non swelling soil
iv. Good proctor density
v. Sufficient Safe bearing capacity
vi. Chemically not aggressive.

General Note:

1. The sub soil formation at the project site consists of Highly Weathered Light grey fine grained Quartzite rock followed by moderately weathered rock and further slightly weathered to fresh Quartzite up to termination depth of bore holes. At some bore holes, Limestone/shale/Basalt is also encountered.
2. The minimum depth of foundation shall be 1 m below Existing Ground Level (EGL).
3. The project site is located in Seismic Zone–II as per IS 1893 Part-1, 2002. Considering very little soil horizon and predominantly Highly weathered to moderately weathered rock at shallow depth, the possibility of liquefaction is ruled out.
4. The existing top layer is highly weathered rock and is suitable for filling/backfilling purposes.
5. Considering the presence of weathered rock from Ground level in almost all bore holes, blasting may be required during excavation. Slope during excavation may be kept as 1:0.5 depending upon type of rock strata.
6. Electrical Resistivity Test results shall be referred from Vol-II
7. Cyclic Plate load test results, Pressure meter test results, Seismic refraction test results and Cross hole shear test results shall be referred from Volume-III
8. For design of Machine foundations, Cross Hole Shear Test results shall be referred.

REFERENCES

IS : 2131	-	Standard Penetration Test
IS : 2720 Part – II	-	Determination of Moisture Content of soil.
IS : 2720 Part – III	-	Determination of Specific Gravity of Soil.
IS : 2720 Part – V	-	Determination of Liquid Limit and Plastic Limit of Soil.
IS : 2720 Part – VI	-	Determination of Shrinkage Limit of Soil.
IS : 2720 Part – IV	-	Grain Size Analysis of Soil.
IS : 2720 Part – XXVII	-	Determination of Sulphate Content of Soil.
IS : 2720 Part – XXVI	-	Determination of pH Value of Soil.
IS : 3025 Part – 24	-	Determination of Sulphate Content of Water.
IS : 3025 Part – 32	-	Determination of Chloride Content of Water.
IS : 1498 – 1970	-	Indian Classification system.
BIS13030 : 1991	-	Determination of Water Absorption and Porosity on Rock
BIS 13030 : 1991	-	Determination of Unit weight of Rock.
BIS 9143 : 1979	-	Determination of Unconfined Compressive Strength of Rock core
Dr. N. V. Nayak	-	Foundation Manual

TECHNICAL SPECIFICATION

FOR LABOUR COLONY

Bharat Heavy Electricals Limited

Project Management Department

Power Sector – Southern Region

690, Anna Salai, Nandanam

Chennai – 600 035

1 BROAD DESCRIPTION OF WORK

Providing labour colony is in the scope of the bidder. The labour colony area is divided in to various blocks and Bidder shall be allotted the blocks according to the size of the man power planned for mobilisation of the awarded work. The following are the broad description of the labour facilities to be provided by the bidder.

1. Pre-Fabricated shed of Standard size of 40m x 11 m consisting 10 Nos of rooms sizing 4mx4m each as per the specification/drawing No. BHEL/PSSR/CVL/LABCOL/03, Rev-00. Bidder may alter size of the shed according to the size of the manpower.
2. Toilet blocks, each sizing 1.5m x 1.5m as per the specification/drawing No. BHEL/PSSR/CVL/LABCOL/02, Rev-00
3. Washing Area & Bathing Area as per the specification/drawing No. BHEL/PSSR/CVL/LABCOL/02, Rev-00
4. Cooking cum Dining Area as per the specification/drawing No. BHEL/PSSR/CVL/LABCOL/02, Rev-00

2 FACILITIES PRVIDED BY BHEL

A. Land for labour colony shall be allotted by BHEL

B. BHEL shall provide water at one point in the Plant Premises. Further tapping the water from for the labour colony shall be under the scope of the bidder.
In case of non-availability of water, the contractor shall make his own arrangements of water suitable for labours at their own cost. No separate payment shall be made for any contingency arrangement made by contractor, due to delay / failure for providing water supply.

C. Power will be provided to the contractor free of cost at one single point within the labour colony area. The contractor shall make his own arrangement for further distribution with necessary isolator/LCB etc. Necessary “Capacitor Banks” to improve the Power factor to a minimum of 0.9 shall be provided by the contractor at his cost.

Penalty if any levied by customer on this account will be recovered from contractor's bills. Any duty, deposit involved in getting the Electricity shall be borne by the bidder. Provision for distribution of electrical power from the given single central common point to the required places with proper distribution boards, approved cables and cable laying including supply of all materials like cables, switch boards, pipes etc., observing the safety rules laid down by electrical authority of the State / BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor. BHEL is not responsible for any loss or damage to the contractor's equipment as a result of variations in voltage / frequency or interruptions in power supply. As there are bound to be interruptions in regular power supply, power cut/ load shedding in any construction sites, contractor should make his own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown / failure to get urgent and important work to go on without interruptions. No separate payment shall be made for this contingency.

D. Bidder shall provide toilet blocks with necessary septic tanks and soak pits as mentioned in the layout drawing. Bidder shall be responsible for clearing the septic tank at regular intervals.

E. Main Roads and Drains shall be constructed by BHEL, further interconnection to main road and drain shall be done by the vendor.

F. Lighting in the roads shall be provided by BHEL, further lighting within the areas allocated to the Bidders shall be taken up by the bidder. The bidder shall provide suitable lighting in their areas.

G. The layout, specification including dimensions of the facilities of the labour colony as provided in the bid drawings shall be strictly followed.

3.0 FACILITIES TO BE PRVIDED BY BIDDER

3.1.1.1 Labour sheds as per the layout, specification shall be provided by the bidder as per the bid drawing including foundations.

3.1.1.2 Toilet, Bath and wash area shall be provided as per the layout and specification provided in the bid drawing including foundations.

3.1.1.3 Kitchen cum dining room as per the layout, specification shall be provided by the bidder as per the bid drawing including foundations.

3.1.1.4 Electrification all the rooms and the Utility areas like toilet, bath area and kitchen.

3.1.1.5 Minimum 2 Nos. of ceiling fans shall be provided per room of the labour shed.

3.1.1.6 Paving shall be provided around labour sheds to avoid stagnation of rain water.

3.1.1.7 The specification/ drawings for the labour shed, attached herewith, are typical arrangements. However, allocation of land, number of sheds and number of rooms in a shed shall be as per the requirement of workmen to be deployed for the scope of work mentioned in the contract in adherence to the schedule of work and meeting to HSE norms of BHEL.

4.0 SPECIFICATION FOR THE LABOUR SHED

4.1 MAIN STRUCTURE & WALLS:

- The Structural walls shall be made out of tubular sections. 50mm thick AEROCON panels or equivalent for walls using 1mm thick GI channels, Colour Coated Sheet roof Supported with steel columns, Trusses & Purlins Inclusive of MS Door frames with flush shutters of Size 3’ X 7’ X 20 Rooms. MS Window frames with 4mm thick Plain glass of Size 4’ X 4’ X 20 No’s, Painting.

4.2 WALLS:

- Pre-fabricated Sandwich Panel ‘AEROCON’ or equivalent of 50 mm thick Made up of two fiber Reinforced cement sheets on either Side of a lightweight concrete core composed of port land Cement, binders, Siliceous and micaceous material aggregate with tongue & groove arrangement.

4.3 ROOF:

- Roofing with 0.45MM thick Colour coated Sheets of Required size fixed to the purlins in gable Shape with self tapping Screws. The Roof shall either thermal insulated or provided with false ceiling.

4.4 CHANNELS:

- Galvanized iron top & bottom channels of size: 38 x 50 x 38 in 1 mm Thickness.

4.5 STEEL STRUCTURE:

- Fabricated structural steel for Columns with 72 X 72MM MS Square Box.
- Trusses with 50 NB MS Pipes for outer frame and 32 NB MS Pipes for internal bracings, & Purlins with 50 NB MS Pipes, Joint Plates 8MM thick, bolts, including one coat of Red- oxide primer.

4.6 COMPONENTS:

- Ridge covers on the roof ridge with plain CGI sheet, all four corners covered with MS Corner covers all fixed with the help of bolts, Nuts, Anchor fasteners, screws etc.

4.7 PAINTING

- (A) Interior: Painting of AEROCON or equivalent internal walls with one coat of cement Primer and two coats of Synthetic/Acrylic paints. (Oil bond distempers) of Asian / ICI make.
- (B) EXTERIOR: Painting of AEROCON or equivalent external walls with one coat of cement Primer and two Coats of exterior plastic emulsion of Asian / ICI make.

4.8 DOOR FRAME:

- Supply & fixing of 1.2 mm thick cold-rolled steel Sections of Size 40 x 50 x 40mm with three mild steel Hinges duly welded on one side as a complete Item of work.

4.9 DOOR SHUTTER:

- Supply & fixing of 30-mm hard core Flush door of boiling Waterproof Grade [BW Grade] including one Al drop, one doorstopper, two handles, one latch in chrome Plated steel.

4.10 WINDOW FRAME:

- Supply & fixing of 1.2 mm thick cold-rolled Steel sections
- In size: 40 x 50 x 28mm 10mm Burglar bars at every 100 mm Center.

4.11 WINDOW SHUTTERS:

- Supply & fixing of mild steel Z section of size: 25 x 25 mm fixed with two
- Hinges and two handles, two Stay rods as Pre required Size with 4mm thick glass In the MS Shutter.

4.12 ELECTRICAL:

- All light points will be connected with 1/18 wire with PVC casing.
- All power points will be connected with 3/20 gauge Wire & 1/18 earth, all the Cables will be Properly
- Conduited The wire will be any ISI mark, switches shall be Anchor or equivalent make. (Points only without fixtures)
- (Each Room Light Points = 2 No's, Fan Points = 2 No minimum, 5Amp Sockets = 4 No's)

4.13 TOILET, BATH AND KITCHEN AREA:

- The toilet, Bath and kitchen shall be of masonry structures and each toilet shall contain Indian Water Closet (IWC) with self-flushing mechanism, Along with suitable required taps. No of toilets shall be apprx. Minimum 1 No for every 5 persons.

4.14 WATER SUPPLY:

- Sintex/other water tanks shall be placed at suitable heights on top steel structure provided by the bidder for distribution of drinking water and service water. The water tank shall be connected to all taps for continuous supply of water. Measures shall be taken to install water saving devices and to prevent water wastage.

4.15 SEWAGE CONNECTION:

- Sanitary fitting along with sewage pipe shall be provided up to septic tank and soak pit. All internal and external plumbing (from water tank to distribution system like toilet and pantry) shall be provided by bidder.

- The waste water out of bathing shall be let out to nearest drain through masonry drain and stagnation of the waste water is strictly prohibited
- The septic tank and soak pit shall be designed by the bidder to accommodate the labour strength planned by them for mobilisation.

4.16 ELECRICAL WORKS:

Each Room in the prefabricated building shall contain the below mentioned fittings:

- Open Tube light 2 x 36 W
- 4Nos of 5 Amps Power socket
- Min 2 Nos of Ceiling Fan point with Fan
- The building should also contain DB's, Earth Pits, Outside light fittings and lights
- Suitable lighting shall be installed to illuminate the entire place using LED Sodium Vapour Lamps. Suitable motor room with water pump for pumping water from BHEL point to vendor Tank

4.17 KITCHEN & DINNING HALL:

- Kitchen shall be of masonry or pre-fabricated structures
- Space nearer to the labour shed shall be allocated for kitchen and dining hall which is exclusive for the particular bidder of the package awarded.
- Dining hall shall be common for all the labours of belongs to the bidder executing a particular package of work of BHEL.
- Dining hall shall be semi closed prefabricated structure shed with sides open and brick wall up to 1m from FFL of the shed
- Dining hall shall be provided with the seating arrangements made of wooden/plastic.
- Dining hall shall be provided with adequate lights, Fans
- All design work of prefabricated buildings, foundations, lighting, fittings, etc. shall be as per the latest Indian Standard Codes and in the scope of bidder.

- The waste water out of utensil cleaning shall be let out to nearest drain through masonry drain and stagnation of the waste water is strictly prohibited

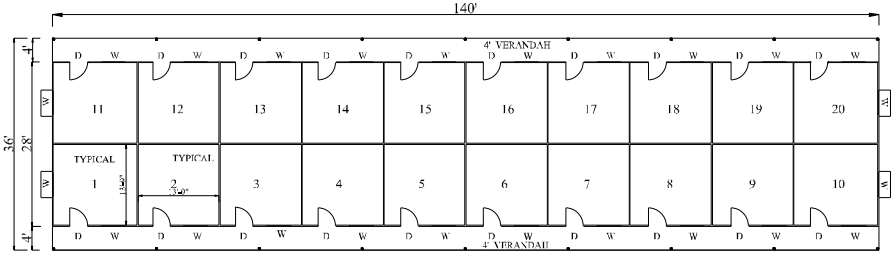
4.18 SALIENT TECHNICAL REQUIREMENTS:

- All design work of prefabricated buildings, foundations, lighting, fittings, etc. shall be as per the latest Indian Standard Codes.
- All designs have to be carried out as per relevant IS/International codes.
- Agency shall submit two sets of proposed drawings of labour colony with foundation, Electrical, Plumbing & other fittings etc., to BHEL-Site for approval within fifteen days from the receipt of LOI.
- Bidders should take care of all Indian site conditions, prevailing local laws etc. No claim shall be entertained to lack of knowledge of site condition.
- Hygienic activities of toilets, bath rooms and kitchen area shall be strictly followed by the bidder.
- Transport from Labour colony to work site shall be provided by the bidder daily.

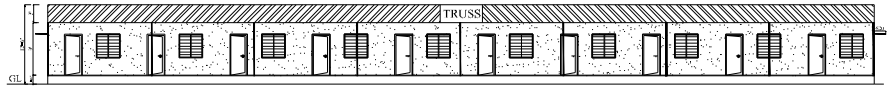
5.0 DRAWINGS & OTHER ENCLOSURES

Following drawings are enclosed strictly for the guidance of the Bidders:

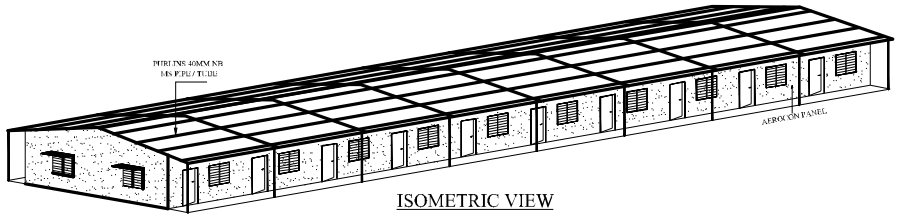
1. Standard Layout of Labour Colony (Typical) Drawing No-BHEL/PSSR/CVL/LABCOL/02, Rev-00
2. Standard drawing of pre-Fabricated Building(Typical) Drawing No-BHEL/PSSR/CVL/LABCOL/03, Rev-00



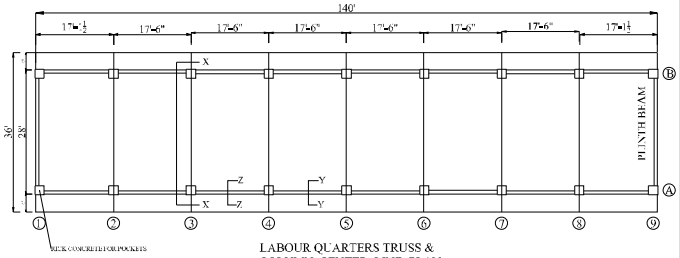
LABOUR QUARTERS PLAN



FRONT ELEVATION



ISOMETRIC VIEW



LABOUR QUARTERS TRUSS &
COLUMN CENTER LINE PLAN

N

E

INDEX:

2MM THK AEROCON PANELS UP TO 2745MM HT.

SPECIFICATION :

1. **Walls** : Pre- fabricated Sandwich Panel 'AEROCON ' (Manufactured by Hyderabad Industries Limited) of 50mm thick Made up of two fiber Reinforced cement sheets on either Side of a lightweight concrete core composed of port land Cement, binders Siliceous and micaceous material Aggregate with tongue & groove arrangement.

2. **Steel Structure**: Fabricated structural steel for Column, Trusses and purlins.

3. **Bottom Channels :** Galvanized iron jindal make Top and bottom channels of size 38x50x38 in 1mm Thickness.

4. **Components** : Ridge covers on the roof ridge with profiled sheet , all four corners covered with MS corner covers all fixed with the the helps of bolts,nuts, Anchor fasteners,screws etc.

5. **Chajja** : 50mm thick Aerocon Panels fixed to wall with 'L' braackets and bolts.

6. **Flooring** : Screed / Concrete Flooring .

7. **Roof**: Roofing with 0.47mm thick Colour coated sheets of United/ Global make Sheets of Required Size fixed to the purlins in gable Shape with self Tapping Screws.

8. **Door Frame** : Supply and fixing of 1.2mm thick cold-rolled steel Sections of Size 40x50x40mm with three mild steel Hinges duly welded on one side as complete item of work.

9. **Door Shutter** : Supply & fixing of 30mm hardcore Flush door of boiling waterproof Grade (BW Grade) including one Al-drop one door stopper ,two handles,one latch in chorme plated steel .

10. **Window Frame** : Supply & fixing of 1.2mm thick cold-rolled Sections in Size 40x50x28mm 10mm Burglar bars at every 100mm center.

11. **Window Shutter** : Supply & fixing of Mild steel Z-section of size : 25x25mm fixed with two Hinges and two handles, two stay rods as pre required Size with 4mm thick glass in the MS Shutter.

12. **Electrical** : All light points will be connected with 1.5 wire and a Proper earth , with PVC casing.

    All power points will be connected with 2.5 gauge wire and 1.5 Earth, all the Cables will be Properly.Conducted. The wire will be Finecab make, switchers shall be Anchore make. (Labour Qtrs : Light points = 50, Fan points = 20, ½ Amps = 20)

13. **Painting** (A) Interior : Painting of AEROCON internal walls with one coat of cement Primer and two coats of Synthetic / Acrylic paints.(Oil bond distempers) of Asian / ICI Make.

    (B) Exterior : Painting of AEROCON External walls with one coat of cement Primer and two coats of exterior plastic emulsion of Asian / ICI Make.

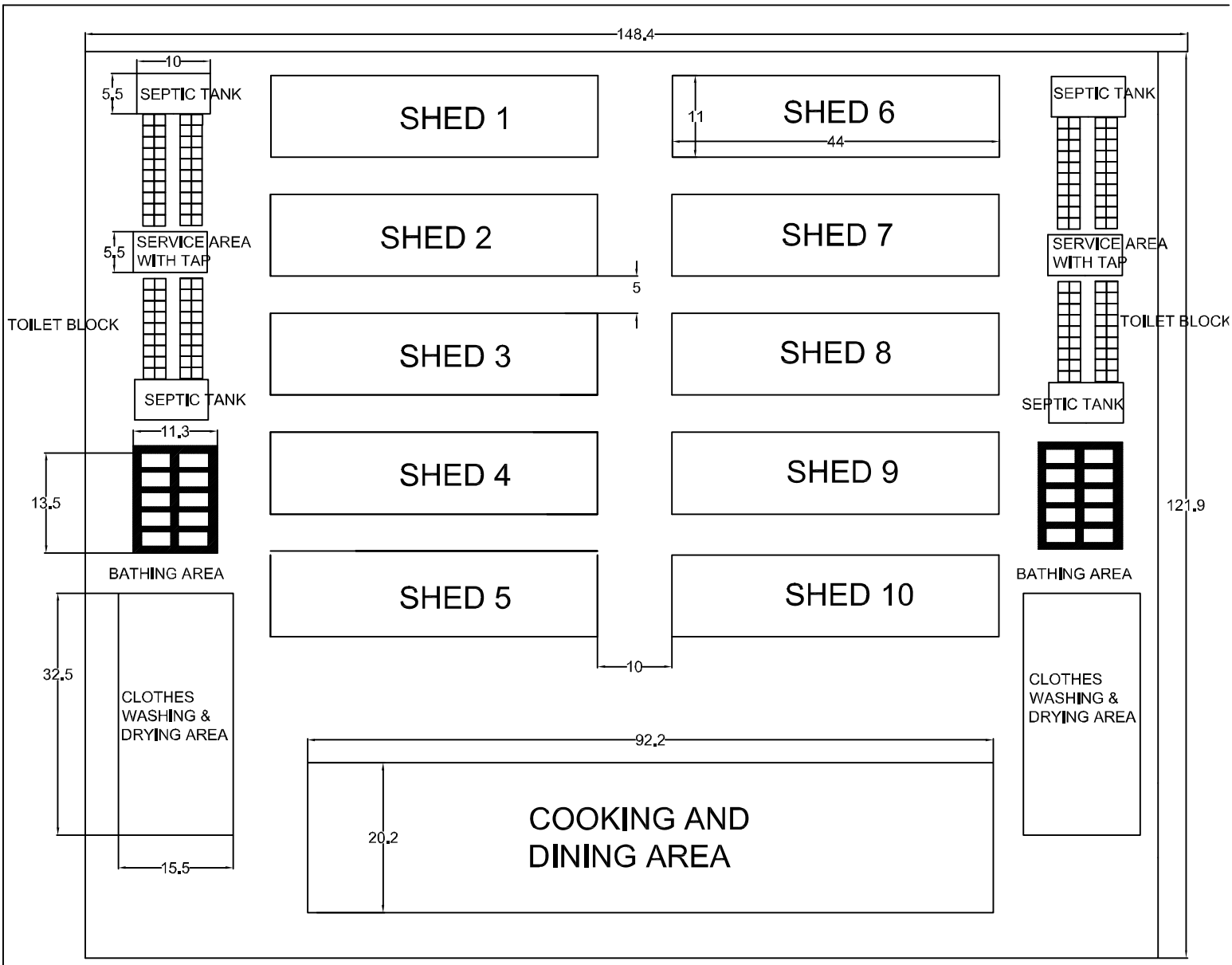
NOTE :
ALL DIMENSION ARE IN FEET .

COMPANY : BHEL PSSR

PROJECT:

TITLE: GENERAL LABOUR COLONY DETAILS

PREPARED BY	REVIEWEDPARED BY	CHECKED BY	APPROVED BY	SIZE	SCALE	DRG NO:	REV
					Not to Scale	BHEL:PSSR:CVL:LAB COL/02	0



ALL DIMENSIONS ARE IN METRES

TYPICAL LAYOUT OF LABOUR COLONY

CUSTOMER: BHEL

DRAWING NO: BHEL -PSSR-CVL-LABCOL-02 REV 00

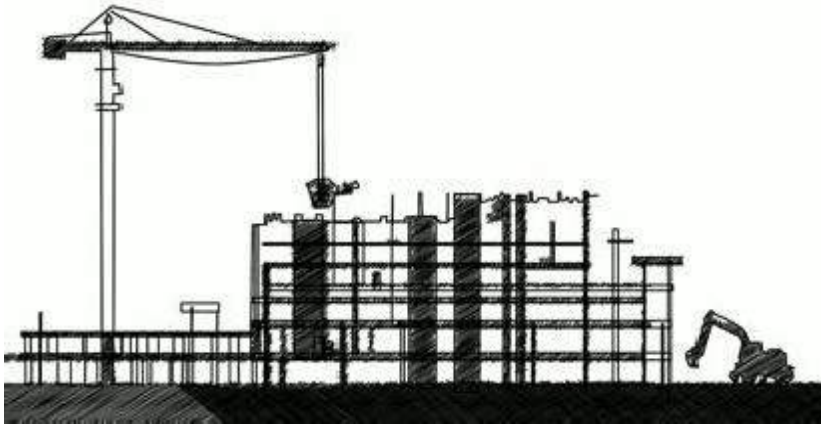
HEALTH, SAFETY and ENVIRONMENT PLAN

for

SITE OPERATIONS

by

SUB-CONTRACTORS



POWER SECTOR

HSE PLAN FOR SITE OPRATIONS BY BHEL'S SUBCONTRACTORS

AT A GLANCE

BEFORE START

SIGNING OF MOU
Agree to comply to HSE requirement- Statutory and BHEL's

PLAN

HSE ORGANISATION	
Manpower • 1 (one) safety officer for every 500 workers or part thereof • 1(one) safety-steward/ supervisor for every 100 workers **Qualification** As per Cl. 7.1	**HSE Roles and responsibilities** • Site In-charge- As per clause 7.2.1 • Safety officer- As per clause 7.2.2

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

PROVIDE

HSE INFRASTUCTURE	
• PPEs • Drinking Water • Washing Facilities • Latrines and Urinals • Provision of shelter for rest • Medical facilities	• Canteen facilities • Labour Colony • Emergency Vehicle • Pest Control • Scrapyard • Illumination

TRAIN

HSE TRAINING , AWARENESS & PROMOTION	
Training • Induction training • Height work and other critical areas • Tool Box talk & Pep Talk	**Awareness & Promotion** • Signage • Poster • Banner • Competition • Awards

COMMUNICATE

HSE COMMUNICATION	
Incident Reporting • Accident- Fatal & Major • Property damage • Near Miss	**Event Reporting** • Celebrations • Training • Medical camp

EXECUTE SAFELY

OPERATIONAL CONTROL PROCEDURES

PERMIT TO WORK

Height work (above 2 metres), Hot Work, Heavy Lifting, Confined Space, Radiography, excavation (More than 4 metres)

SAFETY DURING WORK EXECUTION	
• Welding • Rigging • Cylinder- storage & Movement • Demolition work • T&Ps • Chemical Handling • Electrical works	• Fire • Scaffolding • Height work • Working Platform • Excavation • Ladder • Lifting • Hoisting appliance
HOUSE KEEPING	
WASTE MANGEMENT	
TRAFFIC MANAGEMENT	
ENVIRONMENTAL CONTROL	
EMERGENCY PREPAREDNESS AND RESPONSE PLAN	

CHECKS

HSE AUDITS & INSPECTION	
• Daily Checks • Inspection of PPEs • Inspection of T& Ps • Inspection of Cranes & Winches	• Inspection of Height work • Inspection of Welding and Gas cutting • Inspection of elevators etc.

HSE PERFORMANCE EVALUATION PARAMETERS

NON CONFORMANCE

PENALTY for NON CONFORMANCE

Refer Clause 16

Incremental penalty

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

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

REVISION HISTORY SHEET

Date	Revision No.	Details of Changes	Reason	Prepared	Reviewed	Approved
12.08.2014	00	First Issue	First Issue	S. B. Jayant, Dy Manager-FQA & Safety	A. K. Sinha, GM-FQA & Safety	Anuj Bhatnagar, ED-FQA & Safety
20.01.2020	01	Formats added: **HSEP:14-F30 – Monthly HSE Planning & Review** (Page 11, Clause 8.0 - updated) HSEP:14-F13E-Excavation Inspection Format (part of F30)) HSEP:14-F32B – Job Safety Analysis Format (part of F30) **HSEP:14-F31A – Daily HSE Reporting** (Page 18, Clause 10.3 – added) **HSEP:14-F33 – HSE Performance Evaluation** (Page 31, Clause 13 – revised)	IOM No. **PSHQHSE/MONREP/02** Dated 08-Jan-2020	Rohit Kumar	Santosh Nair, GM (MSX & HSE)	

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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 must be followed.

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

2.0 SCOPE

The document is applicable for BHEL's Subcontractors at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations.

3.0 OBJECTIVES AND TARGETS

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 on the safety aspect of their work.
- 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 person.
- 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.

HSE TARGETS

EXPLOSION	**ZERO**
FATALITY	**ZERO**
LOST TIME INJURY	**ZERO**
FIRE	**ZERO**
VEHICLE INCIDENTS	**ZERO**
ENVIRONMENTAL INCIDENTS	**ZERO**

4.0 BHEL POWER SECTOR HEALTH, SAFETY & ENVIRONMENT POLICY

Health, Safety & Environment Policy of BHEL

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

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

` **sd/-**

CMD, BHEL

5.0 MEMORANDUM OF UNDERSTANDING:

After award of work, subcontractors 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 (HSE Policy).

M/s_____do hereby also commit to comply with the same HSE Policy w h i l e executing the Contract Number _____

M/s_____shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be reached to all workers and supervisors for compliance.

In addition to this, M/S_____shall comply to all applicable statutory and regulatory requirements which are in force in the place of project and any special requirement specified in the contract document of the principal customer.

M/s_____shall co-operate in HSE audits/inspections conducted by BHEL /customer/ third party and ensure to close any non-conformity observed/reported within prescribed time limit.

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

Name :

Place & Date:

6.0 TERMS AND DEFINITIONS

6.1 DEFINITIONS

6.1.1 INCIDENT

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

6.1.2 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".

6.1.3 MAN-HOURS WORKED

The total number of man 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 workdays for a period is the sum of the number of men at work on each day of period. If the daily hours vary from department to department separate estimate shall be made for each department and the result added together.

6.1.4 FIRST AID CASES

First aids are not essentially all reportable cases, where the injured person is given medical treatment and discharged immediately for reporting on duty, without counting any lost time.

6.1.5 LOST TIME INJURY

Any work injury which renders the injured person unable to perform his regular job or an alternative restricted work assignment on the next scheduled work day after the day on which the injury occurred.

6.1.6 MEDICAL CASES

Medical cases come under non-reportable cases, where owing to illness or other reason the employee was absent from work and seeks Medical treatment.

6.1.7 TYPE OF INCIDENTS & THEIR REPORTING:

The three categories of Incident are as follows:

Non-Reportable Cases:
An incident, where the injured person is given medical help and discharged for work without counting any lost time.

Reportable Cases:
In this case the injured person is disable for 48 hours or more and is not able to perform his duty.

Injury Cases:
These are covered under the heading of non-reportable cases. In these cases the incident caused injury to the person, but he still continues his duty.

6.1.8 TOTAL REPORTABLE FREQUENCY RATE

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

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

6.1.9 SEVERITY RATE

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

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

6.1.10 INCIDENCE RATE

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

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

7.0 HSE ORGANISATION

Number of safety officers:
The subcontractor must deploy one safety officer for every 500 workers or part thereof in each package. In addition, there must be one safety-steward/safety-supervisor for every 100 workers.

Deployment: The subcontractor should deploy sufficient safety officers and safety-steward/Safety-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 will attract a penalty of Rs.30,000/- per man month for the delayed period.

7.1 QUALIFICATION FOR HSE PERSONNEL

Sl.no	Designation	Qualification	Experience
1	Safety officer (Construction Agency)	Degree or Diploma in Engineering with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years for degree holder and five years for diploma holder in the field of Construction of power plant/ major industries

2	Safety-Steward/ Safety-Supervisor	Degree or diploma in any discipline with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years

7.2 RESPONSIBILITIES

7.2.1 SITE IN -CHARGE OF SUBCONTRACTOR

- Shall sign Memorandum of Understanding (MoU) for compliance to BHEL's HSE Plan for Site Operations as per clause 5.0
- Shall engage qualified safety officer(s) and steward (s) as per clause 7.0
- 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 person.
- 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, mockdrill, 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
- Power source for hand lamps shall be maximum of 24 v.
- Temporary fencing should be done for open edges if Hand – railings and Toe-guards are not available.

7.2.2 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

8.0 PLANNING BY SUBCONTRACTOR

Monthly planning and review of HSE activities shall be carried out by subcontractor as per format No. HSEP:14-F30 jointly along with BHEL.

8.1 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, inspection shall be arranged by in-house competent authority for acceptance as applicable.

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

  - Mobile cranes.
  - Side Booms.
  - Forklifts.
  - Grinding machine.
  - Drilling machine.
  - Air compressors.
  - Welding machine.
  - Generator sets.
  - Dump Trucks.
  - Excavators.
  - Dozers
  - Grit Blasting Equipment.
  - Hand 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.

8.2 MOBILISATION OF MANPOWER BY SUBCONTRACTOR

- The subcontractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.
- The subcontractor shall take special care of the employees affected with occupational diseases under rule 230 and schedule II of BOCW Rules. The employees not meeting the fitness requirement should not be engaged for such job.
- 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.

8.3 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
- 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
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 shall conform to the relevant standards as below and bear ISI mark.

Relevant is-codes for personal protection

IS: 2925 – 1984	Industrial Safety Helmets.
IS: 4770 – 1968	Rubber gloves for electrical purposes.
IS: 6994 – 1973 (Part-I)	Industrial Safety Gloves (Leather &Cotton Gloves).
IS: 1989 – 1986 (Part-I-II)	Leather safety boots and shoes.
IS: 5557 – 1969	Industrial and Safety rubber knee boots.
IS: 6519 – 1971	Code of practice for selections care and repair of Safety footwear.
IS: 11226 – 1985	Leather Safety footwear having direct molding sole.
IS: 5983 – 1978	Eye protectors.
IS: 9167 – 1979	Ear protectors.
IS: 1179-1967	Eye & Face protection during welding
IS: 3521 – 1983	Industrial Safety Belts and Harness
IS:8519 -1977	Guide for selection of industrial Safety equipment for body protection
IS:9473-2002,14166-1994,14746-1999	Respiratory Protective Devices

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
- Besides the PPEs mentioned above, the persons shall use helmet and safety shoe. The visitors shall use 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.

8.4 ARRANGEMENT OF INFRASTRUCTURE

8.4.1 DRINKING WATER

- Drinking water shall be provided and maintained at suitable places at different elevations.
- Container should be labeled as " Drinking Water"
- Cleaning of the storage tank shall be ensured atleast once in 3 months indicating date of cleaning and next due date.
- Potability of water should be tested as per IS10500 at least once in a year.

8.4.2 WASHING FACILITIES

- 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.

8.4.3 LATRINES AND URINALS

- Latrines and urinals shall be provided in every work place.
- Urinals shall also be provided at different elevations.
- They shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times, by appointing designated person.
- Separate facilities shall be provided for the use of male and female worker if any.

8.4.4 PROVISION OF SHELTER DURING REST

Proper Shed & Shelter shall be provided for rest during break

8.4.5 MEDICAL FACILITIES

8.4.5.1 MEDICAL CENTRE (As per Schedule V, X and XI of BOCW central Rules, 1998)

- A medical centre shall be ensured/identified at site with basic facilities for handling medical emergencies. The medical center can be jointly developed on proportionate sharing basis with permission from BHEL
- A qualified medical professional, not less than MBBS, shall be deployed at the medical centre
- The medical centre shall be equipped with one ambulance, with trained driver and oxygen cylinder.
- Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste –Management and Handling Rules, 1998)

8.4.5.2 FIRST AIDER

- Ensure availability of Qualified First-aider throughout the working hours.
- 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.

8.4.5.3 FIRST AID BOX (as per schedule III of BOCW)

- The subcontractor shall provide necessary first aid facilities as per schedule III of BOCW. 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.

8.4.5.4 HEALTH CHECK UP (As per schedule VII and Form XI)

The persons engaged at the site shall undergo health checkup as per the format no. HSEP:14-F02 before induction. The persons engaged in the following works shall 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 NDE personnel

8.4.6 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.

8.4.7 PROVISION OF ACCOMODATION/LABOUR COLONY

- The subcontractor shall arrange for the accommodation of workmen at nearby localities or by making a labour colony.
- Regular housekeeping of the labour colony shall be ensured.
- Proper sanitation and hygienic conditions to be maintained.
- Drinking water and electricity to be provided at the labour colony.
- Bathing/ washing bay
- Room ventilation and electrification.

8.4.8 PROVISION OF EMERGENCY VEHICLE

- Dedicated emergency vehicle shall be made available at workplace by each subcontractor to handle any emergency

8.4.9 PEST CONTROL

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

8.4.10 SCRAPYARD

- In consultation with customer, scrapyard 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.

8.4.11 ILLUMINATION

- The subcontractor 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 at dark places and during night hours at the work spot as well as at the pre-assembly area.

- Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II). 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

9.0 HSE TRAINING& AWARENESS

9.1 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.

9.2 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.

9.3 TRAINING ON HEIGHT WORK

Training on height work shall be imparted to all workers working at height by in-house/external faculty at least twice in a year. The training shall include following topics:

- Use of PPEs
- Use of fall arrester, retractable fall arrester, life line, safety nets etc.
- Safe climbing through monkey ladders.
- Inspection of PPEs.
- Medical fitness requirements.
- Mock drill on rescue at height.
- Dos & Don'ts during height work.

9.4 HSE TRAINING DURING PROJECT EXECUTION

- Other HSE training shall be arranged by BHEL/ subcontractor 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
  - Fire-warden training
  - EMS and OHSMS
  - 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.

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

9.5.1 Display of HSE posters and banners

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

9.5.2 Display of HSE signage

- 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

9.5.3 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.

9.5.4 HSE awareness programme

- Subcontractor shall arrange HSE awareness programme periodically on different topics including medical awareness for all personnel working at site

10.0 HSE COMMUNICATION

10.1 INCIDENT REPORTING

- The subcontractor shall submit report of all incidents, fires and property damage etc to the Engineer immediately after such occurrence, but in any case not later than 24 hours of the occurrence. Such reports shall be furnished in the manner prescribed by BHEL. (Refer HSE procedure for incident investigation, analysis and reporting for details)
- In addition, periodic reports on safety shall also be submitted by the subcontractor to BHEL from time to time as prescribed by the Engineer. Compiled monthly reports of all kinds of incidents, fire and property damage to be submitted to BHEL safety officer as per prescribed formats.
- HSE incidents of site shall be reported to BHEL site Management as per Procedure for Incident Investigation and Reporting in format no. HSEP:14-F15. Corrective action shall be immediately implemented at the work place and compliance shall be verified by BHEL HSE officer and until then, work shall be put on hold by Construction Manager.

10.2 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.

10.3 DAILY HSE ACTIVITY REPORTING

Daily HSE activities shall be reported by subcontractor to BHEL as per Format No. HSEP:14-F31A

11.0 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 hotwell / deaerator
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		

11.1 HSE ACTIVITIES

HSE activities shall be conducted at site based on the HSEMSM developed by Power Sector and issued to site by Regions.
While planning for any activity the following documents shall be referred for infrastructural requirements to establish control measures:

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

11.2 WORK PERMIT SYSTEM

- The following activities shall come under Work Permit System
  a. Height working above 2 metres
  b. Hot working at height
  c. Confined space
  d. Radiography
  e. Excavation more than 4 meter depth
  f. Heavy lifting above 50 ton
  Refer Annexure 05 for Work permit formats.
- "HSE Procedure for Work Permit System" shall be followed while implementing permit system. Where customer is having separate Work Permit System the same shall be followed.
- Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with 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.

11.3 SAFETY DURING WORK EXECUTION

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

11.3.1 WELDING SAFETY

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.

11.3.2 RIGGING

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.

11.3.3 CYLINDERS STORAGE AND MOVEMENT

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
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.

When cylinders are transported by powered vehicle they shall be secured in a vertical position.

11.3.4 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.

11.3.5 T&Ps

All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test/calibration certificates bearing endorsement from competent authority of BHEL..Subcontractor to also submit monthly reports of T&Ps deployed and validity test certificates to BHEL safety Officer as per the format/procedure of BHEL.

11.3.6 CHEMICAL HANDLING

Displaying safe handling procedures for all chemicals such as lube oil, acid, alkali, sealing compounds etc , at work place.Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the subcontractor shall be responsible for carrying out such provision / storage in accordance with the rules & regulations laid down in the relevant petroleum act, explosive act and petroleum and carbide of calcium manual, published by the chief inspector of explosives of India. All such storage shall have prior approval if necessary from the chief inspector of explosives or any other statutory authority. The subcontractor shall be responsible for obtaining the same.

11.3.7 ELECTRICAL SAFETY

- Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts.
- Fulfilling safety requirements at all power tapping points.
- High/ Low pressure welders to be identified with separate colour clothings. No welders will be deployed without passing appropriate tests and holding valid welding certificates. Approved welding procedure should be displayed at work place.
- The subcontractor 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.
- All portable electric tools used by the subcontractor 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 subcontractor 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
- The subcontractor 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 subcontractor.
- 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 subcontractor 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
- 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
- The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.

11.3.8 FIRE SAFETY

- Providing appropriate fire fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
- Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labor 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 subcontractor of any of his responsibility and liabilities to fire incident occurring either to his materials or equipment or those of others.
- Emergency contacts nos must be displayed at prominent locations
- 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.

11.3.9 SCAFFOLDING

- 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.
- 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 outside 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 from saver, from swaying, from the building or structure.

11.3.10 **WORK AT HEIGHT**:

- Guardrails and toe-board/barricades and sound platform conforming to IS:4912-1978 should be provided.

- Wherever necessary, life-line (pp or metallic) and fall arrestor along with Polyamide rope or Retractable lifeline should be provided.
- Safety Net as per IS:11057:1984 should be used extensively for prevention/ arrest of men and materials falling from height. The safety nets shall be fire resistant, duly tested and shall be of ISI marked 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.
- Reaching beyond barricaded area without lifeline support, moving with support of bracings, walking on beams without support, jumping from one level to another, throwing objects and taking shortcut must be discouraged.
- Use of Rebar steel for making Jhoola and monkey-ladder (Rods welded to vertical or inclined structural members), temporary platform etc. must be avoided.
- Monkey Ladder should be properly made and fitted with cages.
- Jhoola should be made with angles and flats and tested like any lifting tools before use.
- Lanyard must be anchored always and in case of double lanyard, each should be anchored separately.
- In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
- In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
- Empty drums must not be used.
- For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure along with separate fall arrestor. Rope ladder should be discouraged.

11.3.11 WORKING PLATFORM

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. 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.

11.3.12 EXCAVATION

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.

11.3.13 LADDER SAFETY

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.

A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer obtained prior to Construction.

11.3.14 LIFTING SAFETY

- It will be the responsibility of the subcontractor to ensure safe lifting of the equipment, taking due precaution to avoid any incident and damage to other equipment and personnel.

- All requisite tests and inspection of handling equipment, tools & tackle shall be periodically done by the subcontractor by engaging only the Competent Persons as per law.
- Defective equipment or uncertified shall be removed from service.
- Any equipment shall not be loaded in excess of its recommended safe working load.

11.3.15 HOISTING APPLIANCE

- 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 incidentally displaced.
- When workers employed on electrical installations which are already energized, insulating 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.

11.4 ENVIRONMENTAL CONTROL

Environment protection has always been given prime importance by BHEL. Environmental damage is a major concern of the principal subcontractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life. 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 Material Safety Data Sheet (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. The subcontractor shall use appropriate MSDS for clean-up technique

All subcontractors shall be responsible for the cleanliness of their own areas.

The subcontractors shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the subcontractor anticipates the generation of excessive noise levels from his operations the subcontractor shall inform to Construction Manager of BHEL accordingly so that reasonable &practicable precautions can be taken to protect other persons who may be affected.
It is imperative on the part of the subcontractor 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.
The subcontractor shall carry out periodic air and water quality check and illumination level checking in his area of work place and take suitable control measure.

11.5 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

11.6 WASTE MANAGEMENT

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.

11.6.1 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.

11.6.2 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.

11.6.3 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.

11.6.4 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.

11.6.5 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.

11.7 TRAFFIC MANAGEMENT SYSTEM

11.7.1 SAFE WORKPLACE TRANSPORT SYSTEM

- Traffic routes in a work place shall be suitable for the persons or vehicles using them. This shall be sufficient in number and of sufficient size. This shall reflect the suitability of traffic routes for vehicles and pedestrians.
- Where vehicles and pedestrians use the same traffic routes there shall be sufficient space between them. Where necessary all traffic routes must be suitably indicated. Pedestrians or vehicles must be able to use traffic routes without endangering those at work. There must be sufficient separation of traffic routes from doors, gates and pedestrian traffic routes.
- For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
- Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.
- Speed limits shall be clearly displayed. Speed ramps preceded by a warning signs or marker are necessary.
- The traffic route should be wide enough to allow vehicles to pass and re-pass oncoming or parked traffic and it may be advisable to introduce on-way system or parking restrictions.
- Safest route shall be provided between places where vehicles have to call or deliver.
- Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse

- Safe areas shall be provided for loading and unloading.
- Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
- Ensure road crossings are minimum and clearly signed.
- Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.
- Set sensible speed limits which are clearly sign posted.
- Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.
- Forklift trucks shall not pass over road hump unless of a type capable of doing so.
- Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
- Road traffic signs shall be provided on prominent locations for prevention of incidents and hazards and for quick guidance and warning to employees and public. Safety signs shall be displayed as per the project working requirement and guideline of the state in which project is done. Vehicles hired or used shall not be parked within the 15m radius of any working area. Any vehicle, that is required to be at the immediate/near the vicinity, shall be approved by the person in-charge of the site.

11.7.2 TRAFFIC ROUTE FOR PEDESTRIANS

- Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
- Separate routes shall be provided for pedestrians to keep them away from vehicles. Provide suitable barriers/guard at entrances/exit and the corners or buildings.
- Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.
- Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.
- Provide high visibility clothing for people permitted in delivery area.

11.7.3 WORK VEHICLE

Work vehicle shall be as safe stable efficient and roadworthy as private vehicles on public roads. Site management shall ensure that drivers are suitably trained. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

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

11.7.4 DAILY CHECK BY DRIVER

- There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used.
  - Brakes.
  - Tires.
  - Steering.
  - Mirrors.
  - Windscreen waters.
  - Wipers.
  - Warning signals.
  - Specific safety system i.e. control interlocks
- Management should ensure that drivers carry out these checks.

11.7.5 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.

11.7.6 MAINTENANCE

All Vehicles used for transportation of man and material shall undergo scheduled inspections on frequent intervals to secure safe operation. Such inspections shall be conducted in particular for steering, brakes, lights, horn, doors etc. Site management shall ensure that work equipment is maintained in an efficient, working order and in good repair. Inspections and services carried out at regular intervals of time and or mileage. No maintenance shall be carried below HT/LT power lines.

11.8 EMERGENCY PREPAREDNESS AND RESPONSE

- 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 subcontractors
- All the subcontractor's supervisory personnel and sufficient number of workers shall be trained for fire protection systems. Enough number of such trained personnel must be available during the tenure of contract. Subcontractor should nominate his supervisor to coordinate and implement the safety measures.
- Assembly point shall be earmarked and access to the same from different location shall be shown
- 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.
- Disaster Management group shall be formed at site
- Mock drill shall be arranged at regular intervals. Monthly report of the above to be given to BHEL safety Officer as per prescribed BHEL formats
- Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

12.0 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.

12.1 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.

12.2 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.

12.3 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

12.4 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.
- The operator should be above 18 years of age and should be in possession of driving license of HMV man & goods), vision test certificate and should have minimum qualification so that he can read the instructions and check list.

12.5 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.

12.6 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.

12.7 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.

12.8 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.

12.9 INSPECTION OF EXCAVATION

Excavation activities shall be inspected as per Format HSEP:14-F13A

13.0 HSE PERFORMANCE

- Contractor shall be assessed on monthly basis for HSE Compliance by BHEL Safety In-charge at site.
  The HSE compliance shall be based on Online HSE Evaluation System of BHEL as per Format No. HSEP:14-F33.
- BHEL shall reserve the right to use this assessment for evaluating bidder's capacity for future tenders
- Suitable HSE reward system shall be developed at site level to promote HSE compliance amongst workmen by the subcontractor.
  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.

14.0 HSE PENALTIES

- As per contractual provision HSE penalties shall be imposed on subcontractors for non- compliance on HSE requirement as per format no. HSEP:14-F14. The list in the format is only indicative. For any other violation, not listed in the format, the minimum penalty amount is to be decided as per BOCW act.
- If principal customer/statutory and regulatory bodies impose some penalty on HSE due to the non-compliance of the subcontractor the same shall be passed on to them.
- The penalty amount shall be recovered by Site Finance department from subcontractors from the RA/Final bill.

15.0 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.

16. NON COMPLIANCE

NONCONFORMITY OF SAFETY RULES AND SAFETY APPLIANCES WILL BE VIEWED SERIOUSLY AND BHEL HAS RIGHT TO IMPOSE FINES ON THE SUBCONTRACTOR AS UNDER FOR EVERY INSTANCE OF VIOLATION NOTICED:

SN	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
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 properly	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	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
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.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

- Legend:-

  *: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

  #: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

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 subcontractor. The amount collected above will be utilized for giving award to the employees who could avoid incident by following safety rules. Also the amount will be spent for purchasing the safety appliances and supporting the safety activity at site.

17.0 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 management
- 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.

18.0 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 Incharge of Subcontractors and HSE officer of Subcontractors.
- MOM on the discussion will be circulated to the concerned for implementation.

19.0 FORMATS USED (Details available in Annexure-04)

SL. No.	Format Name	Format No.	Rev No.
01	Inspection of First Aid Box	HSEP:14-F01	00
02	Health Check Up	HSEP:14-F02	00
03	HSE Induction Training	HSEP:14-F03	00
04	Tool Box Talk	HSEP:14-F04	00
05	Monthly Site HSE Report	As specified by BHEL	00
06	Inspection of PPE	HSEP:14-F06	00

07	Inspection of T&Ps	HSEP:14-F07	00
08	Status of T&Ps	HSEP:14-F08	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 Penalty	HSEP:14-F14	00
15	Accident /incident / property damage /fire incident report	HSEP:14-F15	00

20.0 ANNEXURES

ANNEXURE 01

As per Contract Labour (Regulation & Abolition Act), Central Rules, 1971,

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

(a) For establishments in which the number of contract 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)	1 copy of the First-Aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.
(xviii)	A bottle containing 100 tablets (each of 5 grains) of aspirin
(xix)	Ointment for burns
(xx)	A bottle of suitable surgical anti-septic solution

(b) For establishment in which the number of contract labour exceeds fifty each first-aid box shall contain the following equipment:

(i)	12 small sterilized dressings
(ii)	6 medium size sterilized dressings
(iii)	6 large size sterilized dressings.
(iv)	6 large size sterilized burn dressings
(v)	6 (15 grams) packets sterilized cotton wool
(vi)	12 pieces of sterilized eye pads in separate sealed packets.

(vii)	12 roller bandages 10 cm wide.
(viii)	12 roller bandages 5 cm wide.
(ix)	One tourniquet.
(x)	A supply of suitable splints.
(xi)	Three packets of safety pins.
(xii)	Kidney tray.
(xiii)	Sufficient number of eye washes bottles filled with distilled water or suitable liquid clearly indicated by a distinctive sign which shall be visible at all times.
(xiv)	4 per cent Xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops.
(xv)	1 (60ml) bottle containing a two percent alcoholic solution of iodine
(xvi)	One (two hundred ml) bottle of mercurochrome (2 per cent) solution in water.
(xvii)	1 (120ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label.
(xviii)	1 roll of adhesive plaster (6 cmX1 meter)
(xix)	2 rolls of adhesive plaster (2 cmX1 meter)
(xx)	A snake bite lancet.
(xxi)	1 (30 grams) bottle of potassium permanganate crystals.
(xxii)	1 pair scissors
(xxiii)	1 copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India.
(xxiv)	a bottle containing 100 tablets (each of 5 grains) of aspirin
(xxv)	Ointment for burns
(xxvi)	A bottle of a suitable surgical anti septic solution.

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

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 + 70^0 from horizontal				
Other				
HOISTS, CRANES AND DERRICKS				
Condition of cables and sheaf OK				
Condition of slings, chains, hooks OK				
Inspection & maintenance log maintained				
Outriggers used				
Signals observed and understood				
Qualified operators				
Others				
MACHINERY, TOOLS & EQUIPMENT				
Proper instruction				
Safety devices				
Proper cords				
Inspection and maintenance				
Other				
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and maintenance				
Licensed drivers				
Other				
TEMPORARY FACILITIES				
Emergency instructions posted				
Fire extinguishers provided				
Fire-aid equipment available				
General neatness				
Others				
FIRE PREVENTION				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas.				
Hydrants				
Clearance				
Others				
ELECTRICAL				
Proper wiring				
ELCB's provided				
Ground fault circuit interrupters				
Protection against damage				
Prevention of tripping hazards				
Other				
HANDLING & STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
Other				
FLAMMABLE GASES AND LIQUIDS				
Containers clearly identified				
Proper storage				
Fire extinguisher nearby				

Other				
WORKING AT HEIGHT				
Safety nets				
Safety belts				
Safety helmets				
Anchoring of safety belt to the life line rope				
ENVIRONMENT				
Lubricant waste/engine oils properly dispose.				
Waste from Canteen, offices, sanitation etc. disposed properly.				
Disposal of surplus earth, stripping materials, expired batteries, oily rags and combustible materials done properly.				
HEALTH CHECKS				
Hygienic conditions at labor camps O.K.				
Availability of first-aid facilities				
Proper sanitation at site, office & labor camps.				
Arrangement of medical facilities.				
Measures for dealing with illness.				
Availability of potable drinking water for workmen & staff.				
Provision of crèches for children.				

ANNEXURE 03

REFERENCES

- Contract documents
- Relevant legislations
- HSEMSM
- Relevant Indian standards as listed below (illustrative only):

SL NO	CODE NAME	TITLE
(1)	IS : 818-1888 (Reaffirmed 2003)	Code of Practice for safety and health requirements in Electric and Gas Welding and Cutting operations.
(2)	IS: 1179-1967 (Reaffirmed 2003)	Specification for Equipment for Eye & Face protection during welding.
(3)	IS : 1989 (Part 2):1986 (Reaffirmed 1997)	Specification for Leather Safety Boots & Shoes
(4)	IS:2925 – 1984 (Reaffirmed 2010)	Specification for Industrial Safety Helmets
(5)	IS:3521 : 1999 (Reaffirmed 2002)	Industrial Safety Belts & Harnesses-Specification
(6)	IS:3646(Part II) – 1966 (Reaffirmed 2003)	Code of Practice for Interior Illumination
(7)	IS:3696 (Part I) – 1987 (Reaffirmed 2002)	Safety Code for Scaffolds and Ladders
(8)	IS: 3696(Part 2) : 1991 (Reaffirmed 2002)	Scaffolds and Ladders-Code of Safety
(9)	IS:3786 – 1983 (Reaffirmed 2002)	Method for Computation of Frequency and Severity Rates for Industrial Injuries and Classification of Industrial Incidents
(10)	IS:4770 : 1991 (Reaffirmed 2006)	Rubber Gloves – Electricals purposes-Specification
(11)	IS:4912 : 1978 (Reaffirmed 2002)	Safety Requirements for Floor and Wall Openings, Railings and Toe Boards
(12)	IS: 5983 – 1980 (Reaffirmed 2002)	Specification for Eye-Protectors
(13)	IS:6519 – 1971 (Reaffirmed 1997)	Code of Practice for Selection, Care and Repair of Safety Footwear
(14)	IS:9167:1979	Specification for Ear-Protectors
(15)	IS:6994(Part I)-1973 (Re affirmed 1996)	Specification for Industrial Safety Gloves Leather and Cotton Gloves
(16)	IS:8519 – 1977 (Reaffirmed 1983)	Guide for Selection of Industrial Safety Equipment for Body Protection.
(17)	IS 11006 : 2011	Flash Back(Flame Arrestor) Specification

(18)	IS:8520 – 1977 (Reaffirmed 2002)	Guide for Selection of Industrial Safety Equipment for Eye, Face and Ear Protection.
(19)	IS:9473:2002	Respiratory Protective Devices-Filtering Half Masks to protect against Particles-Specification.
(20)	IS:9944:1992 (Reaffirmed 2003)	Natural and Man-made Fiber Rope Slings-Recommendations on Safe working loads.
(21)	IS:11057 – 1884 (Reaffirmed 2001)	Specification for Industrial Safety Nets
(22)	IS:12254:1993 (Reaffirmed 2002)	Polyvinyl Chloride (PVC) Industrial Boots-Specification
(23)	IS:13367(Part 1):1992 (Reaffirmed 20030	Safe Use of Cranes-Code of Practice
(24)	IS:14166:1994 (Reaffirmed 2002)	Respiratory Protective Devices-Full Face Masks Specification
(25)	IS:14746 : 1999 (Reaffirmed 2003)	Respiratory Protective Devices-Half Masks and Quarter Masks - Specification
(26)	IS : 15397 :2003 (Reaffirmed 2008)	Portable Extinguisher Mechanical Foam Type(Stored Pressure)-Specification
(27)	IS: 19011:2002	Guidelines for Quality and/or Environmental Management Systems Auditing

ANNEXURE 04 : SAFETY FORMATS
&
ANNEXURE 05 : WORK PERMIT FORMATS

	POWER SECTOR	FORMAT NO: HSEP:14-F01 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF FIRST AID BOX	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Number of employees on the site: -_____

Sl.No.	Item	No. Available	Remarks
1	No. of small sterilized dressings		
2	No of medium sized sterilized dressings		
3	No of large sized sterilized dressings.		
4	No of large sized sterilized burn dressings		
5	No of (15 grams) packets sterilized cotton wool		
6	No of pieces of sterilized eye pads in separate sealed packets.		
7	No of roller bandages 10 cm wide.		
8	No of roller bandages 5 cm wide.		
9	Whether tourniquet available		
10	Whether supply of Suitable splints available.		
11	No of packets of safety pins.		
12	Whether kidney tray available		
13	Whether sufficient number of eye wash bottles, filled with distilled water or suitable liquid, clearly indicated by a distinctive sign which shall be visible at all times, available.		
14	Whether 4%-xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops available.		
15	Whether (60ml) bottle containing a two percent alcoholic solution of iodine available		
16	Whether (two hundred ml) bottle of mercurochrome (2 per cent) solution in water available.		

Sl.No.	Item	No. Available	Remarks
17	Whether 120ml bottle containing Sal volatile having the dose and mode of administration indicated on the label, available.		
18	Whether roll of adhesive plaster (6 cmX1 meter) available		
19	No of rolls of adhesive plaster (2 cmX1 meter)		
20	Whether snake bite lancet available.		
21	Whether (30 grams) bottle of potassium permanganate crystals available.		
22	Whether a pair scissors available		
23	Whether copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India available.		
24	Whether bottle containing 100 tablets (each of 5 grains) of aspirin available		
25	Whether Ointment for burns available		
26	Whether bottle of a suitable surgical anti-septic solution available		

Signature of Subcontractor's Site I/C:

	POWER SECTOR	FORMAT NO: HSEP:14-F02 REV NO.: 00 PAGE NO. 1 OF 02
	HEALTH CHECK UP	

Name of Site :	
Name of Sub-Contractor :	
Name of Employee :	

NAME:

History Of Past Illness	H/O Epilepsy
	H/O Drug Allergy
	H/O Diabetics/ Hypertension
	H/O Unconsciousness
Personal History	

EXAMINATION		**OBSERVATION**	
General Physical Examination			
Height	:		
Weight	:		
BMI	:		
Built And nourishment	:		
Pallor	:		
Temperature	:		
Chest Expansion	:	Inspiration	Expansion
Lymph Node Enlargement	:		
Ear, Nose, Throat	:		
Ear	:		
Nose	:		
Throat	:		

EXAMINATION		OBSERVATION	
Cardiovascular System Examination :			
Inspection	:		
Palpation	:	Pulse	BP
Auscultation (Heart Sounds)	:		
Respiratory System	:		
Inspection	:	Respiratory Rate	
Palpation:	:		
Percussion	:		
Auscultation (Breath Sounds)	:		
Examination of Abdomen	:		
Inspection	:		
Palpation	:		
Auscultation (Bowel Sounds)	:		
Any Other	:		
Clinical Impression			

Signature of the examining doctor

	POWER SECTOR **HSE INDUCTION TRAINING**	FORMAT NO: HSEP:14-F03 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Date :	
Name of Training Co-ordinator	

Sl No.	**Name**	**Designation**	**Organisation**	**Signature**

Signature of Training co-ordinator :

	POWER SECTOR **TOOL-BOX TALK**	FORMAT NO: HSEP:14-F04 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Sub-Contractors Name :	
Date :	

Topic	**Name of person delivered Tool Box Talk**	**No. of Participants attended**	**Remarks**

Signature of Site I/C of Subcontractor :

	POWER SECTOR **PERSONAL PROTECTIVE EQUIPMENTS**	FORMAT NO: HSEP:14-F06 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Item	**Issued this Month**	**Nos. Issued up to the Month**	**Percentage of usage at site**
Safety Helmet			
Safety Shoes			
Full Body Harness			
Fall Arrestor			
Safety Nets			
Other PPEs.			

Signature of Site I/C of Subcontractor :

	POWER SECTOR **INSPECTION OF T&Ps**	FORMAT NO: HSEP:14-F07 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Date of Inspection :	

Sl.No.	Description	Remarks	
1.0	Name of equipment		
2.0	Basic Information of equipment		
2.1	Specification		
2.2	Sr. No. of equipment		
2.3	Make		
2.4	Year of manufacture		
3.0	Major repairs / overhauls(Furnish details of work carried out)		Date(s) of major repair/overhaul
3.1			
3.2			
3.3	Repairs carried out at site		
4.0	Any performance test conducted	Yes/No	
5.0	Document Submitted	Yes/No	
6.0	Manufacturer's test / guarantee certificate	Available/ Not available	
7.0	Performance test	Done/ Not Done	
8.0	Acceptance Norms		
9.0	Committee Observations		
10.0	Date of next review (if accepted)		

Signature-Site Safety Officer (BHEL)	**Signature-Subcontractor/ Subcontractor's Safety Officer**

	POWER SECTOR **STATUS OF T&Ps**	FORMAT NO: HSEP:14-F08 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site	
Name of Sub-Contractor	
Date of Inspection	

Item	**Nos. Deployed**	**Identification No.**	**Nos. Tested by competent person**	**Validity of Test Certificate**
Winches				
Chain Blocks				
Wire Rope Slings				
Man Cages				
D-Shackles				
Air Compressors				
Crawler Cranes				
Mobile Cranes				
Hydra Cranes				
Others				

Signature of Site I/C of subcontractor:

	POWER SECTOR	FORMAT NO: HSEP:14-F09 REV NO.: 00 PAGE NO. 01 OF 03
	INSPECTION OF CRANES AND WINCHES	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Crane Reg. No (Make/Model) _____

Name of Driver/Operator _____

Sl.no.	Description	Observation	Measures
1	Valid Driving license		
2	Hook & Hook Latch		
3	Over Hoist limit switch		
4	Boom limit switch		
5	Boom Angle Indicator		
6	Boom limit cutoff switch		
7	Condition of Boom		
8	Condition of ropes		
9	Number of load lines		
10	Size and condition of the slings		
11	Stability of the cranes		
12	Soil Condition		
13	Swing Break And Lock		
14	Proper Break And Lock		
15	Hoist Break And Lock		
16	Boom Break And Lock		
17	Main Clutch		
18	Leakage in Hydraulic Cylinders		
19	Out riggers filly extendable		
20	Tyre pressure		
21	Condition of Battery And Lamps		

Sl.no.	Description	Observation	Measures
22	Guards of moving and rotating parts		
23	Load chart provided		
24	Number and position of pedant ropes		
25	Reverse Horn		
26	Load Test Details		
27	Operator's fitness		
28	Pollution under control certificate		
29	Fire extinguisher of appropriate type.		
30	Training of the operator		

WINCH

Sl. No.	Description	YES	NO	NA	Remarks
1	Has the copy of Third Party Inspection certificate been provided in winch machine shed?				
2	Is winch machine operator experienced enough to operate the winch machine?				
3	Is the winch machine operated by someone other than the winch machine operator?				
4	Is there guard provided in all moving parts like wheel and motor's shaft?				
5	Will it protect against unforeseen operational contingencies?				
6	Are brakes, clutch and locking arrangement working properly?				
7	Has it been ensured that the guard does not constitute a hazard by itself?				
8	Are the cranks and the connecting rods protected by guardrails?				
9	Is there provision for fully covered shed with wooden plank roof?				

Sl. No.	Description	YES	NO	NA	Remarks
10	Is wire rope free from any kind of damage or wear and tear?				
11	Is split pin provided for the protection of clutch and brake locking arrangement?				
12	Is pulley inspected by competent person and certified before use?				
13	Is pulley free from any wear and tear visually?				
14	Is winch rope barricaded with clipsheet for the protection of rope and person?				
15	Is the wire rope lubricated by cardium oil?				
16	Is there any friction in wire rope which may damage the wire rope rather than the rolling parts?				
17	Is there any oil leakage in the hydraulic system of the winch machine?				
18	Has it been ensured that the guard will not cause discomfort or inconvenience to operator?				
	Total Number of NO:				
	Total Number of NA:				
	% Compliance :				

Signature of Site I/C of subcontractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F10 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF HEIGHT WORKING	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Sl. No.	**Descriptions**	**Observation (Yes/No)**	**Remarks**
1	All the workers have been explained safe work method?		
2	An established communication system has been established and explained to the workers.		
3	Adequate illumination has been ensured.		
4	Work area inspected prior to the start of the work.		
5	Area below the work place barricaded, particularly below hot work.		
6	Workers provided with bags /box to carry bolts, nuts and hand tools		
7	Arrangement for fastening hand tools made.		
8	All work platforms ensured to be of adequate strength and ergonomically suitable.		
9	Fabricated makeshift arrangements are checked for quality and type of material welding, anchoring etc.		
10.	Work at more than one elevation at the same segment is restricted.		
	ACCESS/EGRESS		
1	Walkways provided with handrail, mid-rail and toe guard?		
2	All checkered plates, gratings properly welded/ bolted?		
3	Are ladders inspected and they are in good condition?		
4	Are ladders spliced?		
5	Are ladders properly secured to prevent slipping, sliding or falling?		
6	Do side rails extend 36” above top landing?		
7	Are built up ladders constructed of sound materials?		

Sl. No.	Descriptions	Observation (Yes/No)	Remarks
8	Are rugs and cleats not over 12” on center?		
9	Metal ladders not used around electrical hazards.		
10	Proper maintenance and storage.		
11	Ladders placed at right slope.		
12	Ladders / staircases welded/ bolted properly.		
13	Any obstruction in the stairs.		
14	Are landing provided with handrails, knee rails, toe boards etc.?		
15	Whether ramp is provided with proper slope.		
16	Proper hand rails / guards provided in ramps.		
	Housekeeping		
1	Walkways, aisles & all overhead workplaces cleared of loose material.		
2	Flammable materials, if any, are cleared.		
3	All the de shuttering materials are removed after de shuttering is done.		
4	Platforms and walkways free from oil/grease or other slippery material.		
5	Collected scrap are brought down or lowered down and not dropped from height.		
	PPE And Safety Devices		
1	Use of safety helmet, safety belts ensured for all workers		
2	Anchoring points provided at all places of work.		
3	Common lifeline provided wherever linear movement at height is required.		
4	Safety nets are use wherever required.		
5	Proper fall arrest system is deployed at critical workplaces.		
6	Crawler boards/Safety system or works on fragile roof are used.		

Signature of Site I/C of subcontractor :

	POWER SECTOR **INSPECTION OF WELDING AND GAS CUTTING**	FORMAT NO: HSEP:14-F11 REV NO.: 00 PAGE NO. 1 OF 02

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Welding				
Sl.no.	Description	Yes	No	Remarks
1	Is electric connection given through 30 mA ELCB/RCCB to welding m/c?			
2	Is electric cable fitted properly in junction box on m/c?			
3	Is electrical cable free from joints?			
4	Are the joints attached firmly & insulated with tape?			
5	Is double earthing given to body of m/c?			
6	Is the physical condition of the m/c good?			
7	Is ON/OFF switch connected to the m/c is working and in good condition?			
8	Are indication lamps on m/c working?			
9	Is the electrode holder in good condition?			
10	Are the cables of the welding m/c lugged & tight properly?			
11	Are return lead connected properly (Rod, Angle, Channels shall not be used)			
	Total No of NO			
	Total No of YES			

	POWER SECTOR **INSPECTION OF WELDING AND GAS CUTTING**	FORMAT NO: HSEP:14-F11 REV NO.: 00 PAGE NO. 2 OF 02

Gas Cutting				
Sl. no	Description	Yes	No	Remarks
1	Are Cylinders kept on trolleys?			
2	Physical condition of Gas cylinders Good?			
3	Is there Oil/Grease on valve of the cylinder?			
4	Are pressure regulators in good condition?			
5	Condition of hose pipe OK?			
6	Are hose pipe clamped with hose clip?			
7	Is flash back arrestor & NRV fitted on torch both for O2 and LPG cylinder?			
8	Is nozzle of the torch cleaned?			
	Total Number of NO			
	Total No of YES			
	% Compliance			

Signature of Site I/C of subcontractor :

	POWER SECTOR **INSPECTION OF ELECTRICAL INSTALLATION**	FORMAT NO: HSEP:14-F12 REV NO.: 00 PAGE NO. 01 OF 02

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection:	

Sr. No.	**Contents**	**Yes/No**	**Remarks**
A	**Cable**		
1.	Whether the condition of cable is checked?		
2.	Are cables received from other sites checked for insulation resistance before putting them into use?		
3.	Are all main cables taken either underground / overhead?		
4.	Are welding cables routed properly above the ground?		
5.	Are welding and electrical cables overlapping?		
6.	Is any improper joining of cables/wires prevailing at site?		
B	**DBs/SDBs**		
1.	Is earth conductor continued up to DB / SDB?		
2.	Whether DBs and extension boards are protected from rain / water?		
3.	Is there any overloading of DBs / SDBs?		
4.	Are correct / proper fuses & CBs provided at main boards and sub-boards?		
5.	Is energized wiring in junction boxes, CB panels & similar places covered all times?		
C	**ELCB**		
1.	Whether the connections are routed through ELCB?		
2.	Is ELCB sensitivity maintained at 30 mA?		

Sr. No.	Contents	Yes/No	Remarks
3.	Are the ELCB numbered and tested periodically & test results recorded in a logbook countersigned by a competent person?		
D	**Grounding**		
1.	Is natural earthing ensured at the source of power (main DB at Generator or Transformer)?		
2.	Whether the continuity and tightness of the earth conductor are checked?		
3.	Mention the gauge of the earth conductor used at the site.		
4.	Mention the value of Earth Resistance.		
E	**Electrically operated Machines or Accessories**.		
1.	Whether the plug top is provided everywhere.		
2.	Are all metal parts of electrical equipment and light fittings / accessories grounded?		
3.	Is there any shed or cover for welding machines?		
4.	Are halogen lamps fixed at proper places?		
5.	Are portable power tools maintained as per norms?		
6.	Any other information:		

Signature of Site I/C of subcontractor :

	POWER SECTOR **INSPECTION OF ELEVATOR**	FORMAT NO: HSEP:14-F13 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Sr. No.	**Description**	**Remarks**
1.0	Name of equipment	
2.0	Basic Information of equipment	
2.1	Specification	
2.2	Sr. No. of equipment	
2.3	Make	
2.4	Year of manufacture	
3.0	Major repairs/overhauls(Furnish details of work carried out)	Date(s) of major repair/overhaul
3.1		
3.2		
3.3	Repairs carried out at site	
4.0	Any performance test conducted	Yes/No
5.0	Document Submitted	Yes/No
6.0	Manufacturer's test / guarantee certificate	Available/ Not available
7.0	Performance test	Done/ Not Done
8.0	Acceptance Norms	
9.0	Committee Observations	
10.0	Date of next review (if accepted)	

Signature-Subcontractor/ Subcontractor's Safety Officer	**Signature-Site Safety Officer (BHEL)**

	POWER SECTOR	FORMAT NO: **HSEP:14-F13E** REV NO.: 00 PAGE NO. 01 OF 01
	Inspection of Excavation	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Sl.no.	Description	Yes	No	Remarks
1	Precautions taken for Underground Electrical Cable			
2	Precautions taken for Under / Above ground sewer/ Drinking Water Line			
3	Precautions taken for Underground Telecommunication Line			
4	Precautions taken for Underground Product/Utility Line			
5	Precautions taken for Underground Fire Water Line			
6	Shoring / Shuttering / Sheet piling done to prevent collapse of excavation walls. Strength of Excavation wall ensured at all times			
7	Slope Cutting / Angle Maintained			
8	Hard Barricading & Edge Protection provided			
9	Separate Safe Access for Man and Vehicle			
10	Lighting arrangement			
11	Banksman Provided			
12	Required basic PPEs provided			
13	Excavated soil / Construction Material / equipment kept away from the edge.			
14	First aid in attendance.			
15	Other:			
	Total No of YES			

Signature-Subcontractor/ Subcontractor's Safety Officer **Signature-Site Safety Officer (BHEL)**

Sub: MEMO for Penalty for non-compliances in Safety

Following lapse (tick marked) was observed and penalty is imposed as stated at the bottom of this memo. It is requested that such occurrences be please avoided in future.

Safety Area

SN	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
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 properly	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	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
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.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

Legend: -

*: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

Details (if any) related to non- compliance (Name of persons, Nature of deficiency, etc.)

_____

Penalty imposed:

1, Rate as per above chart_____

2. No. of Persons/ machine/ event/ labour _____

3. Total Penalty= 1. X 2. =_____

Signature:

Witnessed by: (Sub- Contractor representative) (BHEL Personnel)

Name_____ Name_____

Distribution: 1 Copy: to Sub- contractor,
1 Copy to Site Construction Manager (BHEL)

बी एच ई एल BHEL	**POWER SECTOR- HQ** **Incident Report** (To be submitted within 24 hours of time of incident)	FORMAT NO: HSEP:14-F15 REV NO.: 00 PAGE NO. 01 OF 01

Type of incident: Fatal/Major/ Minor/Fire/Property Damage/Near-miss

1	NAME OF SITE		3	ACTIVITY AREA	
2	SCOPE OF WORK		4	NAME OF CONTRACTOR	
			5	NAME & DESIGNATION OF BHEL ACTIVITY I/C	
6	DATE & TIME OF ACCIDENT		7	DATE RESUMED	
8	NO. OF WORK-DAYS LOST BY VICTIM (If duty not resumed, give estimated figure)				
9	NO. OF 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 ACCIDENT / INJURY / DAMAGE					
12	PERSON (NAME & DESIGNATION) WITH MOST CONTROL OVER AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) CAUSING ACCIDENT INJURY / DAMAGE				
13	DESCRIBE CLEARLY HOW THE ACCIDENT OCCURRED (USE ADDITIONAL SHEET, IF REQUIRED				
ANALYSIS					
14	WHAT ACTS AND / OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS ACCIDENT				
15	WHAT ARE THE BASIC REASON FOR THE EXISTENCE OF THESE ACTS AND / OR CONDITION ?				
16	WHAT CORRECTIVE ACTIONS HAVE BEEN TAKEN TO PREVENT ACCIDENT RECURRENCE ?				
	DATE :			SIGNATURE OF SITE HSE COORDINATOR	
17	COMMENTS OF HEAD / SOX				
	DATE:			SIGNATURE OF HEAD/SOX	

	POWER SECTOR	FORMAT NO: **HSEP:14-F30** REV NO.: 00 PAGE NO. 01 OF 3
	Format for Monthly HSE Planning & Review	

Note: This is a template and can be modified in consultation with BHEL			
Name of the Site		**Name of the Subcontractor**	
Scope of Work		**Date**	
PART- A: PLAN OF HSE ACTIVITIES FOR THE MONTH OF……			**PART-B: REVIEW ON ……**
SN.	**Description of HSE Activity & Formats**	**Plan & Targets for the month**	**Review**
1	Availability of First Aid Box at Required Places and Inspection thereof as per Format: F01	Areas 1. … …	
2	Health check-up as per Format: F02	Health check-up for Nos 1. New inductees 2. Drivers & Operators 3. Workers in following high risk areas: a. …	
3	Induction training of newly joined workers as per Format: F03	Minimum No. of workers:	
4	Toolbox talks (TBT) conducted before start of work as per Format: F04	Locations of TBTs & No. of workers **1.** …	
5	PPE usage and issue as per Format: F06		
6	Inspection of T&Ps as per Format: F07	List of T&Ps to be inspected 1.	
7	Identification & Inspection Status of T&Ps as per Format: F08		
8	Inspection of Cranes & Winches as per Format: F09	List of Cranes & Winches & Nos. 1. …	
9	Inspection of Height Working as per Format: F10	Areas: 1. …	
10	Inspection of Welding & Gas Cutting operations as per Format: F11	Areas: 1. …	
11	Inspection of Electrical Installations as per Format: F12	Locations: 1. …	
12	Inspection of Elevators (as applicable) as per Format: F13	Locations: 1. …	
13	Inspection of Excavation as per Format: F13E	**Locations:** **1. …**	

SN.	Description of HSE Activity & Formats	Plan & Targets for the month	Review
14	Job Safety Analysis as per Format F32B	**Activities:** **1. …**	
15	Regular Job Specific Training (Re-training) for workers involved in hazardous activities	Topics/ Hazards & No. of workers **1.** …	
16	Mass housekeeping (HK) drive in work areas	Areas **1.** …	
17	Vertigo Test of Height workers	Minimum No. of workers:	
18	Deployment of qualified HSE Officers as per contract	Location(s) & Nos. **1.** …	
19	Deployment of qualified HSE Stewards as per contract	Location(s) & Nos. **1.** …	
20	Deployment of Safety tools & Equipment (Safety Nets, Lifelines, Fall arrestors, Man-cages, flashback arrestors, scaffolding etc.)	Tool/ Equipment & Location **1.** …	
21	Safety Walks by site in charge of agency (4 -Weekly once)	Dates:	
22	Safety walks by departmental head (8-Weekly twice)	Dates:	
23	Availability/ deployment of Safety posters/ placards/ signage at strategic locations	Locations: Nos. **1.** …	
24	Provision of clean drinking water sources for workers	Locations: Nos. **1.** …	
25	Provision of toilets for workers (separate for male & female workers)	Locations: Nos. **1.** …	
26	Rest sheds for workers during lunchtime, rain, dust storm etc.	Locations: Nos. **1.** …	
27	Availability of following in Labor colony	**1. Clean drinking water** **2. Toilets** **3. Cleanliness & Hygiene** **4. Grass cutting,** **5. Fogging** **6. Electrical Inspection …**	

SN.	Description of HSE Activity & Formats	Plan & Targets for the month	Review
28	Availability of dust/ waste bins at various locations	Locations: **1.** …	
29	Availability of Ambulance (individual/ joint) in each shift	Ambulance No.	
30	Availability of emergency vehicle in each shift	Emergency vehicle	
31	Deployment/ Availability of tested Fire Extinguishers	Locations & Nos. **1.** …	
32	Tree plantation	Locations & Nos. **1.** …	
33	Waste disposal & Scrap Bins	Locations **1.** …	
34	Illumination checks	Locations **1.** …	
35	Safety award function: 1. Display of good practices Award presentation	Minimum 1 per month	
36	**Submission of Daily Reports as per Format No.F31A**	**Daily Reports (Night & Day Shifts)**	

PLAN		**REVIEW**	
Agency Name: Sign: Date:	**BHEL** Name: Sign: Date:	**Agency** Name: Sign: Date:	**BHEL** Name: Sign: Date:

	POWER SECTOR	FORMAT NO: **HSEP:14-F31** A REV NO.: 00 PAGE NO. 01 OF 1
	Format for Daily HSE Reporting	

Note: Following format to be submitted (preferably) in excel/ soft copy by subcontractor daily at the end of each shift. Any photographs/ records to be attached

Site									**Subcontractor**																				
Year								**Month**													**Day**								
SHIFT	Submitted By	Work Area(s)	Staff	Man-Power	Safety Officers	Safety Stewards	Tool Box (Topics and No. of Participants)	Induction Training (No. of Participants)	Vertigo Test (Numbers Tested)	On-the-Job Training (Topic & participants)	Work Permits	Job Safety Analyses conducted	Height Work Inspection	Other Hazardous Activities Inspection	T&P Inspection (Names & Nos. Inspected)	Safety Walk (Designation, Areas)	HSE Meeting	Safety Reward (Details)	Housekeeping/ Dust Suppression/ Tree Plantation Activities (Locations/Details)	Lost time Accident	Restricted Work Case	Medical Treatment Case	First Aid Case	Near miss	Property Damage/ Fire	Non-Compliances Submitted by BHEL	Complied by Agency	Any other Remarks/ Inputs
Day																													
Night															NA		NA	NA	NA										

	POWER SECTOR **Job Safety Analysis Format**	FORMAT NO: **HSEP:14-F32B** REV NO.: 00 PAGE NO. 01 OF 1

Name of the Site	
Name of the Subcontractor	
Activity, Area	

HAZARDS	**PRECAUTIONS**

(Name)	**Submitted By (Agency HSE)**		**Reviewed By (BHEL Execution)**		**Approved By (BHEL HSE)**	
(Sign)						
(Date)						

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
1a	Induction training for new workers conducted through audio-visual medium & documented ?	M	1	Induction Training Records
1b	Tool box talk conducted regularly as per plan, and documented?	M	1	Toolbox Talk Records
1c	Contractor in charge and safety in charge attended safety meetings?	M	2	Minutes of Meeting
1d	Whether observations in safety meetings are complied before next meeting?	M	2	-do-
1e	Preparation and submission of Monthly HSE report within stipulated time	M	1	Report submission date
1f	Preparation and submission of Incident/near-miss report and RCA Report (as applicable) within stipulated time	M	1	Incident/ Near Miss Records
1g	Carrying out Inspections and submission of Inspection reports within stipulated time	M	1	Inspection Records
1h	Regular Job Specific Training ensured for High Risk Workers (through audio-visual medium) as per plan	M	1	Training & Attendance Records
2a	Whether the contractor is registered under BOCW	M	2	BOCW Registration Certificate
2b	Availability of Qualified safety officer (1 for every 500 labour)	M	2	Safety Officer qualification & experience records
2c	Availability of Qualified safety supervisor (1 for every 100 labour)	M	2	Safety Officer qualification & experience records
2d	All the workers are provided and using safety helmets and safety shoes/gum boots	M	2	PPE Issue Records, Inspection/ non-conformity records
2e	Housekeeping done on regular basis and scrap removal at site	M	1	Housekeeping records, Inspection/ non-conformity records
2f	Usage of Goggles/Face shields and Hand gloves for gas cutter and grinders		1	PPE Issue Records, Inspection/ non-conformity records
2g	Wall openings & floor openings are guarded?		1	Inspection/ non-conformity records
2h	Adequate illumination provided in all working area?		1	Inspection/ non-conformity records
2i	Safety posters, sign boards and emergency contact numbers in all prominent location are displayed?		1	Inspection/ non-conformity records
2j	Availability of automatic reverse horns, Main horn, hook latches for Vehicles, mobile cranes, Hydras		1	Inspection/ non-conformity records
2k	Ban of carrying mobile phones to work place is implemented for workers		1	Inspection/ non-conformity records
2l	Availability of Tags & Inspection Certificates for Cranes of all capacities		1	Master T&P List with internal & external test details
2l.2	Availability of Tags & Inspection Certificates for Winches of all capacities		1	Master T&P List with internal & external test details
2l.3	Availability of Tags & Inspection Certificates, color coding for Chain pulley blocks		1	Master T&P List with internal & external test details
2l.4	Availability of Tags & Inspection Certificates for Vehicles - Trailers, Dozers, Dumpers, Excavators. Mixers etc.		1	Master T&P List with internal & external test details
2l.5	Availability of Tags & Inspection Certificates for Welding machines, grinders, Drilling machines, etc.		1	Master T&P List with internal & external test details
2l.6	Availability of Tags & Inspection Certificates, colour coding for Wire rope slings etc.		1	Master T&P List with internal & external test details
2l.7	Availability of Tags & Inspection Certificates for Batching plants		1	Master T&P List with internal & external test details

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
2m.1	Use of Lifting Permit as per requirement		1	Permit Records
2m.2	Use of Height Permit as per requirement		1	Permit Records
2m.3	Use of Hot Work Permit as per requirement		1	Permit Records
2m.4	Use of Excavation permit as per requirement		1	Permit Records
2m.5	Use of Confined space work permit as per requirement		1	Permit Records
2m.6	Use of Grating removal and safety net removal permit as per requirement		1	Permit Records
2m.7	Use of Lockout-Tag out permit as per requirement		1	Permit Records
2m.8	Use of Radiography permit as per requirement		1	Permit Records
2m.9	Use of Night/ Holiday Work Permit as per requirement		1	Permit Records
2m.10	Use of Any other Applicable Permit as per requirement		1	Permit Records
3a	Material safety data sheet(MSDS) available for all chemicals and displayed in usage and storage area?		1	Inspection/ non-conformity records
3b	Spillages of oil/concrete and other chemical is controlled and cleaned by proper method in case of spill?		1	Inspection/ non-conformity records
3c	Availability of adequate number of urinals in workplace and in elevations and maintained	M	1	
3d	Availability of rest rooms for workers at site	M	1	
3e	Availability of Drinking water facility at work spot		1	
3f	Hygienic Labour colony is provided for workers.		1	
4a	Is heavy/complex critical lifting permit obtained for heavy, complex materials before handling/erection activity?		1	Work Permit records
4b	Whether area below lifting activities barricaded		1	Inspection/ non-conformity records
4c	Availability of experienced rigging foreman		1	Experience details of rigging foreman
4d	Is agency is following proper storage and handling procedure as per manufacturer standard for all hazardous material?		1	Procedure for storage & handling
4e	Are oxygen and acetylene cylinders are transported to work place from storage area in trolleys		1	
5a	Whether all deep excavation has been protected by barrier		1	Inspection/ non-conformity records
5b	Sloping/benching & shoring provided for excavation as per requirement?		1	-do-
5c	Proper access and egress provided for excavations?		1	-do-
5d	Blasting is done in controlled manner?		2	-do-
6a	Whether Electrical booth is equipped with Co_2 fire extinguishers and fire buckets filled with sand?		2	Inspection/ non-conformity records
6b	Availability of Illumination lamp in electric booth?		1	-do-
6c	whether Caution Boards have been displayed?		1	-do-
6d	Usage of Metal Plug top for all hand power tools ?		1	-do-
6e	Usage of Insulated welding cables.		1	-do-
6f	Electrical Booth/Distribution Board to be covered by proper Canopy.		1	-do-
6g	Availability of functional & individual 30ma ELCB / RCCB and MCB for protection and conducting periodical check-up?		1	-do-
6h	Double earthing for panel boards and all machinery & proper earth pit with regular inspection available?		1	-do-
6i	Whether Electrician is qualified and experienced		1	Qualification & Experience records of electrician
6j	Availability and usage of Rubber hand gloves by electrician?		1	Inspection/ non-conformity records

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
7a	Whether Scaffolding pipes made with steel or aluminum, are being used and checked periodically by experienced/ certified scaffolder?		2	Inspection/ non-conformity records
7b	8mm Stainless Steel wire rope with plastic cladding is provided for life line (Vertical / Horizontal) during height work?		2	-do-
7c	Availability of emergency lighting in case of power failure		1	-do-
7d	Whether all the openings are covered with Safety Nets made of fire proof Nylon?		1	-do-
7e	Whether MS pipe rails around staircases & platforms in usage are provided with top, middle rails and toe guard ?		1	-do-
7f	Whether Ladder with vertical life line /Fall arrestor is available to climb?		1	-do-
7g	Whether all workers deployed for working at height have been issued height pass after undergoing vertigo test?		1	Height Pass records
7h	Whether all workers deployed for height work / climbing ladder are provided and using Double lanyard safety belt?		1	PPE Issue records, inspection/ non-conformity reports
7i	Is all hand tools/Small material used by height workers is tied firmly to prevent fall?		1	-do-
8a	Flash back arrestors for all gas cutting sets is available on Torch side and cylinder side		1	Inspection/ non-conformity records
8b	Oxygen/Acetylene/LPG cylinders not in use have caps in place and stored separately?		1	-do-
8c	Availability of Face screen, Hand gloves, and Apron, for welders		1	-do-
8d	Protection from falling hot molten metal during metal cutting / welding at height by providing GI sheet below the cutting area especially in fire prone areas		1	-do-
9a	Pre-employment medical check-up done for all workers and submitted?		1	Medical check records
9b	Availability of first aid center, with MBBS doctor(Own or Sharing basis)	**M**	2	Attendance records
9c	Availability of Ambulance facility 24 hours (Own or sharing basis)	**M**	2	-do-
9d	Is First aid trained personnel's are available and their names are displayed at site?	**M**	1	-do-
9e	Availability of Emergency vehicle at site		1	
9f	Periodical medical check-up is conducted for all the workers and submitted?		1	Medical check records
9g	Availability of sufficient number of first aid box as per standard list and maintaining record		1	Inspection records
10a	Availability of Fire extinguishers, buckets at all vulnerable points		2	Fire extinguisher records
10b	Periodic fire mock drill conducted?		1	Fire, Mock drill records
10c	Are all flammable materials are stored separately?		1	
10d	Periodic grass cutting is done in material storage area?		1	
10e	Availability of 24V DC lighting in confined space work area		1	
10f	Availability of exhaust fan in confined space work area		1	

Note:

- **M: Mandatory; O: Optional**. Points other than mandatory can be excluded with appropriate justification (scope etc.) by BHEL
- Additionally: 30 Marks for each Fatal Accident and 10 mark for each major accident shall be deducted.

	SAFETY WORK CLEARANCE	**Permit no.**
	Project:	**Emergency Contact Nos:**
	Subcontractor:	

BURNING/WELDING /HOT WORK PERMIT

Area :_____ Date:_____ Time:_____

Name of Site Engineer (Permit Requesting Authority):_____ Sign:_____

Name of Work Performing Contractor: _____

Name of Package In charge:_____ Sign:_____ Date:_____

Description of Work: _____

_____

Work Execution Date:_____ Time Valid from:_____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Proper Access/Exit available		
2.	Proper ventilation and /or lighting provided.		
3.	Proper and safe scaffolding, platform, ladder provided.		
4.	Welding machine located in a clean and dry area.		
5.	Welding machine grounded at the equipment and proper leakage current protection device (ELCB) provided for welding machine.		
6.	Emergency STOP buttons are in working condition. Welder /Helper knows how to operate it.		
7.	Welding machine input/output cables, welding holder and weld return clamp (Holder) are insulated and in good condition.		
8.	Welder & Fitter trained to connect ground/work return clamps (Holder) to work place prior to energization of welding machine.		
9.	Gas cylinders are stacked vertically and not below the welding / cutting area. Regulator key is available with cylinder.		
10.	Pressure gauges/Flash back arrestor provided and in working condition.		
11.	Personal Protective equipment Minimum applicable: safety helmet, safety goggles, welding helmet, safety shoes, leather gloves, long sleeve and nose mask -provided		
12.	In case of pits, water removed from the pit and wood/rubber insulation provided.		
13.	Safety signboards are in place.		
14.	Adequate and Suitable nos. of fire fighting extinguisher provided.		
15.	Nearby combustible material removed. Housekeeping done.		
16.	Other		

Name of Contractor Safety Officer:_____ Sign:_____ Date:_____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name:_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Safety Representative:_____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority:_____ Sign:_____ Date:_____ Time:_____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority:_____ Sign:_____ Date:_____ Time:_____

Name of Site Engr. (Permit Requesting Authority):_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____ Sign:_____ Date:_____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site **Second Copy – BHEL SAFETY** **Third Copy : Contractor**

SAFETY WORK CLEARANCE	Permit no.
Project:	Emergency Contact Nos:
Subcontractor:	

LIFTING ACTIVITY PERMIT

Area :_____ Date:_____ Time:_____

Name of Site Engineer (Permit Requesting Authority):_____ Sign: Name of Work

Performing Contractor: _____

Name of Package In charge:_____ Sign:_____ Date:_____

Description of Work: _____

_____

Work Execution Date:_____ Time Valid from:_____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Crane used for lifting activity tested, certified and approved for rated lifting		
2.	All lifting tackles, gears/appliances are tested and certified for lifting works.		
3.	Crane operator is trained and competent for lifting operation.		
4.	Lifting sling/ belt is protected against sharp edge of the jobs to be lifted.		
5.	Access and exit marked and without obstruction.		
6.	Lifting arrangement adequate.		
7.	Unwanted rubbish material removed from work platform.		
8.	Minimum 2 guidelines have been provided for balancing and guiding jobs to be lifted.		
9.	Periphery area of crane booms as well as lifting job is barricaded and unauthorized/no-entry sign board posted.		
10.	Rigger and signal man is trained and competent for lifting work.		
11.	No lifting activity to be carried out during lightening, heavy wind/rain.		
12.	If scaffolding to be used during lift, scaffolding with valid tag available for use.		
13.	Double lanyards safety harness/belt checked an in working condition.		
14.	Safety shoes (non-slip), helmet with chin strap available with employees.		
15.	Others.		

Name of Contractor Safety Officer:_____ Sign:_____ Date:_____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name:_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Safety Representative:_____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority:_____ Sign:_____ Date:_____ Time:_____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority:_____ Sign:_____ Date:_____ Time:_____

Name of Site Engr. (Permit Requesting Authority):_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____ Sign:_____ Date:_____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site **Second Copy – BHEL SAFETY** **Third Copy : Contractor**

SAFETY WORK CLEARANCE	Permit no.
Project:	**Emergency Contact Nos:**
Subcontractor:	

WORKING AT HEIGHT PERMIT

Area :_____ Date:_____ Time:_____

Name of Site Engineer (Permit Requesting Authority):_____ Sign: Name of Work

Performing Contractor: _____

Name of Package In charge:_____ Sign:_____ Date:_____

Description of Work: _____

_____

Work Execution Date:_____ Time Valid from:_____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	All workers on job are medically fit for working at height (Person should not have vertigo)		
2.	Scaffolding with valid tag available for use		
3.	Safety harness with life line support/ fall arrester are checked and in working condition		
4.	Safety shoes (non-slip), Helmet with chin strip available with employees		
5.	Safety nets are provided as per design and provided 25 ft. below working area & extending 8 ft beyond.		
6.	Horizontal life lines are provided to cater to design specification of 2300kg per person.		
7.	Ladders have been inspected and provided as per BHEL standard/contract.		
8.	All lifting / tightening tools, hand tools/equipment checked and in good condition		
9.	Access and exit marked and without obstruction.		
10.	Lighting arrangement adequate.		
11.	Unwanted and rubbish material removed from working platform.		
12.	Electrical cable, welding Hose/Compressed air hose properly secured and lay down without obstruction.		
13.	Signboards provided on working platforms		
14.	Hazards in the vicinity are identified and communicated to the worker.		
15.	Other		

Name of Contractor Safety Officer:_____ Sign:_____ Date:_____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name:_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Safety Representative:_____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority:_____ Sign:_____ Date:_____ Time:_____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority:_____ Sign:_____ Date:_____ Time:_____

Name of Site Engr. (Permit Requesting Authority):_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____ Sign:_____ Date:_____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site **Second Copy – BHEL SAFETY** **Third Copy : Contractor**

बी एच ई एल
BHEL

Project		**Vendor**			**Package/Unit**	
SL	**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 ref erences
#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	**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	Shortfall attributable to contractor w.r.t. Plan as per Form-14 for the subject month	PERFORMANCE	35		Percentage of shortfall to be calculated w.r.t. Total planned target for the month as per part-A of F-14. If more than one work has been planned in a month then Weightages of works shall be assigned at the time of plan to arrive at plan vs achievement calculation.	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	**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	Number of days of non-availability of required Manpower including supporting staff as per plan submitted in F-14 for the month.	RESOURCES	7		Cumulative number of days Sufficient Manpower was not available as per Plan in F-14	Daily Log Book entry/Incident Registers/letter references
#3.02	Number of days of non-availability of required T&P as per plan submitted in F-14 for the month.	RESOURCES	7		Cumulative number of days Sufficient T&P was not available as per Plan in F-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	**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	**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	**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.) @ 3 points/ accident						
Less Deduction in Score Due to Minor Accidents(All Others) @ 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**	

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

PSSR	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)

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)

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)

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)

PSSR	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)

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)

Annexure

C1

DATE:31/05/2019

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/06/2019 to 31/5/2021 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/06/2019 to 31/5/2021 (BEYOND USEFUL LIFE)
I.	CRANES:-			
1	Portal Gantry Crane 500T	15	20100.00	19980.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	11370.00	11320.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	56290.00	55940.00
4	PORTAL CRANE, 360T	15	14070.00	13980.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	55460.00	55110.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	68610.00	68180.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	33510.00	33300.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	20940.00	20810.00
9	MANITOWOC M-250T TRUCK CRANE	15	30160.00	29970.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	31660.00	31470.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	26390.00	26220.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	36110.00	36110.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	15130.00	15030.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	18850.00	18850.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	16750.00	16650.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	21780.00	21640.00
15	CRAWLER CRANE SUMITOMO, 150T	15	10890.00	10820.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	13400.00	13320.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	10830.00	10780.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	10720.00	10650.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	8880.00	8820.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	10050.00	9990.00
20	CRAWLER CRANE 100 T (KH 500)	15	10050.00	9990.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	5410.00	5390.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6140.00	6110.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5370.00	5340.00
24	Mobile Crane, 55MT (TIL)	12	4410.00	4390.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3030.00	3010.00
26	MOBILE CRANE, 20MT (TIL)	10	2270.00	2260.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2270.00	2260.00
28	MOBILE CRANE ESCORTS- 14MT	10	710.00	710.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	390.00	380.00
30	ELECTRIC GANTRY CRANE 3T	5	430.00	430.00
31	ELECTRIC GANTRY CRANE 5T	5	540.00	540.00
32	ELECTRIC GANTRY CRANE 30T	5	3640.00	3620.00
33	FORK LIFT 5T	5	650.00	650.00
34	FORK LIFT 3T	5	540.00	540.00

Annexure C2 DATE 31/05/2019

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/06/2019 to 31/5/2021 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/06/2019 to 31/5/2021 (BEYOND USEFUL LIFE)
I.	CRANES:-			
1	Portal Gantry Crane 500T	15	22340.00	22200.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	12630.00	12570.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	62550.00	62160.00
4	PORTAL CRANE, 360T	15	15630.00	15540.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	61620.00	61240.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	76230.00	75760.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	37230.00	37000.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	23270.00	23120.00
9	MANITOWOC M-250T TRUCK CRANE	15	33510.00	33300.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	35180.00	34960.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	29320.00	29130.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	40120.00	40120.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	16810.00	16700.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	20950.00	20950.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	18610.00	18500.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	24200.00	24050.00
15	CRAWLER CRANE SUMITOMO, 150T	15	12100.00	12020.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	14890.00	14800.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	12030.00	11970.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	11910.00	11840.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	9860.00	9800.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	11170.00	11100.00
20	CRAWLER CRANE 100 T (KH 500)	15	11170.00	11100.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	6010.00	5980.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6830.00	6790.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5970.00	5940.00
24	Mobile Crane, 55MT (TIL)	12	4900.00	4880.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3370.00	3350.00
26	MOBILE CRANE, 20MT (TIL)	10	2520.00	2510.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2520.00	2510.00
28	MOBILE CRANE ESCORTS- 14MT	10	790.00	790.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	430.00	430.00
30	ELECTRIC GANTRY CRANE 3T	5	480.00	480.00
31	ELECTRIC GANTRY CRANE 5T	5	600.00	600.00
32	ELECTRIC GANTRY CRANE 30T	5	4040.00	4030.00
33	FORK LIFT 5T	5	720.00	720.00
34	FORK LIFT 3T	5	600.00	600.00

ANNEXURE-T I
DT: 31/05/2019

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	20930
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	310
3	MULTI SHEAVE PULLEY BLOCK 100T	630
4	MULTI SHEAVE PULLEY BLOCK 150T	1260
5	ELCTRIC WINCH 5T	1270
6	ELCTRIC WINCH 10T	2360
7	ELECTRIC WINCH 15 T	2150
8	PASSENGER CUM GOODS HOIST 1T	2270
9	FURNACE MAINTENANCE PLATFORM	5040
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2100
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	16380
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	8190
3	WELDING GENERATOR 320/300 A	300
4	WELDING RECTIFIER 400A/300A	300
5	WELDING RECTIFIER 600A	400
6	DIESEL WELDING GENERATOR 400A/300A	400
7	TRANSFORMER,600A	300
8	TRANSFORMER 300/400A	200
III	SERVICE PLANTS & ALLIED EQUIPT.	0
1	500KVA DIESEL GENERATOR	3800
2	TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	6370
3	-DO- , WITH STORAGE TANK	7280
4	OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	910
5	OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON	1360
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON	1820
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON	3640
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750	1270
9	Low Vacuum de-hydration unit	630
10	DIESEL GENERATING SET,250 KVA	1770
11	DIESEL GENERATING SET,25 KVA	500
12	VACUUM PUMP(ABSOLUTE V.C.)	540
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1090
14	ACID TRANSFER PUMP 20/50 T/HR	540
15	DEWATERING PUMP (Kirloskar make,11KW/15HP)	80
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4240

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
17	AIR COMPRESSORS 250/300/330/360/350 CFM	2730
18	AIR COMPRESSORS 140/150/190/210 CFM	910
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	1820
20	Industrial Blower 2000CFM	1270
21	Air Leak Test Blower (Flow: 40000 m^3/Hr)	1160
22	Air Blower (Flow: 20000 m^3/Hr)	940
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	630
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1630
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	1800
4	-do- Gun with nose Assembly only	540
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	36980
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	800
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1090
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1270
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1330
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2230
7	BOLT STRETCHING DEVICE	910
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	3640
9	ULTRASONIC FLAW DETECTOR	2730
10	MPI TEST KIT	360
11	GAS LEAK DETECTOR	270
12	VIBRATION/SOUND LEVEL METER IRD-306	360
13	VIBRATION/SOUND LEVEL METER IRD-308	360
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1450
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2540
16	SHOCK PULSE METER	630
17	HV.DC TEST KIT UPTO 50 KV	540
18	HV.DC TEST KIT ABOVE 50 KV	1000
19	HV.AC TEST KIT UPTO 50KV	810
20	HV.AC TEST KIT ABOVE 50KV	2910
21	MOTORISED MEGGER 2.5KV	400
22	MOTORISED MEGGAR 5KV	450
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	450
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1090
25	WAVEFORM ANALYSER	910
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1630
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1090
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	910
29	DIGITAL LOW RESISTANCE METER	630
30	DC POTENTIOMETER	180
31	PRECISION DEAD WEIGHT TESTER	1000
32	OPTICAL ALIGNMENT KIT	1360
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1200
34	VERNIER THEODOLITE,PRECISION	1200
35	VERNIER THEODOLITE,ORDINARY	200
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	120
37	ISKAMATIC 'A'	3200
38	CALIBRATOR '03'	1000
39	48 POLE EXTENDER CARD	200

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
40	MULTIJET NPM	400
41	OSCILLOMETER	10190
42	VOC EQUIPMENT	1400
43	BINARY SIGNAL GENERATOR	290
44	ELECTRIC COUNTER	690
45	FREQUENCY GENERATOR	1000
46	DBF 3 VIBRATION RECORDER/ANALYSER	3270
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	490
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1180
49	VIBROPORT 41/FFT ANALYSER	5460
50	ELCID kit	10010
51	UNIVERSAL CALIBRATION SYSTEM	2730
52	NATURAL FREQUENCY TESTER	2910
53	DIGITAL HARDNESS TESTER	360
54	ADRE 208 VIBRATION ANALYSER	7280
55	PCB DIAGONISTIC REPAIR KIT	2000
56	SECONDARY INJECTION RELAY TEST KIT	5270
57	MICRO OHM METER	1450
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 μΩ TO 20KΩ	3230
59	PMI Machine OLYMPUS make	3350
60	Mobile Lighting Mast - 9 metres (4X400 W)	860
61	10KVA RESISTANCE BRAZING MACHINE	140
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	460
63	HYDROGEN GAS LEAK DETECTOR	50
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	4980
65	WEDGE DEFLECTION KIT	80
66	TILE PRESSING MACHINE FOR GAS TURBINE	270
67	INDUCTION BRAZING MACHINE	4870
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	3640
69	ULTRASONIC FLOW METER	180
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	40
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. : FLOW 60 M3/HR	470
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. : FLOW 15 M3/HR	430
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	1810
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1260
75	5KV Insulation Tester	450
76	4 Channel Digital Oscilloscope /Fast Recorder	1710
77	4 Channel Oscillographic Recorder	580
78	Sound Level Meter	230
79	Thermal Imaging Camera	770
80	Videoscope (Video Boroscope)	1510
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1310
82	Conductivity Meter	80
83	Core Flux Test Kit	7280
84	Primary Current Injection Kit (2000A)	870
85	3 Phase Secondary Injection Kit (Relay Test)	3760
86	FRF Filtration Kit	1330
87	FFT Analyser	2290

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
88	Flue Gas Analyser	1030
89	Oil Test Kit (Mineral Oil)-Transformer	1010
90	Winding Resistance kit (R L C Load)	880
91	SFRA test Kit	1190
92	Tan Delta test Kit	4060
93	PF Meter	330
94	Ultrasonic Flow Meter	830
95	Oil Particle Counter	360

ANNEXURE-T II
DT: 31/05/2019

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	23250
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	350
3	MULTI SHEAVE PULLEY BLOCK 100T	700
4	MULTI SHEAVE PULLEY BLOCK 150T	1400
5	ELCTRIC WINCH 5T	1410
6	ELCTRIC WINCH 10T	2620
7	ELECTRIC WINCH 15 T	2390
8	PASSENGER CUM GOODS HOIST 1T	2520
9	FURNACE MAINTENANCE PLATFORM	5600
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2330
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	18190
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	9090
3	WELDING GENERATOR 320/300 A	330
4	WELDING RECTIFIER 400A/300A	330
5	WELDING RECTIFIER 600A	440
6	DIESEL WELDING GENERATOR 400A/300A	440
7	TRANSFORMER,600A	330
8	TRANSFORMER 300/400A	220
III	SERVICE PLANTS & ALLIED EQUIPT.	
1	500KVA DIESEL GENERATOR	4220
2	TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH	7070
3	-DO- , WITH STORAGE TANK	8080
4	OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	1010
5	OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON	1510
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON	2020
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON	4040
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750	1410
9	Low Vacuum de-hydration unit	700
10	DIESEL GENERATING SET,250 KVA	1970
11	DIESEL GENERATING SET,25 KVA	560
12	VACUUM PUMP(ABSOLUTE V.C.)	600
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1210
14	ACID TRANSFER PUMP 20/50 T/HR	600
15	DEWATERING PUMP (Kirloskar make,11KW/15HP)	90
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4710

ANNEXURE-T II
DT: 31/05/2019

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
17	AIR COMPRESSORS 250/300/330/360/350 CFM	3030
18	AIR COMPRESSORS 140/150/190/210 CFM	1010
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	2020
20	Industrial Blower 2000CFM	1410
21	Air Leak Test Blower (Flow: 40000 m^3/Hr)	1290
22	Air Blower (Flow: 20000 m^3/Hr)	1040
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	700
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1810
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	2000
4	-do- Gun with nose Assembly only	600
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	41090
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	880
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1210
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1410
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1480
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2480
7	BOLT STRETCHING DEVICE	1010
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	4040
9	ULTRASONIC FLAW DETECTOR	3030
10	MPI TEST KIT	400
11	GAS LEAK DETECTOR	300
12	VIBRATION/SOUND LEVEL METER IRD-306	400
13	VIBRATION/SOUND LEVEL METER IRD-308	400
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1610
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2830
16	SHOCK PULSE METER	700
17	HV.DC TEST KIT UPTO 50 KV	600
18	HV.DC TEST KIT ABOVE 50 KV	1110
19	HV.AC TEST KIT UPTO 50KV	900
20	HV.AC TEST KIT ABOVE 50KV	3230
21	MOTORISED MEGGER 2.5KV	440
22	MOTORISED MEGGAR 5KV	500
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	500
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1210

ANNEXURE-T II
DT: 31/05/2019

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
25	WAVEFORM ANALYSER	1010
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1810
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1210
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	1010
29	DIGITAL LOW RESISTANCE METER	700
30	DC POTENTIOMETER	200
31	PRECISION DEAD WEIGHT TESTER	1110
32	OPTICAL ALIGNMENT KIT	1510
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1330
34	VERNIER THEODOLITE,PRECISION	1330
35	VERNIER THEODOLITE,ORDINARY	220
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	130
37	ISKAMATIC 'A'	3550
38	CALIBRATOR '03'	1110
39	48 POLE EXTENDER CARD	220
40	MULTIJET NPM	440
41	OSCILLOMETER	11320
42	VOC EQUIPMENT	1550
43	BINARY SIGNAL GENERATOR	320
44	ELECTRIC COUNTER	760
45	FREQUENCY GENERATOR	1110
46	DBF 3 VIBRATION RECORDER/ANALYSER	3630
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	540
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1310
49	VIBROPORT 41/FFT ANALYSER	6060
50	ELCID kit	11120
51	UNIVERSAL CALIBRATION SYSTEM	3030
52	NATURAL FREQUENCY TESTER	3230
53	DIGITAL HARDNESS TESTER	400
54	ADRE 208 VIBRATION ANALYSER	8080
55	PCB DIAGONISTIC REPAIR KIT	2220
56	SECONDARY INJECTION RELAY TEST KIT	5860
57	MICRO OHM METER	1610
58	DIGITAL MICRO OHM METER	3590
59	PMI Machine OLYMPUS make	3730
60	Mobile Lighting Mast -	960
61	10KVA RESISTANCE BRAZING MACHINE	160
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH	510

ANNEXURE-T II

DT: 31/05/2019

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
63	HYDROGEN GAS LEAK DETECTOR	60
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE	5530
65	WEDGE DEFLECTION KIT	90
66	TILE PRESSING MACHINE FOR GAS TURBINE	300
67	INDUCTION BRAZING MACHINE	5410
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	4040
69	ULTRASONIC FLOW METER	200
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	50
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR	520
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR	480
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL	2010
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1400
75	5KV Insulation Tester	500
76	4 Channel Digital Oscilloscope /Fast Recorder	1900
77	4 Channel Oscillographic Recorder	650
78	Sound Level Meter	260
79	Thermal Imaging Camera	860
80	Videoscope (Video Boroscope)	1680
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1460
82	Conductivity Meter	90
83	Core Flux Test Kit	8090
84	Primary Current Injection Kit (2000A)	960
85	3 Phase Secondary Injection Kit (Relay Test)	4180
86	FRF Filtration Kit	1480
87	FFT Analyser	2550
88	Flue Gas Analyser	1140
89	Oil Test Kit (Mineral Oil)-Transformer	1120
90	Winding Resistance kit (R L C Load)	970
91	SFRA test Kit	1320
92	Tan Delta test Kit	4510
93	PF Meter	360
94	Ultrasonic Flow Meter	920
95	Oil Particle Counter	400

Form WAM 23

PROFORMA OF BANK GUARANTEE (in lieu of EARNEST MONEY)
(On non-Judicial paper of appropriate value)
(Para 4.7.6 of Works Accounts Manual)

Bank Guarantee No……
Date……

To
(Employer's Name and Address)
……..

Dear Sirs,

In accordance with the terms and conditions of Invitation for Bids/Notice Inviting Tender No……[1] (Tender Conditions), M/s. ……[2] having its registered office at ……[3] (hereinafter referred to as the 'Tenderer'), is submitting its bid for the work of……..[4] invited by 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 Southern Region, 690, Anna Salai, Nandanam, Chennai 600035*

The Tender Conditions provide that the Tenderer shall pay a sum of Rs ……..[5] 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 .....[6] 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.....[6] (in words Rupees.....) without any reservation, protest, and recourse and without the beneficiary needing to prove or demonstrate reasons for its such demand.

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. _____.[6]

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Tenderer in any suit or proceeding pending before any Court or Tribunal, Arbitrator or any other authority, 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 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 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 Tenderer 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…….[7] 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 ……[8] 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……[6]
b) This Guarantee shall be valid up to …….[7]
c) Unless the Bank is served a written claim or demand on or before _____[8] 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)

(Signature of Authorised signatory)

Date…….
Place of Issue…….

[1] Details of the Invitation to Bid/Notice Inviting Tender (Tender Ref. No. Eg. - BHEL PSSR SCT XXXX)
[2] Name of Tenderer
[3] REGISTERED Office Address of the Tenderer
[4] Details of the Work i.e Tender Description
[5] EMD Amount as mentioned in Notice Inviting Tender
[6] BG Amount in words and Figures (BG Amount shall be Minimum of EMD amount less Rs. 2 Lakhs)
[7] Validity Date
[8] Date of Expiry of Claim Period (Claim Period shall be minimum of 3 Months after the validity date of Bank Guarantee)

Note:
1. The BG should be on Non-Judicial Stamp paper/e-stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG was executed, whichever is higher. The Stamp Paper/e-stamp paper shall be purchased in the name of Vendor/Contractor/Supplier /Bank issuing the guarantee.
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's (BHEL's Consortium Bank) branch in India. 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).

PROFORMA OF BANK GUARANTEE (in lieu of SECURITY DEPOSIT)
(On non-Judicial paper of appropriate value)
(Para 4.7.6 of Works Accounts Manual)

Bank Guarantee No……
Date……

To
(Employer's Name and Address)
……..

In consideration of 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 Southern Region, 690, Anna Salai, Nandanam, Chennai 600035* having agreed to exempt _____[1] (Name of the Vendor / Contractor / Supplier) with its registered office at_____[2] (hereinafter called the said "Contractor" which term includes supplier), from demand under the terms and conditions of the Contract arising vide Letter of Intent (LOI) reference No._____ dated _____[3] valued at Rs. _____[4] (Rupees _____ only)[4] (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. _____[5] (Rupees _____ only),

We, the .....(Name & address of the Bank) ..... having our Head Office at ……..(hereinafter referred to as the Bank), at the request of _____ [Contractor(s)], being the Guarantor under this Guarantee, do hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer, an amount not exceeding Rs._____ without any demur, immediately on demand from the Employer and without any reservation, protest, and recourse and without the Employer needing to prove or demonstrate reasons for its such demand

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. _____[5].

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 or Arbitrator or any other authority, 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 claims satisfied & the Employer certifies that the terms and conditions of the said Contract have been fully and properly carried out by the said contractor(s) or acceptance of the final bill or discharge of this guarantee by the Employer, whichever is earlier. This guarantee shall initially 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. 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 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.

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 not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor 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. 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……[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.

Date _____ Day of _____

for_____ (indicate the name of the Bank)

(Signature of Authorised signatory)

[1] NAME OF VENDOR /CONTRACTOR / SUPPLIER
[2] REGISTERED OFFICE ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.
[3] LETTER OF INTENT(LOI) REFERENCE NO. WITH DATE
[4] CONTRACT VALUE (AS MENTIONED IN LOI)
[5] BG AMOUNT IN FIGURES AND WORDS
[6] VALIDITY DATE
[7] DATE OF EXPIRY OF CLAIM PERIOD (CLAIM PERIOD SHALL BE MINIMUM OF 3 MONTHS AFTER VALIDITY DATE)

Note:

1. The BG should be on Non-Judicial Stamp paper/e-stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG was executed, whichever is higher. The Stamp Paper/e-stamp paper shall be purchased in the name of Vendor/Contractor/Supplier /Bank issuing the guarantee.
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's (BHEL's Consortium Bank) branch in India. 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).

Annexure-1

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 BHEL: PSSR: SCT: 1894 - Structural steel works (i.e. transporting from BHEL store, fabrication, erection, alignment including blast cleaning & painting and other allied works) of Ash Handling Plant, Lime Handling Plant, and Gypsum Handling Plant at 5x800 MW Yadadri Power project, Veerlapalem village, Dameracherla Mandal, Nalgonda District., Telangana state. The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

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

Section 1- Commitments of the Principal

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Section 4 - Compensation for Damages

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

4.2 If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/ Performance Bank Guarantee, whichever is higher.

Section 5 - Previous Transgression

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

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

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

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

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

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

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

Section 8 -Independent External Monitor(s)

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

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

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

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

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

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

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

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

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

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

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

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

Section 9 - Pact Duration

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

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

Section 10 - Other Provisions

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

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

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

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

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

Ashtlex

For & On behalf of the Principal

(Office Seal)

For & On behalf of the Bidder/ Contractor

(Office Seal)

Place--- Chennai

Date--- 12.03.2020

Witness:_____

(Name & Address) _____

_____

Witness:_____

(Name & Address) _____

_____

Procedure-2.3

PROCEDURE FOR CONDUCT OF CONCILIATION PROCEEDINGS

1. 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 herein:

2. The party desirous of resorting to Conciliation shall send an invitation/notice in writing to the other party to conciliate specifying all points of Disputes with details of the amount claimed. The party concerned shall not raise any new issue thereafter. Parties shall also not claim any interest on claims/counter-claims from the date of notice invoking Conciliation till the conclusion of the Conciliation proceedings. If BHEL is to initiate Conciliation, then, the invitation to Conciliate shall be extended to the concerned Stakeholder in **Format 7** hereto. Where the stakeholder is to initiate the Conciliation, the notice for initiation of Conciliation shall be sent in **Format-8** hereto.

3. The party receiving the invitation/notice for Conciliation shall within 30 days of receipt of the notice of Conciliation intimate its consent for Conciliation along with its counter-claims, if any.

4. The Conciliation in a matter involving claim or counter-claim (whichever is higher) up to Rs 5 crores shall be carried out by sole Conciliator nominated by BHEL while in a matter involving claim or counter-claim (whichever is higher) of more than Rs 5 crores Conciliation shall be carried out by 3 Conciliators nominated by BHEL. The appointment of Conciliator(s) shall be completed and communicated by the concerned Department/Group of BHEL Unit/Division/Region/Business Group to the other party and the Conciliator(s) within 30 days from the date of acceptance of the invitation to conciliate by the concerned party in the **Format-9**. The details of the Claim, and counter-claim, if any, shall be intimated to the Conciliator(s) simultaneously in **Format-5**.

5. The Parties shall be represented by only their duly authorized in-house executives/officers and neither Party shall be represented by a Lawyer.

6. The first meeting of the IEC shall be convened by the IEC by sending appropriate communication/notice to both the parties as soon as possible but not later than 30 days from the date of his/their appointment. The hearings in the Conciliation proceeding shall ordinarily be concluded within two (2) months and, in exceptional cases where parties have expressed willingness to settle the matter or there exists possibility of settlement in the matter, the proceedings may be extended by the IEC by a maximum of further 2 months with the consent of the Parties subject to cogent reasons being recorded in writing.

7. The IEC shall thereafter formulate recommendations for settlement of the Disputes supported by reasons at the earliest but in any case within 15 days from the date of conclusion of the last hearing. The recommendations so formulated along with the reasons shall be furnished by the IEC to both the Parties at the earliest but in any case within 1 month from the date of conclusion of the last hearing.

8. Response/modifications/suggestions of the Parties on the recommendations of the IEC are to be submitted to the IEC within time limit stipulated by the IEC but not more than 15 days from the date of receipt of the recommendations from the IEC.

9. In the event, upon consideration, further review of the recommendations is considered necessary, whether by BHEL or by the other Party, then, the matter can be remitted back to the IEC with request to reconsider the same in light of the issues projected by either/both the Parties and to submit its recommendations thereon within the following 15 days from the date of remitting of the case by either of the Parties.

10. Upon the recommendations by the Parties, with or without modifications, as considered necessary, the IEC shall be called upon to draw up the Draft Settlement Agreement in terms of the recommendations.

11. When a consensus can be arrived at between the parties only in regard to any one or some of the issues referred for Conciliation the draft Settlement Agreement shall be accordingly formulated in regard to the said Issue(s), and the said Settlement Agreement, if signed, by the parties, shall be valid only for the said issues. As regards the balance issues not settled, the parties may seek to resolve them further as per terms and conditions provided in the contract.

12. In case no settlement can be reached between the parties, the IEC shall by a written declaration, pronounce that the Conciliation between the parties has failed and is accordingly terminated.

13. Unless the Conciliation proceedings are terminated in terms of para 22 (b), (c) & (d) herein below, the IEC shall forward his/its recommendations as to possible terms of settlement within one (1) month from the date of last hearing. The date of first hearing of Conciliation shall be the starting date for calculating the period of 2 months.

14. In case of 3 members IEC, 2 members of IEC present will constitute a valid quorum for IEC and meeting can take place to proceed in the matter after

seeking consent from the member who is not available. If necessary, videoconferencing may be arranged for facilitating participation of the members. However, the IEC recommendations will be signed by all members. Where there is more than one (1) Conciliator, as a general rule they shall act jointly. In the event of differences between the Members of IEC, the decision/recommendations of the majority of the Members of IEC shall prevail and be construed as the recommendation of the IEC.

15. The Draft Settlement Agreement prepared by the IEC in terms of the consensus arrived at during the Conciliation proceedings between the Parties shall be given by the IEC to both the parties for putting up for approval of their respective Competent Authority.

16. Before submitting the draft settlement agreement to BHEL's Competent Authority viz. the Board Level Committee on Alternative Dispute Resolution (BLCADR) for approval, concurrence of the other party's Competent Authority to the draft settlement agreement shall be obtained by the other party and informed to BHEL within 15 days of receipt of the final draft settlement agreement by it. Upon approval by the Competent Authority, the Settlement Agreement would thereafter be signed by the authorized representatives of both the Parties and authenticated by the members of the IEC.

17. In case the Draft Settlement Agreement is rejected by the Competent Authority of BHEL or the other Party, the Conciliation proceedings would stand terminated.

18. A Settlement Agreement shall contain a statement to the effect that each of the person(s) signing thereto (i) is fully authorized by the respective Party(ies) he/she represents, (ii) has fully understood the contents of the same and (iii) is signing on the same out of complete freewill and consent, without any pressure, undue influence.

19. The Settlement Agreement shall thereafter have the same legal status and effect as an arbitration award on agreed terms on the substance of the dispute rendered by an arbitral tribunal passed under section 30 of the Arbitration and Conciliation Act, 1996.

20. Acceptance of the Draft Settlement Agreement/recommendations of the Conciliator and/or signing of the Settlement Agreement by BHEL shall however, be subject to withdrawal/closure of any arbitral and/or judicial proceedings initiated by the concerned Party in regard to such settled issues.

21. Unless otherwise provided for in the agreement, contract or the Memorandum of Understanding, as the case may be, in the event of likelihood of prolonged

absence of the Conciliator or any member of IEC, for any reason/incapacity, the Competent Authority/Head of Unit/Division/Region/Business Group of BHEL may substitute the Conciliator or such member at any stage of the proceedings. Upon appointment of the substitute Conciliator(s), such reconstituted IEC may, with the consent of the Parties, proceed with further Conciliation into the matter either de-novo or from the stage already reached by the previous IEC before the substitution.

22. The proceedings of Conciliation under this Scheme may be terminated as follows:

a. On the date of signing of the Settlement agreement by the Parties; or,

b. By a written declaration of the IEC, after consultation with the parties, to the effect that further efforts at conciliation are no longer justified, on the date of the declaration; or,

c. By a written declaration of the Parties addressed to the IEC to the effect that the Conciliation proceedings are terminated, on the date of the declaration; or,

d. By a written declaration of a Party to the other Party and the IEC, if appointed, to the effect that the Conciliation proceedings are terminated, on the date of the declaration; or,

e. On rejection of the Draft Settlement Agreement by the Competent Authority of BHEL or the other Party.

23. The Conciliator(s) shall be entitled to following fees and facilities:

Sl No	**Particulars**	**Amount**
1	Sitting fees	Each Member shall be paid a Lump Sum fee of Rs 75,000/- for the whole case payable in terms of paragraph No. 27 herein below.
2	Towards drafting of settlement agreement	In cases involving claim and/or counter-claim of up to Rs 5crores. Rs 50,000/- (Sole Conciliator) In cases involving claim and/or counter-claim of exceeding Rs 5 crores but less than Rs 10 crores. Rs 75,000 (per Conciliator)

Sl No	Particulars	Amount
		In cases involving claim and/or counter-claim of more than Rs 10 crores. Rs 1,00,000/- (per Conciliator) Note: The aforesaid fees for the drafting of the Settlement Agreement shall be paid on the, Signing of the Settlement Agreement after approval of the Competent Authority or Rejection of the proposed Settlement Agreement by the Competent Authority of BHEL.
3	Secretarial expenses	Rs 10,000/- (one time) for the whole case for Conciliation by a Sole Member IEC. Where Conciliation is by multi member Conciliators –Rs 30,000/- (one time)- to be paid to the IEC
4	Travel and transportation and stay at outstation Retired Senior Officials of other Public Sector Undertakings (pay scale wise equivalent to or more than E-8 level of BHEL)	As per entitlement of the equivalent officer (pay scale wise) in BHEL.
	Others	As per the extant entitlement of whole time Functional Directors in BHEL. Ordinarily, the IEC Member(s) would be entitled to travel by air Economy Class.
5	Venue for meeting	Unless otherwise agreed in the agreement, contract or the Memorandum of Understanding, as the case may be, the venue/seat of proceedings shall be the location of the concerned Unit / Division / Region /

Sl No	Particulars	Amount
		Business Group of BHEL. Without prejudice to the seat/venue of the Conciliation being at the location of concerned BHEL Unit / Division / Region / Business Group, the IEC after consulting the Parties may decide to hold the proceedings at any other place/venue to facilitate the proceedings. Unless, Parties agree to conduct Conciliation at BHEL premises, the venue is to be arranged by either Party alternately.

24. The parties will bear their own costs including cost of presenting their cases/evidence/witness(es)/expert(s) on their behalf. The parties agree to rely upon documentary evidence in support of their claims and not to bring any oral evidence in IEC proceedings.

25. If any witness(es) or expert(s) is/are, with the consent of the parties, called upon to appear at the instance of the IEC in connection with the matter, then, the costs towards such witness(es)/expert(s) shall be determined by the IEC with the consent of the Parties and the cost so determined shall be borne equally by the Parties.

26. The other expenditures/costs in connection with the Conciliation proceedings as well as the IEC's fees and expenses shall be shared by the Parties equally.

27. Out of the lump sum fees of Rs 75,000/- for Sitting Fees, 50% shall be payable after the first meeting of the IEC and the remaining 50% of the Sitting Fees shall be payable only after termination of the conciliation proceedings in terms of para 22 hereinabove.

28. The travelling, transportation and stay at outstation shall be arranged by concerned Unit as per entitlements as per Serial No. 4 of the Table at para 23 above, and in case such arrangements are not made by the BHEL Unit, the same shall be reimbursed to the IEC on actuals limited to their entitlement as per Serial No. 4 of the Table at Para 23 above against supporting documents. The IEC Member(s) shall submit necessary invoice for claiming the fees/reimbursements.

29. The Parties shall keep confidential all matters relating to the conciliation proceedings. Confidentiality shall extend also to the settlement agreement,

except where its disclosure is necessary for purposes of its implementation and enforcement or as required by or under a law or as per directions of a Court/Governmental authority/ regulatory body, as the case may be.

30. The Parties shall not rely upon or introduce as evidence in any further arbitral or judicial proceedings, whether or not such proceedings relate to the Disputes that is the subject of the Conciliation proceedings:

a. Views expressed or suggestions made by the other party in respect of a possible settlement of the Disputes;

b. admissions made by the other party in the course of the Conciliator proceedings;

c. proposals made by the Conciliator;

d. The fact that the other Party had indicated his willingness to accept a proposal for settlement made by the Conciliator.

31. The Parties shall not present the Conciliator(s) as witness in any Alternative Dispute Resolution or Judicial proceedings in respect of a Disputes that is/was the subject of that particular Conciliation proceeding.

32. None of the Conciliators shall act as an arbitrator or as a representative or counsel of a Party in any arbitral or judicial proceeding in respect of a Disputes that is/was the subject of that particular Conciliation proceeding.

33. The Parties shall not initiate, during the Conciliation proceedings, any arbitral or judicial proceedings in respect of a Disputes that is the subject matter of the Conciliation proceedings except that a Party may initiate arbitral or judicial proceedings where, in his opinion, such proceedings are necessary for preserving his rights including for preventing expiry of period of limitation. Unless terminated as per the provisions of this Scheme, the Conciliation proceedings shall continue notwithstanding the commencement of the arbitral or judicial proceedings and the arbitral or judicial proceedings shall be primarily for the purpose of preserving rights including preventing expiry of period of limitation.

34. The official language of Conciliation proceedings under this Scheme shall be English unless the Parties agree to some other language.

FORMAT-5

STATEMENT OF CLAIMS/COUNTER CLAIMS TO BE SUBMITTED TO THE IEC BY BOTH THE PARTIES

1. Chronology of the Disputes

2. Brief of the Contract/MoU/Agreement/LOI/LOA

3. Brief history of the Disputes:

4. Issues:

5. Details of Clam(s)/Counter Claim(s):

Sl. No.	**Description of claim(s)/Counter Claim**	**Amount (in INR)Or currency applicable in the contract**	**Relevant contract clause**

6. Basis/Ground of claim(s)/counter claim(s) (along with relevant clause of contract)

Note– *The Statement of Claims/ Counter Claims may ideally be restricted to maximum limit of 20 pages. Relevant documents may be compiled and submitted along with the statement of Claims/ Counter Claims. The statement of Claims/ Counter Claims is to be submitted to all IEC members and to the other party by post as well as by email.*

FORMAT-7

FORMAT FOR NOTICE INVOKING CONCILIATION CLAUSE BY BHEL FOR REFERRING THE DISPUTES TO CONCILIATION THROUGH IEC

To,

M/s. (Stakeholder's name)

Subject: **NOTICE FOR INVOCATION OF THE CONCILIATION CLAUSE OF THE CONTRACT BY BHEL**

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Dear Sir/Madam,

As you are aware, with reference to above referred Contract/MoU/Agreement/LOI/LOA, certain disputes have arisen, which, in-spite of several rounds of mutual discussions and various correspondences have remained unresolved. The brief particulars of our claims which arise out of the above- referred Contract/MoU/Agreement/LOI/LOA are reproduced hereunder:

Sl. No.	Claim description	Amount involved

As you are aware, there is a provision in the captioned Contract/MoU/Agreement/LOI/ LOA for referring disputes to conciliation.

In terms of Clause ---------of Procedure i.e., Annexure ------ to the Contract/MoU /Agreement / LOI / LOA, we hereby seek your consent to refer the matter to Conciliation by Independent Experts Committee to be appointed by BHEL. You are invited to provide your consent in writing to proceed with conciliation into the above mentioned disputes within a period of 30 days from the date of this letter along with details of counter-claims, if any, which you might have with regard to the subject Contract/ MoU/ Agreement/ LOI/ LOA.

Please note that upon receipt of your consent in writing within 30 days of the date of receipt of this letter by you, BHEL shall appoint suitable person(s) from the BHEL Panel of Conciliators.

This letter is being issued without prejudice to our rights and contentions available under the contract and law.

Thanking you
Yours faithfully

Representative of BHEL

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

FORMAT-8

FORMAT FOR NOTICE INVOKING CONCILIATION CLAUSE BY A STAKEHOLDER FOR REFERRING THE DISPUTES TO CONCILIATION THROUGH IEC

To,
BHEL (Head of the Unit/Division/Region/Business Group)

Subject: **NOTICE FOR INVOCATION OF THE CONCILIATION CLAUSE OF THE CONTRACT BY A STAKEHOLDER**

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Dear Sir/Madam,

As you are aware, with reference to above referred Contract/MoU/Agreement/LOI/LOA, certain disputes have arisen, which, in-spite of several rounds of mutual discussions and various correspondences have remained unresolved. The brief particulars of our claims which have arisen out of the above-referred Contract/MoU/Agreement/LOI/LOA are enumerated hereunder:

Sl. No.	Claim description	Amount involved

As you are aware, there is a provision in the captioned Contract/MoU/Agreement/LOI/ LOA for referring inter-se disputes of the Parties to conciliation.

We wish to refer the above-said disputes to Conciliation as per the said Clause of the captioned Contract/MoU/Agreement/LOI/ LOA. In terms of Clause ---------of Procedure i.e., Annexure ------ to the Contract/MoU /Agreement / LOI / LOA, we hereby invite BHEL to provide its consent in writing to proceed with conciliation into the above mentioned disputes within a period of 30 days from the date of this letter along with details of counter-claims, if any, which it might have with regard to the subject Contract/ MoU/ Agreement/ LOI/ LOA and to appoint suitable person(s) as Conciliator(s) from the BHEL Panel of Conciliators.

This letter is being issued without prejudice to our rights and contentions available under the contract and law.

Thanking you
Yours faithfully

Representative of the Stakeholder

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

FORMAT-9

FORMAT FOR INTIMATION TO THE STAKEHOLDER ABOUT APPOINTMENT OF CONCILIATOR/IEC

To,

M/s. (Stakeholder's name)

Subject: **INTIMATION BY BHEL TO THE STAKEHOLDER AND CONCILIATOR(S) ABOUT APPOINTMENT OF CONCILIATOR/IEC**

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Sir,

This is with reference to letter dated ---------- regarding reference of the disputes arising in connection with the subject Contract No /MoU/Agreement/LOI/LOA to conciliation and appointment of Conciliator(s).

In pursuance of the said letter, the said disputes are assigned to conciliation and the following persons are nominated as Conciliator(s) for conciliating and assisting the Parties to amicably resolve the disputes in terms of the Arbitration & Conciliation Act, 1996 and the Procedure ---- to the subject Contract ...../MoU/Agreement/LOI/LOA, if possible.

Name and contact details of Conciliator(s)

a) .....

b) .....

c) .....

You are requested to submit the Statement of Claims or Counter-Claims (strike off whichever is inapplicable) before the Conciliator(s) in Format 5 (enclosed herewith) as per the time limit as prescribed by the Conciliator(s).

Yours faithfully,

Representative of BHEL

CC: To Conciliator(s)… for Kind Information please.
Encl: As above

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

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.

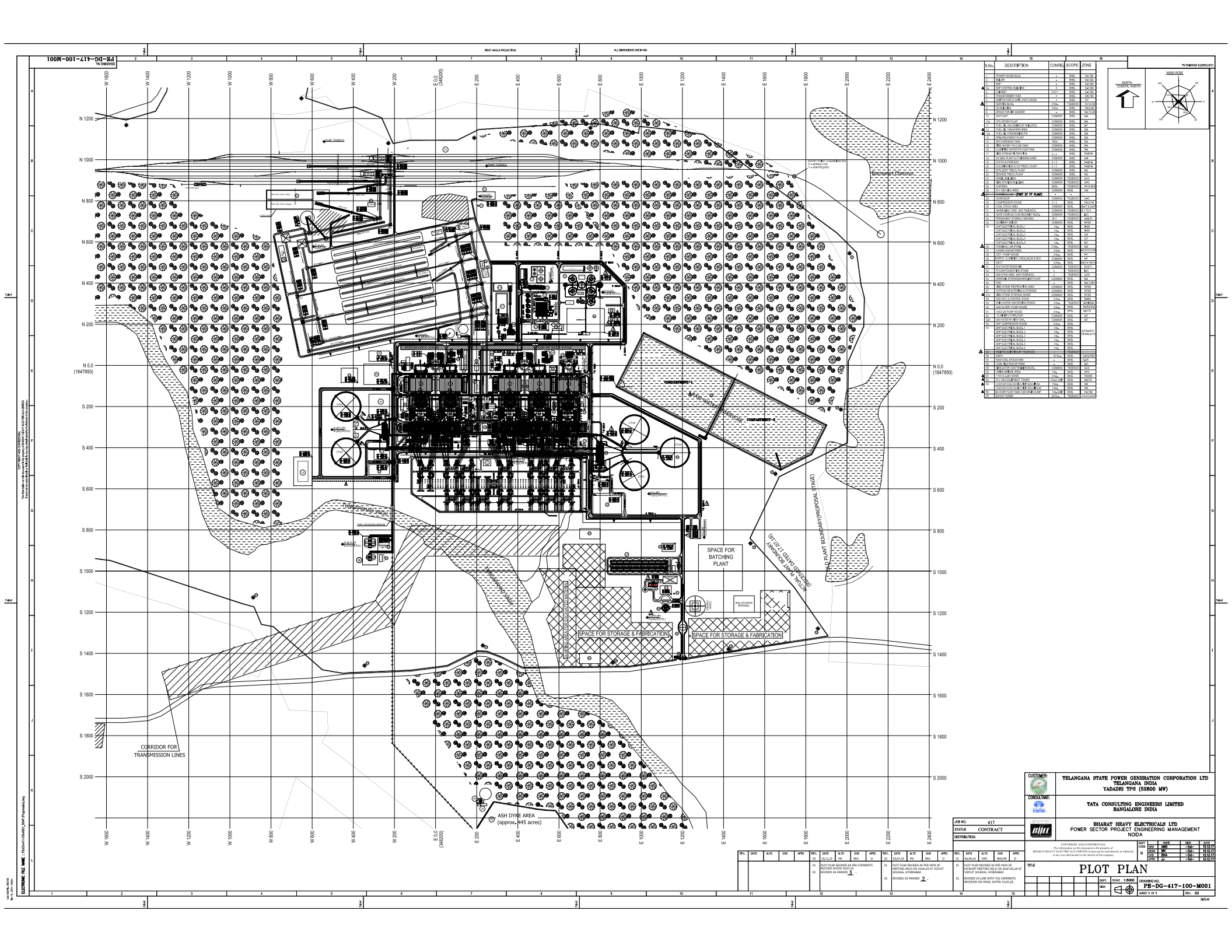
We further confirm our unqualified acceptance to all Terms and Conditions, unqualified compliance to Tender Conditions, Integrity Pact (if applicable) and opening of price bid submitted in the E-tendering portal https://www.bhel.abcprocure.com.

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)



S.No.	DESCRIPTION	CONFIG	SCOPE	ZONE
1	POWER HOUSE BLDG	-	BHEL	S4,C3E
2	BOILER	-	BHEL	S4,C3E
3	ESP	-	BHEL	S4,C3E
4	ESP CONTROL BUILDING	-	BHEL	S4,C3E
5	CHIMNEY	2x1+1	BHEL	S4,C3E
6	TRANSFORMER YARD	-	BHEL	S4,C3E
7	SWITCHYARD & SWTL CONT. ROOM	-	BHEL	S4
8	DISTR.EL.BLDG.	1No.	BHEL	S4,C4,M
9	DG BUILDING	1No	BHEL	S4,C,EC
10	SPACE FOR 4TH WASHER	-	BHEL	S4,T,M,EC
11	DM PLANT	COMMON	BHEL	S4
12	CPU REGEN PLANT	COMMON	BHEL	S4
13	FUEL OIL UNLOADING BY RAIL/MTG	COMMON	BHEL	S4
14	FUEL OIL FORWARDING AREA	COMMON	BHEL	S4
15a	FUEL OIL FORWARDING BY	COMMON	BHEL	S4
15b	FUEL EQUIPMENT PLANT	COMMON	BHEL	S4
16	DM STORAGE TANK	1No.	BHEL	S4
17	CIRC WATER PIP.CLM TANK	COMMON	BHEL	S4
18	CLARIFIED WATER PUMP TANK	COMMON	BHEL	S4
19	RES.FIRE PUMP STATION	2 x 3	BHEL	S4,EC,M
20	NG GEN. PLANT & CYLINDERS SHED	COMMON	BHEL	S4C
21	CAUSTIC & CARBONAY	2 x 3	BHEL	S4,EC,M
22	CHLORINATION & CW TREAT. PLANT	2 x 3	BHEL	S4,EC,M
23	EFFLUENT TREAT. PLANT	COMMON	BHEL	S4
24	SEWAGE TREAT. PLANT	COMMON	BHEL	S4
25	ADMN. BUILDING	COMMON	TGENCO	S4,O
26	FIRE STATION BUILDING	COMMON	TGENCO	S4O
27	CANTEEN	200A	TGENCO	S4,C,EA
28	FLY ASH SILO NOS	COMMON	BHEL	S4
29	[illegible] - [illegible] (PART OF PT PLANT)	-	-	-
30	WORKSHOP	COMMON	TGENCO	S4O
31	COMPRESSOR HOUSE	2 x 3	BHEL	S4,C,EC
32	COAL STOCK AREA	COMMON	BHEL	S4,T,C,MO
33	MARSHALLING YARD AND TRSFRCES	COMMON	TGENCO	S4,T,O,S
34	GATE COMPLEX COMMERCIAL BLDG.	COMMON	TGENCO	S4O
35	PERMANENT STORES / MAGZINE	2CH	TGENCO	S4,N,S
36	RAILWAY SIDING	COMMON	BHEL	S4,EC
37	CHP ELECTRICAL BLDG-1	1No.	BHEL	S4,EC
38	CHP ELECTRICAL BLDG-2	1No.	BHEL	S4,EC
39	CHP ELECTRICAL BLDG-3	1No.	BHEL	S4C
40	CHP ELECTRICAL BLDG-4	1No.	BHEL	S4C
41a	CHP ELECTRICAL BLDG-5	1No.	BHEL	S4C
41b	CHEMICAL LAB (PT.P.)	1No.	TGENCO	S4
42	ANCHO LEAKAGE SHED	1No.	BHEL	S4,T,O,S,EC
43	CST + PUMP HOUSE	3 No.	BHEL	S4
44	BERTH SLOPE PR. CHEM. BLDG & MCC	COMMON	BHEL	S4
45	MCC	3 No.	BHEL	S4,T,C,EC
46	RAW WATER RESERVOIR	COMMON	BHEL	S4,T,C
47	PYLON FOUNDATION STORE	-	TGENCO	S4O
48	ASH DYKE AREA - ENT. TGENCO'S	-	TGENCO	S4,O,S
49	WORKSHOP, STORES & HANDLING PLANT	COMMON	BHEL	S4
50	FWP	-	BHEL	S4,T,EC
51	LIME STONE PREPARATION AREA	COMMON	BHEL	S4,T,M
52	GYPSUM DEWATERING & STORAGE	COMMON	BHEL	S4,T,M
53a	LIME STONE STORAGE SHADE	COMMON	BHEL	S4,T,M
53	FLY ASH SILO CONTROL ROOM	2 No.	BHEL	S4,EC
54	RAIN WATER HARVESTING PONDS	2 No.	TGENCO	S4,T,EC,O
55	ASH SLURRY PUMP HOUSE	2 No.	BHEL	S4,T,C,EC
56	MACERATOR HOUSE	3 No.	BHEL	S4,T,S
57	SUMPS (TYPE-1 TO 5)	COMMON	BHEL	S4
57A	ASH WATER RECIRCULATING PUMP HOUSE	COMMON	BHEL	S4
58	AHP COMPRESSOR HOUSE	2 No.	BHEL	S4
59	AHP ELECTRICAL BLDG-1	1No.	BHEL	S4,T,EC,M,O
	AHP ELECTRICAL BLDG-2	1No.	BHEL	S4,T,EC,M,O
	AHP ELECTRICAL BLDG-3	1No.	BHEL	
	AHP ELECTRICAL BLDG-4	1No.	BHEL	
	AHP ELECTRICAL BLDG-5	1No.	BHEL	
	AHP ELECTRICAL BLDG-6	1No.	BHEL	
	[illegible] AND [illegible] - TGENCO	-	TGENCO	-
60	DEPH	10 No.	BHEL	S4,T,C,EC
61	RAW COAL STOCK YARD	-	BHEL	S4,O
62	COAL & LIMESTONE MIXING	4 No.	BHEL	S4,T,O
63	TRANSLATOR CUM TRANSFER BLDG.	COMMON	TGENCO	S4,O
64	CLARIFLOCCULATOR	2 No.	BHEL	S4,T,C
65	FLY ASH SILO EXTENSION TANKS	4 No. (4+1)	BHEL	S4,T,C
66	ADMIN BUILDING & ITI BUILDING	1No.	BHEL	S4
67	EX-SITE RETURN TANK TURBIDITY DUMP	1No.(P)	BHEL	S4,C,T,M
68	ENTRY TOWER	2 No.	TGENCO	S4,O,EC,M

REV.	DATE	ALTD	CHD	APPD
03	23.11.18	RNL	BNA	JJ
02	PLOT PLAN REVISED AS PER COMMENTS RECEIVED DATED 19.07.18 REVISED AS MARKED 1.			
01	PLOT PLAN REVISED AS PER MOM OF KICK-OFF MEETING HELD ON 29.06.18 AT VIDYUT SOUDHA, HYDERABAD			

REV.	DATE	ALTD	CHD	APPD
03	23.11.18	RNL	BNA	JJ
02	PLOT PLAN REVISED AS PER MOM OF MEETING HELD ON 19.04.18 AT VIDYUT SOUDHA, HYDERABAD			
01	REVISED IN LINE WITH TCE COMMENTS RECEIVED VIA EMAIL DATED 15.03.18. REVISED AS MARKED 2.			

REV.	DATE	ALTD	CHD	APPD
01	05.04.18	AMS	BNA/RNL	JJ
02	23.11.18	RNL	BNA	JJ

JOB NO. 417
STATUS CONTRACT
DISTRIBUTION

CUSTOMER:
TELANGANA STATE POWER GENERATION CORPORATION LTD
TELANGANA, INDIA
YADADRI TPS (5X800 MW)

CONSULTANT:
TATA CONSULTING ENGINEERS LIMITED
BANGALORE INDIA

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
NOIDA

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DEPT	NAME	DES	DATE
DSN	AMS	--Sd--	15.12.17
CHTD	MK	--Sd--	15.12.17
CHD	BNA	--Sd--	15.12.17
APPD	JJ	--Sd--	15.12.17

TITLE
PLOT PLAN

DEPT. SCALE 1:5000 DRAWING NO. PE-DG-417-100-M001
DSN CHD
SHEET 1 OF 1 REV. 03

PE-DG-417-100-M001
THIS DRAWING SUPERSEDES

FIRST ANGLE PROJECTION
ALL DIMENSIONS ARE IN MM

THIS DRAWING IS ELECTRONICALLY GENERATED

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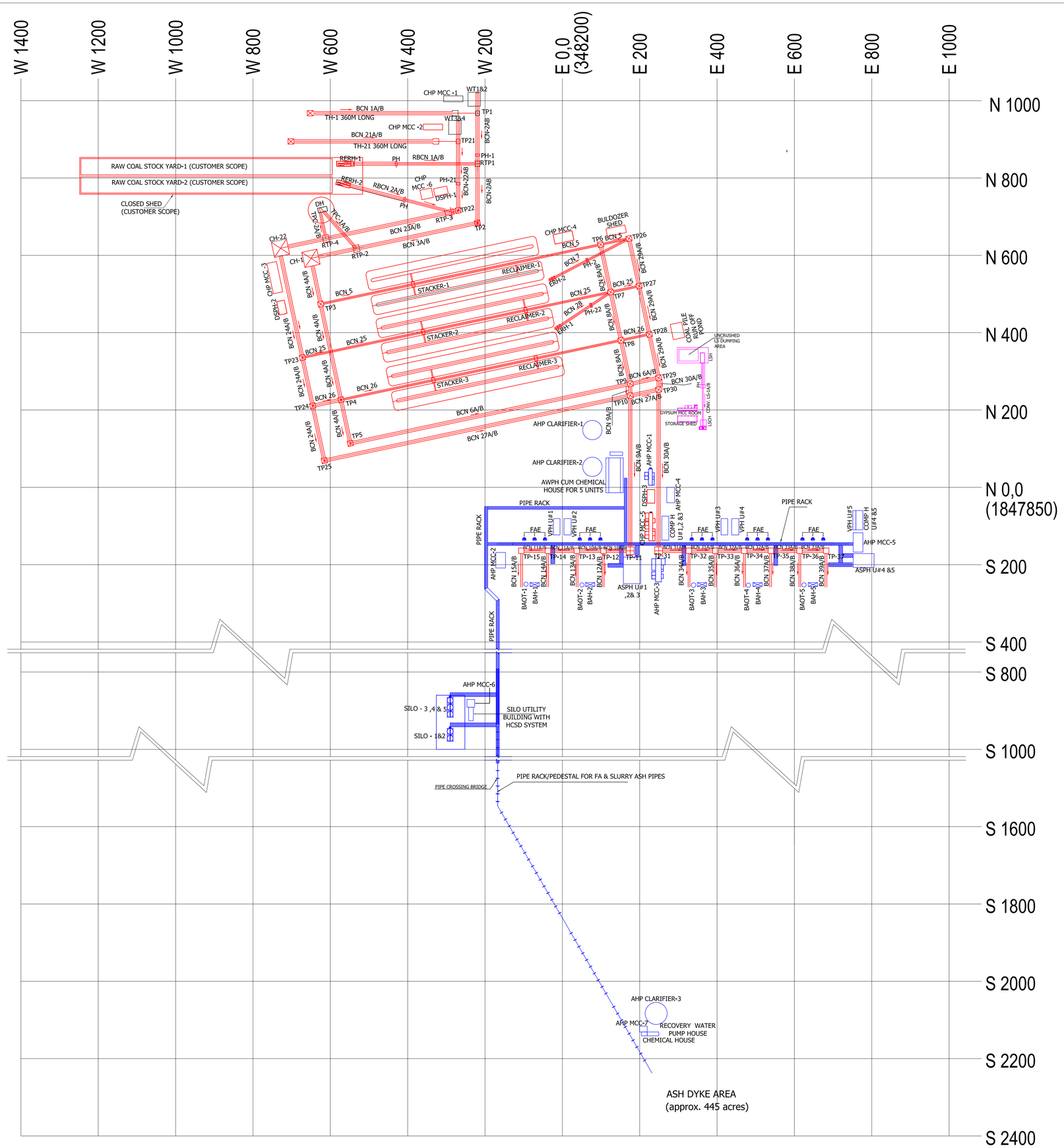
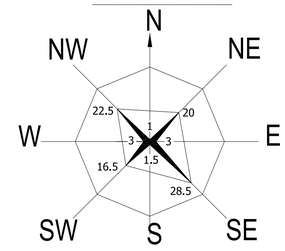


NORTH

WIND ROSE



LEGENDS:

CHP (SHOWN IN RED)

CHP -- COAL HANDLING PLANT
TP -- TRANSFER POINT
RTP -- RAW COAL TRANSFER POINT
BCN -- BELT CONVEYOR
RBCN -- RAW COAL BELT CONVEYOR
TPC -- TAPPING CONVEYOR
CH -- CRUSHER HOUSE
DSPH -- DUST SUPPRESSION PUMP HOUSE
WT -- WAGON TIPPLER
DH -- DRIVE HOUSE
RERH -- RAW COAL EMERGENCY RECLAIM HOPPER
ERH -- EMERGENCY RECLAIM HOPPER
TH -- TRACK HOPPER
PH -- PENT HOUSE

AHP (SHOWN IN BLUE)

AHP -- ASH HANDLING PLANT
COMP H -- COMPRESSOR HOUSE
ASPH -- ASH SLLURY PUMP HOUSE
VPH -- VACCUM PUMP HOUSE
FAE -- FLY ASH EQUIPMENT TOWER
AWPH -- ASH WATER PUMP HOUSE
BAH -- BOTTOM ASH HOPPER
BAOT -- BOTTOM ASH OVERFLOW TANK
AWPH -- ASH WATER PUMP HOUSE

LHP & GHP (SHOWN IN MAGENTA)

LHP -- LIMESTONE HANDLING PLANT
GHP -- GYPSUM HANDLING PLANT
LSCH -- LIME STONE CRUSHER HOUSE
LSH -- LIME STONE HOPPER

CUSTOMER
TELANGANA STATE POWER GENERATION CORPORATION LTD.
HYDRERABAD - TELANGANA INDIA

PROJECT
5X800MW YADADRI THERMAL POWER STATION
UNIT # 1 TO 5

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI
Maharatna Company

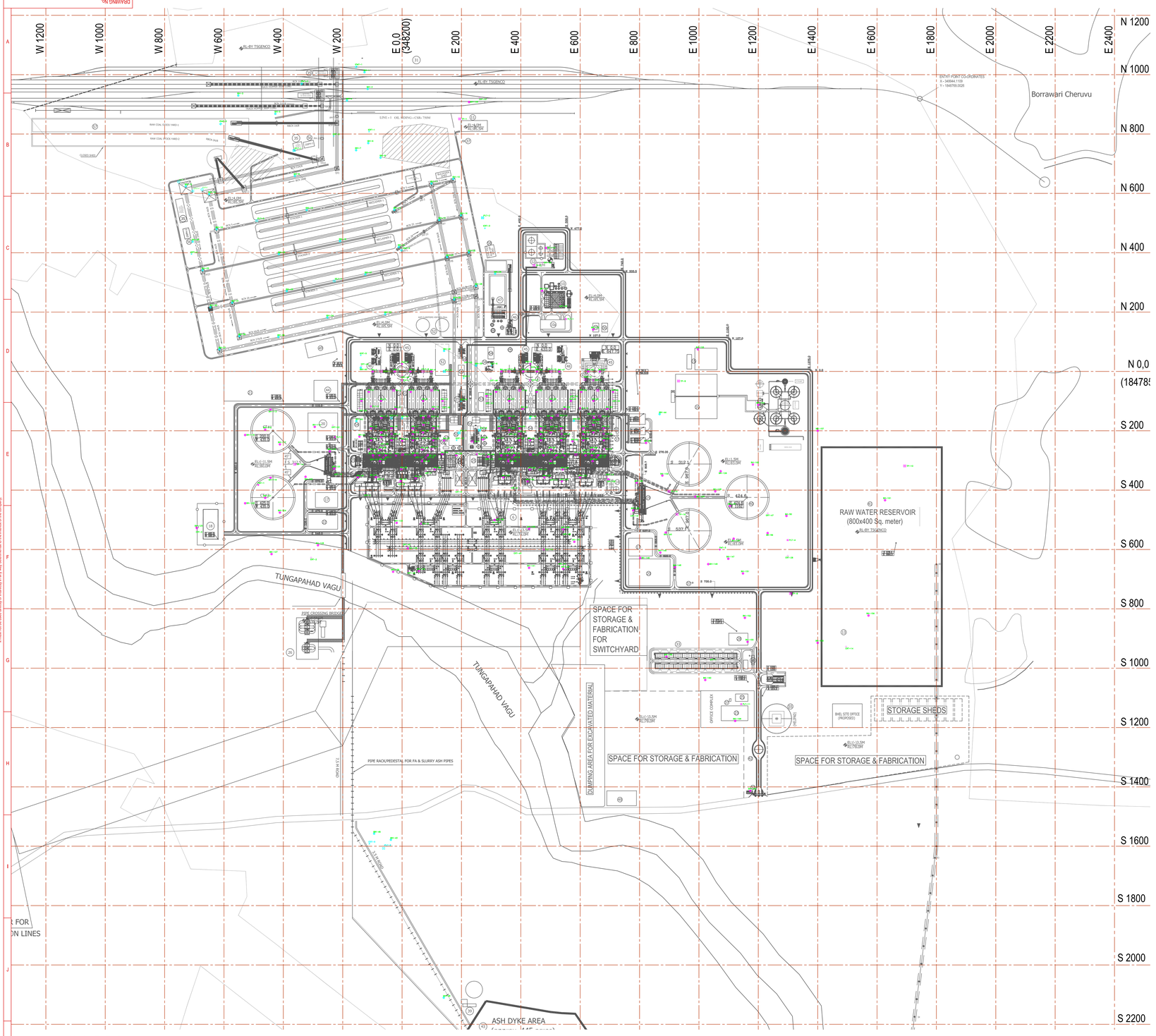
		NAME	SIGN	DATE
DEPT CODE C	DRN	PRASHANTH	-SS-	23.03.2018
	DESN	SUSHANTH	-SS-	23.03.2018
	CHD	REDDY	-SS-	23.03.2018
	APPD	SANJAY	-SS-	23.03.2018

TITLE
CHP-AHP-LHP & GHP LAYOUT

DEPT.
SCALE
SIGN
DATE
DRAWING NO.
SHEET 01 OF 01
REV. 0

DRAWING No. PE-DG-417-602-C001

FIRST ANGLE PROJECTION | ALL DIMENSIONS ARE IN MM



BORE HOLE (BH)

MARKING	CO-ORDINATES		DEPTH (M) (REFER NOTE-2)
BH-1	0.0 N/S	100 W	10
BH-2	0.0 N/S	20 W	20
BH-3	0.0 N/S	29 E	15
BH-4	0.0 N/S	99 E	10
BH-5	69 S	112 W	10
BH-6	69 S	29 E	10
BH-7	99 S	137 W	10
BH-8	99 S	71 W	20
BH-9	99 S	70 E	20
BH-10	99 S	136 E	10
BH-11	126 S	22 W	10
BH-12	126 S	105 E	10
BH-13	157 S	69 W	20
BH-14	157 S	71 E	20
BH-15	191 S	105 W	10
BH-16	191 S	38 W	10
BH-17	191 S	36 E	10
BH-18	191 S	105 E	10
BH-19	205 S	70 W	15
BH-20	205 S	70 E	15
BH-21	220 S	144 W	10
BH-22	232 S	104 W	10
BH-23	232 S	36 W	15
BH-24	233 S	0.00 E/W	10
BH-25	232 S	36 E	10
BH-26	232 S	105 E	15
BH-27	232 S	141 E	10
BH-28	263 S	74 W	15
BH-29	263 S	68 E	15
BH-30	283 S	98 W	15
BH-31	283 S	55 W	20
BH-32	283 S	43 E	15
BH-33	283 S	87 E	20
BH-34	279 S	135 E	10
BH-35	283 S	182 E	15
BH-36	302 S	74 W	15
BH-37	302 S	68 E	15
BH-38	329 S	3 W	10
BH-39	330 S	110 E	10
BH-40	357 S	149 W	10
BH-41	356 S	88 W	10
BH-42	360 S	45 E	15
BH-43	369 S	5 W	10
BH-44	0.0 N/S	334 E	10
BH-45	0.0 N/S	408 E	10
BH-46	0.0 N/S	454 E	20
BH-47	0.0 N/S	530 E	10
BH-48	0.0 N/S	627 E	15
BH-49	0.0 N/S	666 E	20
BH-50	487 S	1295 E	10
BH-51	69 S	317 E	15
BH-52	69 S	454 E	10
BH-53	69 S	604 E	15
BH-54	69 S	711 E	10
BH-55	83 S	284 E	10
BH-56	545 S	1231 E	15
BH-57	99 S	361 E	20
BH-58	99 S	501 E	20
BH-59	99 S	569 E	10
BH-60	99 S	644 E	20
BH-61	126 S	406 E	15
BH-62	126 S	548 E	15
BH-63	126 S	691 E	15
BH-64	157 S	362 E	15
BH-65	157 S	502 E	15
BH-66	157 S	645 E	20
BH-67	191 S	327 E	15
BH-68	196 S	361 E	20
BH-69	191 S	395 E	15
BH-70	191 S	467 E	15
BH-71	191 S	536 E	15
BH-72	191 S	610 E	15
BH-73	191 S	679 E	15
BH-74	205 S	501 E	20
BH-75	205 S	644 E	10
BH-76	229 S	273 E	10
BH-77	232 S	327 E	15
BH-78	232 S	396 E	15
BH-79	232 S	431 E	10
BH-80	232 S	468 E	15
BH-81	232 S	536 E	15
BH-82	235 S	574 E	10
BH-83	232 S	611 E	10
BH-84	232 S	679 E	15
BH-85	241 S	822 E	10
BH-86	263 S	358 E	15
BH-87	263 S	501 E	15
BH-88	263 S	642 E	15
BH-89	287 S	290 E	10
BH-90	283 S	334 E	15
BH-91	283 S	377 E	20
BH-92	283 S	477 E	15
BH-93	283 S	520 E	20
BH-94	283 S	618 E	15
BH-95	283 S	661 E	20
BH-96	302 S	358 E	15
BH-97	302 S	501 E	15
BH-98	302 S	642 E	15
BH-99	330 S	431 E	10
BH-100	330 S	541 E	10
BH-101	357 S	341 E	10
BH-102	357 S	479 E	10
BH-103	357 S	599 E	10
BH-104	350 S	877 E	10
BH-105	363 S	695 E	10
BH-106	370 S	423 E	10
BH-107	370 S	538 E	10
BH-108	375 S	790 E	15
BH-109	908 N	226 E	10
BH-110	416 N	485 E	15
BH-111	272 N	472 E	10
BH-112	141 N	644 E	10
BH-113	129 S	443 W	15
BH-114	187 S	294 W	10
BH-115	196 S	461 W	15
BH-116	214 S	529 W	10
BH-117	246 S	412 W	15
BH-118	269 S	244 W	15
BH-119	359 S	443 W	15
BH-120	328 S	228 W	15
BH-121	426 S	461 W	15
BH-122	355 S	325 W	10
BH-123	444 S	529 W	10
BH-124	476 S	412 W	15
BH-125	527 S	692 W	15
BH-126	586 S	283 W	10
BH-127	615 S	440 W	10
BH-128	336 S	1073 E	15
BH-129	404 S	1055 E	15
BH-130	422 S	987 E	10
BH-131	453 S	1104 E	10
BH-132	468 S	778 E	15
BH-133	510 S	18 W	10
BH-134	500 S	312 E	10
BH-135	530 S	428 E	10
BH-136	532 S	543 E	10
BH-137	574 S	580 E	10
BH-138	596 S	19 E	10
BH-139	675 S	30 W	10
BH-140	673 S	57 E	10
BH-141	662 S	428 E	10
BH-142	685 S	543 E	10
BH-143	643 S	885 E	10
BH-144	564 S	1117 E	10
BH-145	611 S	870 E	15
BH-146	629 S	802 E	10
BH-147	631 S	1099 E	15
BH-148	660 S	919 E	10
BH-149	649 S	1031 E	10
BH-150	915 S	1400 E	10
BH-151	681 S	1148 E	10
BH-152	830 S	1155 E	10
BH-153	74 N	997 E	10
BH-154	113 S	1200 E	10
BH-155	911 S	1164 E	15
BH-156	823 S	1571 E	10
BH-157	200 S	1400 E	15
BH-158	1178 S	1122 E	15

ELECTRICAL RESISTIVITY TEST (ERT)

MARKING	CO-ORDINATES	
ERT-1	965 S	1040 E
ERT-2	828 S	307 W
ERT-3	534 S	692 W
ERT-4	410 S	126 W
ERT-5	357 S	80 W
ERT-6	374 S	11 W
ERT-7	536 S	79 E
ERT-8	400 S	182 E
ERT-9	386 S	369 E
ERT-10	324 S	463 E
ERT-11	359 S	501 E
ERT-12	354 S	589 E
ERT-13	480 S	771 E
ERT-14	927 S	1496 E
ERT-15	341 S	226 W
ERT-16	290 S	97 W
ERT-17	283 S	54 E
ERT-18	289 S	283 E
ERT-19	296 S	355 E
ERT-20	281 S	488 E
ERT-21	265 S	636 E
ERT-22	181 S	233 W
ERT-23	238 S	70 W
ERT-24	218 S	70 E
ERT-25	205 S	361 E
ERT-26	180 S	501 E
ERT-27	151 S	644 E
ERT-28	621 S	1299 E
ERT-29	125 S	143 W
ERT-30	114 S	140 E
ERT-31	101 S	285 E
ERT-32	78 S	568 E
ERT-33	93 S	711 E
ERT-34	13 S	0.00 E/W
ERT-35	13 N	431 E
ERT-36	226 N	532 E
ERT-37	922 N	261 E
ERT-38	492 S	319 E
ERT-39	542 S	544 E
ERT-40	606 S	378 E
ERT-41	642 S	528 E
ERT-42	590 S	13 E
ERT-43	673 S	21 E
ERT-44	18 N	138 W
ERT-45	37 N	213 E
ERT-46	24 S	299 E
ERT-47	478 S	1232 E
ERT-48	367 N	473 E

PRESSURE METER TEST (PMT)

MARKING	CO-ORDINATES	
PMT-1	382 S	485 W
PMT-2	211 S	36 E
PMT-3	600 S	1071 E
PMT-4	211 S	467 E
PMT-5	211 S	610 E
PMT-6	283 S	77 W
PMT-7	25 N	0.00 E/W
PMT-8	283 S	355 E
PMT-9	25 N	431 E
PMT-10	283 S	639 E

CROSSHOLE SHEAR TEST (CST)

MARKING	CO-ORDINATES	
CST-1	30 S	0.00 E/W
CST-2	30 S	431 E
CST-3	30 S	644 E
CST-4	211 S	35 W
CST-5	211 S	538 E
CST-6	211 S	679 E
CST-7	290 S	62 W
CST-8	290 S	80 E
CST-9	290 S	371 E
CST-10	290 S	514 E
CST-11	290 S	655 E

CYCLIC PLATE LOAD TEST (CPLT)

MARKING	CO-ORDINATES		DEPTH (M)
CPLT-1	0.0 N/S	70 W	1.5
CPLT-2	27 S	615 E	1.5
CPLT-3	152 S	90 E	1.5
CPLT-4	148 S	523 E	1.5
CPLT-5	151 S	666 E	1.5
CPLT-6	210 S	397 E	1.5
CPLT-7	262 S	101 E	1.5
CPLT-8	0.0 N/S	70 E	1.5
CPLT-9	0.0 N/S	361 E	1.5
CPLT-10	0.0 N/S	501 E	1.5

BORE HOLE FOR ISG SCOPE(IBH)

MARKING	CO-ORDINATES		DEPTH (M) (REFER NOTE-2)
IBH-1	1008 N	127 W	20
IBH-2	952 N	116 W	10
IBH-3	930 N	552 W	15
IBH-4	913 N	186 W	20
IBH-5	868 N	427 W	15
IBH-6	769 N	114 W	10
IBH-7	746 N	155 W	10
IBH-8	720 N	72 W	10
IBH-9	659 N	361 W	10
IBH-10	649 N	172 E	10
IBH-11	635 N	99 E	10
IBH-12	624 N	729 W	10
IBH-13	597 N	650 W	10
IBH-14	545 N	26 W	15
IBH-15	544 N	321 W	10
IBH-16	526 N	198 E	10
IBH-17	510 N	125 E	10
IBH-18	479 N	625 W	10
IBH-19	439 N	209 W	10
IBH-20	437 N	705 W	10
IBH-21	419 N	11 W	15
IBH-22	401 N	225 E	10
IBH-23	395 N	415 W	10
IBH-24	385 N	152 E	10
IBH-25	341 N	672 W	10
IBH-26	329 N	314 E	10
IBH-27	327 N	124 W	10
IBH-28	288 N	249 E	10
IBH-29	271 N	389 W	10
IBH-30	242 N	176 E	10
IBH-31	232 N	572 W	10
IBH-32	216 N	646 W	10
IBH-33	193 N	57 W	10
IBH-34	182 N	252 W	10
IBH-35	119 N	548 W	10
IBH-36	116 N	417 W	10
IBH-37	74 N	615 W	10
IBH-38	69 N	142 E	10
IBH-39	20 N	249 E	10
IBH-40	13 N	139 W	10
IBH-41	158 S	0.0 E/W	10
IBH-42	158 S	431 E	10
IBH-43	1578 S	38 W	10
IBH-44	144 S	867 E	10
IBH-45	167 S	154 W	10
IBH-46	158 S	94 W	10
IBH-47	166 S	579 E	10
IBH-48	2110 S	140 E	10

S.No.	DESCRIPTION	CONFIG.
1	POWER HOUSE BLDG	-
2	BOILER	-
3	ESP	-
4	CHIMNEY	2+2+1
5	TRANSFORMER YARD	-
6	SWITCHYARD (CONT. ROOM)	-
7	SERVICE BLDG.	COMMON
8	DG BUILDING	2 Nos
9	COOLING TOWER(NDCT)	-
10	DM PLANT & CPU REGEN.	COMMON
11	FUEL OIL UNLOADING	COMMON
12	FUEL OIL COMPLEX	COMMON
13	PRE-TREATMENT PLANT	COMMON
14	CLARIFIED WATER TANK	COMMON
15	FIRE WATER TANK	COMMON
16	CLARIFIED CUM FIRE WATER P/H	COMMON
17	SIDE STREAM FILTERATION	2 + 3
18	H2 GEN. PLANT & CYLINDERS SHED	COMMON
19	CW P/H & FOREWAY	2 + 3
20	CHLORINATION & CW TREAT. PLANT	2 + 3
21	EFFLUENT TREAT. PLANT	COMMON
22	SEWAGE TREAT. PLANT	COMMON
23	ADMIN. BUILDING	COMMON
24	FIRE STATION BUILDING	COMMON
25	CANTEEN	2NOs
26	FLY ASH SILO AREA	COMMON
27	CHEMICAL LAB	COMMON
28	WORKSHOP	COMMON
29	COMPRESSOR HOUSE	2 + 3
30	COAL STOCK AREA	COMMON
31	MARSHLING YARD (BY TSGENCO)	COMMON
32	GATE COMPLEX CUM SECURITY BLDG.	COMMON
33	PERMANENT STORES (15MX30M)	1B+1
34	AUXILIARY BOILER	-
35	CHP MCC	4 NOs
36	CHEMICAL LAB (PCRI)	COMMON
37	AAQMS (4MX4M SHED)	4 NOs
38	CST + PUMP HOUSE	2 + 3
39	AWRP/H & MCC	1
40	NDCT	5
41	RAW WATER RESERVOIR	COMMON
42	PYLON/FOUNDATION STONE	-
43	ASH DYKE AREA	-

PLATE LOAD TEST (PLT)

MARKING	CO-ORDINATES		DEPTH (M)
PLT-1	177 N	552 E	1.5
PLT-2	118 S	105 W	1.5
PLT-3	124 S	600 E	1.5
PLT-4	568 S	1299 E	1.5
PLT-5	221 S	227 W	1.5
PLT-6	262 S	113 W	1.5
PLT-7	279 S	252 E	1.5
PLT-8	262 S	681 E	1.5
PLT-9	513 S	63 E	1.5
PLT-10	600 S	477 E	1.5
PLT-11	1121 S	1142 E	1.5

BLOCK VIBRATION TEST (BVT)

MARKING	CO-ORDINATES		DEPTH (M)
BVT-1	283 S	547 E	1.5
BVT-2	283 S	31 W	1.5
BVT-3	180 S	72 E	1.5
BVT-4	180 S	644 E	1.5
BVT-5	221 S	70 W	1.5

SEISMIC REFRACTION TEST (SRT)

S.NO	PROFILE
1	30 S / 99 W TO 30 S / 675 E
2	196 S / 99 W TO 196 S / 675 E
3	283 S / 99 W TO 283 S / 675 E
4	30 S / 99 W TO 283 S / 99 W
5	30 S / 70 E TO 283 S / 70 E
6	30 S / 361 E TO 283 S / 361 E
7	30 S / 498 E TO 283 S / 498 E
8	30 S / 675 E TO 283 S / 675 E

CYCLIC PLATE LOAD TEST FOR ISG SCOPE (ICPLT)

MARKING	CO-ORDINATES		DEPTH (M)
ICPLT-1	608 N	705 W	1.5
ICPLT-2	158 S	326 E	1.5
ICPLT-3	158 S	36 W	1.5

PLATE LOAD TEST FOR ISG SCOPE (IPLT)

MARKING	CO-ORDINATES		DEPTH (M)
IPLT-1	744 N	364 W	1.5
IPLT-2	518 N	271 E	1.5
IPLT-3	508 N	490 W	1.5
IPLT-4	305 N	228 W	1.5
IPLT-5	0.0 N/S	143 E	1.5
IPLT-6	1607 S	62 W	1.5
IPLT-7	207 S	192 E	1.5
IPLT-8	198 S	261 E	1.5

PRESSURE METER TEST FOR ISG SCOPE (IPMT)

MARKING	CO-ORDINATES	
IPMT-1	1027 N	155 W
IPMT-2	969 N	338 W
IPMT-3	834 N	611 W
IPMT-4	409 N	2 W

CROSSHOLE SHEAR TEST (ICST)

MARKING	CO-ORDINATES	
ICST-1	639 N	753 W
ICST-2	613 N	674 W

ELECTRICAL RESISTIVITY TEST FOR ISG SCOPE (IERT)

MARKING	CO-ORDINATES	
IERT-1	808 N	111 W
IERT-2	793 N	231 W
IERT-3	482 N	279 E
IERT-4	396 N	709 W
IERT-5	54 N	139 W
IERT-6	20 N	301 E
IERT-7	23 S	208 E
IERT-8	101 S	199 E
IERT-9	1591 S	110 W
IERT-10	232 S	184 E

TRIAL PIT (TP)

MARKING	CO-ORDINATES		DEPTH (M)
TP-1	851 N	194 E	1.5
TP-2	357 N	445 E	1.5
TP-3	64 S	29 W	1.5
TP-4	64 S	99 E	1.5
TP-5	64 S	396 E	1.5
TP-6	64 S	659 E	1.5
TP-7	236 S	236 E	1.5
TP-8	748 S	1309 E	1.5
TP-9	32 S	931 E	1.5
TP-10	318 S	1693 E	1.5
TP-11	280 S	1 E	1.5
TP-12	280 S	432 E	1.5
TP-13	280 S	585 E	1.5
TP-14	313 S	361 W	1.5
TP-15	404 S	899 E	1.5
TP-16	482 S	926 E	1.5

BORE HOLE (BH)

MARKING	CO-ORDINATES		DEPTH (M) (REFER NOTE-2)
BH-159	961 S	890 E	10
BH-160	1040 S	1021 E	10
BH-161	434 S	1627 E	15
BH-162	314 S	1182 E	10
BH-163	1413 S	1173 E	10

NOTES:-

1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
2. BORE HOLE SHALL BE DRILLED UPTO THE DEPTH INDICATED AGAINST EACH BORE HOLE OR UPTO 5M IN ROCK WITH CONTINUOUS ROD OF 50% WHICHEVER IS EARLIER. ROCK CORES SHALL BE ARRANGED AND PLACED IN WOODEN CORE BOXES SEQUENTIALLY AND SHALL BE NUMBERED SERIALLY AS PER SPECIFICATION.
3. BACKFILLING OF BORE HOLES AND PITS SHALL BE AS PER SPECIFICATION AND AS DIRECTED BY THE ENGINEER-IN-CHARGE.
4. STARTING DEPTH OF STANDARD PENETRATION TEST (SPT) SHALL BE 1M BELOW GROUND LEVEL AND THE TEST SHALL BE CONDUCTED AT EVERY 1M INTERVAL ALTERNATE TO COLLECTION OF UNDISTURBED SAMPLE (UDS) UPTO 5M DEPTH AND AT EVERY 1.5M INTERVAL ALTERNATE TO COLLECTION OF UDS BEYOND 5M DEPTH, AT CHANGE OF STRATA & AT DEPTHS WHEREVER UDS COULD NOT BE COLLECTED.
5. STARTING DEPTH OF COLLECTION OF UDS SHALL BE 2M BELOW GROUND LEVEL AND UDS SHALL BE COLLECTED AT 1M INTERVAL ALTERNATE TO CONDUCTING SPT UPTO 5M DEPTH & AT EVERY 1.5M INTERVAL ALTERNATE TO CONDUCTING SPT BEYOND 5M DEPTH.
6. PUMP IN TYPE FIELD PERMEABILITY TEST SHALL BE CARRIED OUT AT 1.5M, 4M & 8M DEPTH BELOW GROUND LEVEL IN BH-3, BH-20, BH-48, BH-66, BH-121, BH-135, BH-150, BH-161, IBH-1, IBH-3 & IBH-14.
7. ELECTRICAL RESISTIVITY TEST SHALL BE CARRIED OUT AS PER WENNER'S METHOD.
8. PRESSURE METER TEST SHALL BE CARRIED OUT AT 1M, 3M, 5M, 7M, 9M, 12M, 15M, 18M & 20M DEPTH BELOW GROUND LEVEL.
9. GROUND WATER SAMPLE SHALL BE COLLECTED FROM BH-20, BH-50, BH-74, BH-110, BH-118, BH-140, BH-147, IBH-1, IBH-10, IBH-12, IBH-26, IBH-44 & IBH-47.
10. CROSS HOLE SHEAR WAVE TEST SHALL BE CARRIED OUT AT 2M, 4M, 6M, 8M, 10M, 12M, 15M, 18M & 20M DEPTH BELOW GROUND LEVEL.
11. GEOTECHNICAL INVESTIGATION SHALL BE CARRIED OUT AS PER SPECIFICATION NO. PE-TS-999-603-002 AND PE-DC-K52-602-C002.
12. DO NOT SCALE THIS DRAWING.

GEOTECHNICAL INVESTIGATION LEGEND:

1. BOREHOLE (BH / IBH)
2. CYCLIC PLATE LOAD TEST (CPLT / ICPLT)
3. TRIAL PIT (TP)
4. PRESSURE METER TEST (PMT / IPMT).
5. CROSSHOLE SHEAR TEST (CST / ICST).
6. ELECTRICAL RESISTIVITY TEST (ERT / IERT)
7. PLATE LOAD TEST (PLT / IPLT)
8. BLOCK VIBRATION TEST (BVT)
9. SEISMIC REFRACTION TEST (SRT)

REF DRG :

PE-DG-417-100-M001, REV-01 "PLOT PLAN".

REV.	DATE	ALTD	CHD	APPD
02	09.04.18	PK -sd-	TMSR/AKV -sd-	CPK -sd-
	DRAWING IS GENERALLY REVISED AS PER REVISED PLOT PLAN.			
01	13.11.15	PK -sd-	TMSR -sd-	CPK -sd-
	DRAWING REVISED DUE CHANGE IN PLOT PLAN. REVISION MARKED △1 THUS.			

TELANGANA STATE POWER GENERATION CORPORATION LIMITED
HYDERABAD, TELANGANA STATE

TSGENCO-YADRADRI TPS
THERMAL POWER PLANT 5X800 MW
AT VEERLAPALEM , VILLAGE,DAMERACHERLA MANDAL
NALGONDA DISTRICT, TELANGANA STATE

JOB NO. 417
STATUS CONTRACT
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POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

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DESN	V.K.	-sd-	24.08.2015
CHD	TMSR	-sd-	24.08.2015
APPD	CPK	-sd-	24.08.2015

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