



भारत हेवी इलेक्ट्रिकल्स लिमिटेड
Bharat Heavy Electricals Limited

CIN: L74899DL1964GOI004281

पॉवर सेक्टर - दक्षिण क्षेत्र / Power Sector - Southern Region

२x६६० मेगा वाट - एन्नोर एस ई ज़ेड, एसटीपीपी वोयालूर पीओ, मिंजुर, पोन्नरी तालुक, तमिलनाडु - ६०१२०३)
(2X660 MW - Ennore S.E.Z STPP, Voyalur P.O. Minjur, Ponneri Taluk, Tamil Nadu - 601203)

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04 / 2024

TENDER SPECIFICATION

BHEL : PSSR : ENR – SEZ : 2024–25 : SCT : 081

FOR

**BTG Area balance Civil, Structural and Architectural works
of Main plant at 2x660 MW Ennore SEZ STPP,
Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203**

VOLUME-I BOOK-I

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,
- Volume-IC : General conditions of Contract
- Volume-ID : Forms & Procedures



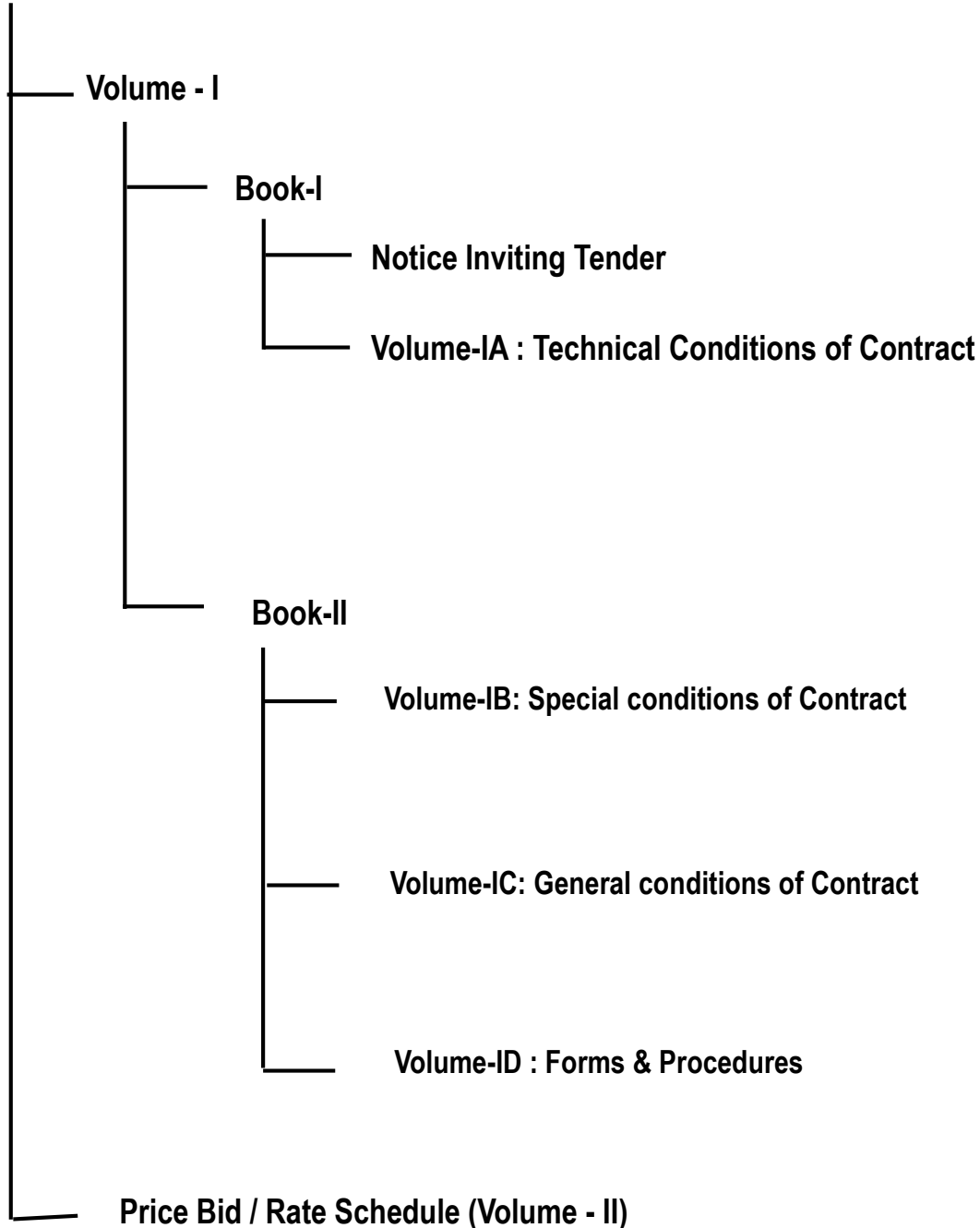
Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

TENDER SPECIFICATION CONSISTS OF

Tender Specification





Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024



NOTICE INVITING TENDER

Bharat Heavy Electricals Limited





Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

NOTICE INVITING TENDER

BHEL PSSR ENNORE SEZ SITE invites tender in Two Part - bid system (i.e. Technical Bid & Price bid - **thro' email**) for BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

The Bidder shall submit the Price Bid (password protected) along with all signed and scanned documents should be sent to tender.ennore@bhel.in. Price bid must be sent with password protected mode in PDF and the password shall be asked from bidder at the time of price bid opening.

1. Salient Features of NIT:

SL NO	ISSUE	DESCRIPTION	
i	TENDER NUMBER	BHEL: PSSR: ENR-SEZ:2024-25: SCT:081	
ii	Broad Scope of job	BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.	
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 (SCC)	Applicable
c	Volume-IC	General Conditions of Contract (GCC)	Applicable
d	HSEP14	Health, Safety and Environment (HSE)	Applicable
e	Volume-II	Price Bid (Rate Schedule).	Applicable
iv	BID / OFFER SUBMISSION START TIME	Start Date: 15/ 04 / 2024 , Time : 17:00 Hrs	
v	DUE DATE & TIME OF OFFER SUBMISSION	Date : 22/ 04/ 2024 , Time : 11:00 Hrs Noon Place : The bidder should submit their offer through email at tender.ennore@bhel.in only. Bidders are requested to send their offer well in advance in order to avoid last minute congestion. Hard copy bids shall not be accepted.	Applicable
vi	OPENING OF PART-1 TECHNO-COMMERCIAL BID	Date : 22/ 04/ 2024 , Time : 17:00 Hrs Notes: (1) In case the due date of opening of tender becomes a non-working day, then the due date & time of offer submission and opening of tenders get extended to the next working day. (2) Bidders who wish to be present to witness the tender opening may depute their authorised representative on the due date to BHEL Site Office, 2X660 MW Ennore SEZ STPP. (3) Bidders have to mail their Password to tender.ennore@bhel.in for opening the password	Applicable



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

		protected pdf format Price Bid at least 15 mins before the scheduled date and time of Price Bid opening. Bidders to note that, in case of wrong password / no password received, the bid will not be considered for further evaluation. No further correspondence will be entertained in this regard.													
vii	EMD AMOUNT	₹5,00,000/- (Rupees Five Lakhs only) Refer Clause No. 3.0 of this NIT for mode of payment of Earnest Money Deposit (EMD)	Applicable												
viii	LAST DATE FOR SEEKING CLARIFICATION	Date: 19-04-2024 upto 14:00 Hrs Along with soft version also, addressing to undersigned & to others as per contact address given below: 1) Name: A V Gireesh Babu Designation: Sr Engineer Deptt: MM, SCT & Purchase Address: BHEL/Ennore SEZ STPP site Phone: 9442516865 Email : gireesh@bhel.in 2) Name: Saurabh Kumar Verma Designation: Dy Manager Deptt: MM, SCT & Purchase Address: BHEL/Ennore SEZ STPP site Phone: 9486402561 Email : saurabhverma@bhel.in	Applicable												
ix	Integrity Pact & Details of Independent External Monitor (IEM)	a) IP is a tool to ensure that activities and transactions between the Company and its Bidders/ Contractors are handled in a fair, transparent and corruption free manner. Following Independent External Monitors (IEMs) on the present panel have been appointed by BHEL with the approval of CVC to oversee implementation of IP in BHEL. <table><tr><td>Sl. No</td><td>IEM</td><td>Email</td></tr><tr><td>1.</td><td>Shri Otem Dai, IAS (Retd)</td><td>iem1@bhel.in</td></tr><tr><td>2.</td><td>Shri Bishwamitra Pandey, IRAS (Retd)</td><td>iem2@bhel.in</td></tr><tr><td>3</td><td>Shri Mukesh Mittal, IRS (Retd)</td><td>iem3@bhel.in</td></tr></table> b) The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory) along with techno-commercial bid (Part-I, in case of two/ three part bid). Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In	Sl. No	IEM	Email	1.	Shri Otem Dai, IAS (Retd)	iem1@bhel.in	2.	Shri Bishwamitra Pandey, IRAS (Retd)	iem2@bhel.in	3	Shri Mukesh Mittal, IRS (Retd)	iem3@bhel.in	Applicable
Sl. No	IEM	Email													
1.	Shri Otem Dai, IAS (Retd)	iem1@bhel.in													
2.	Shri Bishwamitra Pandey, IRAS (Retd)	iem2@bhel.in													
3	Shri Mukesh Mittal, IRS (Retd)	iem3@bhel.in													



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

		other words, entering into this Pact would be a preliminary qualification. c) Please refer Section-8 of IP for Role and Responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to any of the above IEM(s). All correspondence with the IEMs shall be done through email only. Note: <i>No routine correspondence shall be addressed to the IEM (phone/ post/ email) regarding the clarifications, time extensions or any other administrative queries, etc. on the tender issued. All such clarification/ issues shall be addressed directly to the tender issuing (procurement) department's officials whose contact details are provided in clause 1 ix) above</i>	
x	Latest updates	Latest updates on the important dates, Amendments, Correspondences, Corrigenda, Clarifications, Changes, Errata, Modifications, Revisions, etc. to Tender Specifications will be informed through email (either from saurabhverma@bhel.in or gireesh@bhel.in) only. Bidders to keep themselves updated with all such information. This also form part of tender hence the same shall be enclosed with their offer.	Applicable
xi	Bids shall be addressed to	G.M. & P.D. / ENNORE SEZ, SITE OFFICE: BHEL, PSSR, 2X660 MW ENNORE SEZ STPP, VOYALUR PO MINJUR PONNERI TALUK TAMIL NADU – 601 203	Applicable

- 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, scanned and send through email at tender.ennore@bhel.in, 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.**

- Unless specifically stated otherwise, bidder shall deposit EMD and Security Deposit as per the procedure mentioned as below: -

Detailed Instruction Brochure for depositing EMD/SD through SBI e-collect is detailed given below:

Step 1: Vendors may visit SBI collect website, the URL of which is <https://www.onlinesbi.sbi/sbicollect> where they get the home page with various categories of institutions.

Step 2: Select PSU - Public Sector Undertakings – leading to a page with list of PSUs

Step 3: Type BHEL and search, they get to see all BHEL divisions wherein they shall select BHEL PSSR Chennai. The screen shot of the same is given below.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Name of PSU-Public Sector Undertaking	State
BHEL BAP RANIPET	Tamil Nadu
BHEL PSSR CHENNAI	Tamil Nadu

Step 4: Select EMD receipts. Having selected the Payee in the Payment Progress, it will lead to the payment details – a drop down list of values. From that list, vendors shall select EMD receipts. Upon clicking the entry EMD receipts, a form will open asking for the remitters details and the details of the tender.

Step 5: Confirm details and pay

Fill in all the details correctly, verify the details, and complete the payment as it is leading to the payment gateway.

Step 6: Take a printout on completing the payment and enclose the copy of the same along with the bid submission. Store the copy of receipt for future reference.

- Procedure of Submission of Tenders/ Bids:** This is an E-tender floated online through Email (either from gireesh@bhel.in or saarabhverma@bhel.in). The bidder should respond by submitting their offer online through email at tender.ennore@bhel.in only. Offers are invited in two-parts only.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- a) **Part – I – Techno-Commercial Bid:** All Technical details (e.g. Eligibility Criteria requested (as mentioned below)) should be attached in email, failing which the tender stands invalid & may be REJECTED. Bidders shall furnish the following information along with technical tender (preferably in pdf format)

SL. No.	Description	Applicability for Tender
<u>i</u>	Proof of remittance of Earnest Money Deposit (EMD).	Applicable
<u>ii</u>	Signed & Stamped Copy of Notice Inviting Tender (NIT) & Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc.	Applicable
<u>iii</u>	No Deviation Certificate (Signed & Sealed on <u>company's letter head</u>) 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) & (ii) 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. a. In case of acceptance of the deviations, appropriate loading shall be done by BHEL b. In case of unacceptable deviations, BHEL reserves the right to reject the tender.	Applicable
<u>iv</u>	Undertaking on company's letter head related to insolvency/ liquidation/ bankruptcy.	Applicable
<u>v</u>	Undertaking - Declaration confirming knowledge about Site conditions	Applicable
<u>vi</u>	Acceptance of UNPRICED Rate Schedule. (without disclosing rates/price, but mentioning only 'QUOTED' or 'UNQUOTED'.	Applicable
<u>vii</u>	All Amendments / Correspondences / Corrigenda / Clarifications / Changes / Errata etc. pertinent to this NIT.	Applicable
<u>viii</u>	Integrity Pact Agreement (Duly signed by the authorized signatory) (As applicable)	Applicable
<u>ix</u>	Duly filled-in annexures, formats etc. as required under this Tender Specification/ NIT.	Applicable
<u>x</u>	Any other details preferred by bidder with proper indexing.	Applicable
<u>xi</u>	Caution to Bidders: - The duly signed & stamped scanned copies of all above mentioned documents are to be sent at tender.ennore@bhel.in as Techno-commercial Bid.	

- b) **Part – II – Price Bid (Rate Schedule) - Volume – II** consisting of the following shall be provided as mentioned below



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- i) Prices are to be quoted in the attached Price Bid Format **Price Bid (Rate Schedule) – Volume - II**, duly filled, signed and password protected mode in PDF format only.
- ii) The price should be quoted for the accounting unit indicated in the tender document.
- iii) Note: 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.
- iv) 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.
- v) 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.

NOTE : File (pdf) / Email size should be less than 25 MB.

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 in place of email, the same shall not be considered. **Also, uploading of the price bid in prequalification bid or technical bid may RESULT IN REJECTION of the tender.**

5. 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.
6. 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).
7. 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.
8. For any clarification on the tender document, the bidder may seek the same in 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.
9. 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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

clerical errors in the tender documents, noticed must be pointed out before pre-bid meeting / submission of offer, else BHEL's interpretation shall prevail.

10. Unless specifically mentioned otherwise, bidder's quoted price shall be deemed to be in compliance with tender including PBD.
11. Bidders shall submit Integrity Pact Agreement (Duly signed by authorized signatory who signs in the offer), if applicable, along with techno-commercial bid. This pact shall be considered as a preliminary qualification for further participation. The names and other details of Independent External Monitor (IEM), if applicable for the subject tender is as given at point {1 (ix)} above.
12. Validity of the offer shall be for **six months** from the latest due date of offer submission (including extension, if any) unless specified otherwise.
13. **Reverse Auction (RA):** BHEL shall be resorting to Reverse Auction (RA) (Guidelines for Reverse Auction – 2021 available elsewhere in this tender) for this tender. RA shall be conducted among all the techno-commercially qualified bidders.
Price Bids of all the techno-commercially qualified bidders shall be opened and same shall be considered as initial bids of bidders in RA. In case any bidder(s) do(es) not participate in online Reverse Auction, their sealed envelope price bid along with applicable loading, if any, shall be considered for ranking.
14. On submission of offer, further consideration will be subject to compliance to tender & qualifying requirement and customer's acceptance, as applicable.
15. The bidders shall not enter into any undisclosed M.O.U. or any understanding amongst themselves with respect to tender.
16. **Consortium Bidding is not applicable for this tender.**
17. The bidder may have to produce original document for verification if so decided by BHEL.
18. Guidelines/rules in respect of Suspension of Business dealings, Vendor evaluation format, Quality, Safety & HSE guidelines, Experience Certificate, etc. may undergo change from time to time and the latest one shall be followed. The abridged version of extant 'Guidelines for suspension of business dealings with suppliers/ contractors' is available on www.bhel.com on "**supplier registration page**".
19. Integrity commitment, performance of the contract and punitive action thereof:

19.1 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.

19.2 Commitment by Bidder/ Supplier/ Contractor:

- i. The bidder/ supplier/ contractor commit to take all measures to prevent corruption and will not directly or indirectly influence any decision or benefit which he is not legally entitled to nor will act or omit in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1860 or any other law in force in India.
- ii. The bidder/ supplier/ contractor will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

connection with the award of the contract and shall adhere to relevant guidelines issued from time to time by Govt. of India/ BHEL.

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

If any bidder/ supplier/ contractor during pre-tendering/ tendering/ post tendering/ award/ execution/ post-execution stage 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 prices or acts or omits in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1860 or any other law in force in India, then, action may be taken against such bidder/ supplier/ contractor as per extent guidelines of the company available on www.bhel.com and / or under applicable legal provisions.

20.0 Micro and Small Enterprises (MSE)- Not Applicable

- 21.0 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.

22.0 PREFERENCE TO MAKE IN INDIA:

For this procurement, the local content to categorize a supplier as a Class I local supplier/ Class II local supplier/ Non- Local supplier and purchase preference to Class I local supplier, is as defined in Public Procurement (Preference to Make in India), Order 2017 dated 04.06.2020 issued by DPIIT. In case of subsequent Orders issued by the Nodal Ministry, changing the definition of local content for the items of the NIT, the same shall be applicable even if issued after issue of this NIT, but before opening of Part-II bids against this NIT.

- 23.0 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.

- 24.0 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.

- 25.0 The Bidder declares that they will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s). 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.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

In case, the Bidder is found having indulged in above activities, suitable action shall be taken by BHEL as per extant policies/ guidelines.

26.0 One Bid per Bidder

A Bidder shall submit only one bid in a particular bidding process. In case of a holding company having more than one subsidiary having common business ownership/ management, only one business entity amongst the holding company and its subsidiaries should quote for a particular tender. Similar restrictions shall apply to closely related sister companies. Bidder's sister/ Associated/ Allied concern(s) participating or applying against the same tender, shall lead to disqualification of Bidders. Sister/ Associated/ Allied concern means a company, society, partnership firm or proprietorship firm having one or more common persons as Director/ Partner/ Member/ Owner. A Bidder who submits more than one bid will cause all the proposals submitted in the particular bid to be disqualified.

In relation to the above, a person will include firm(s) of Proprietorship / Partnership Firm /Limited Liability Partnership / Private Limited / Limited company / Society registered under Society's Act / Statutory Bodies / any other legal entity, as the case maybe, & will be deemed to have submitted multiple bids in a particular bid if a person bids in any of the two formats given below:

- i. individual or proprietorship format and/or
- ii. a partnership or association of persons format and/or
- iii. a company format

Whereby,

- A company shall for this purpose include any artificial person whether constituted under the Indian laws or of any other country.
- A person shall be deemed to have bid in a partnership format or in association of persons format if he is a partner of the firm which has submitted the bid or is a member of any association of persons which has submitted a bid.
- A person shall be deemed to have bid in a company format if the person holds:
 - i. more than 10% (ten percent) of the voting share capital of the company which has submitted a bid, or

ii. is a director and / or Key Managerial Personnel of the company which has submitted a bid, or holds more than 10% (ten percent) of voting share capital in and/or is a director and / or Key Managerial Personnel of a holding company of that company which has submitted the bid.

By making a bid pursuant to the Tender Documents, the bidder / tenderer shall be deemed to have declared that the bidder / tenderer has not made any other bid or multiple bids as understood or deemed in terms of this clause.

All the bids of a bidder who has submitted multiple bids, as per the clause, shall be rejected. Bidder shall submit Declaration as per format provided in Annexure-11.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

27.0 Conflict of interest

A bidder shall not have conflict of interest with other bidders. Such conflict of interest can lead to anti-competitive practices to the detriment of Procuring Entity's interests. **The bidder found to have a conflict of interest shall be disqualified.** A bidder may be considered to have a conflict of interest with one or more parties in this bidding process, if:

- a) They have controlling partner (s) in common; **OR**
- b) They receive or have received any direct or indirect subsidy/ financial stake from any of them; **OR**
- c) They have the same legal representative/agent for purposes of this bid; **OR**
- d) They have relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the bid of another Bidder; **OR**
- e) Bidder participates in more than one bid in this bidding process. Participation by a Bidder in more than one Bid will result in the disqualification of all bids in which the parties are involved. However, this does not limit the inclusion of the components/ sub-assembly/Assemblies from one bidding manufacturer in more than one bid; **OR**
- f) In cases of agents quoting in offshore procurements, on behalf of their principal manufacturers, one agent cannot represent two manufacturers or quote on their behalf in a particular tender enquiry. One manufacturer can also authorize only one agent/dealer. There can be only one bid from the following:
 1. The principal manufacturer directly or through one Indian agent on his behalf; and
 2. Indian/foreign agent on behalf of only one principal;

Or
- g) A Bidder or any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the contract that is the subject of the Bid; **OR**
- h) In case of a holding company having more than one independently manufacturing units, or more than one unit having common business ownership/management, only one unit should quote. Similar restrictions would apply to closely related sister companies. Bidders must proactively declare such sister/ common business/ management units in same/ similar line of business.

28.0 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-IA
- e. Special Conditions of Contract (SCC) —Volume-IB
- f. General Conditions of Contract (GCC) —Volume-IC
- g. Forms and Procedures —Volume-ID - It may please be noted that guidelines/ circulars/ amendments/ govt. directives issued from time to time shall also be applicable.

29.0 Modification / Deletions in Standard Clause of General Conditions of Contract (GCC) and Special Conditions of Contract (SCC)



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

I. The following GCC Clauses are excluded/relaxed in this tender:

- 1.7 – Data to be enclosed
- 2.8.6 - While BHEL would pay the inspection fees and Registration fees of Boiler/Electrical Inspectorate, all other arrangements for site visits periodically by the Inspectorate to site, Inspection certificate etc. will have to be made by contractor. However, BHEL will not make any payment to the Inspectorate in connection with contractor's Welders/Electricians qualification tests etc.
- 2.9 - EXECUTION PLAN, PROGRESS MONITORING, MONTHLY REVIEW AND PERFORMANCE EVALUATION,
- 2.12 - OVERRUN COMPENSATION,
- 2.13 - INTEREST BEARING RECOVERABLE ADVANCES,
- 2.17 - PRICE VARIATION COMPENSATION

II. The following SCC Clauses are excluded/relaxed in this tender:

- 1.0 - INTENT OF THE SPECIFICATION
- 2.0 - GENERAL SERVICES TO BE RENDERED BY THE BIDDER
- 3.0 - GENERAL TECHNICAL REQUIREMENTS (CODES AND STANDARDS)
- 4.0 - OBLIGATIONS OF CONTRACTOR
- 7.0 - DRAWINGS AND DOCUMENTS
- 11.0 - PERFORMANCE MONITORING

Other clauses of Standard GCC & SCC shall remain unchanged.

30.0 TAXES AND OTHER DUTIES

30.1 Goods and service Tax (GST) & Cess

- 30.1.1 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. If the Successful Bidder submits Invoice from a GST No. from outside the state where the project is being executed, then the Bidder shall furnish a declaration for the same in their Letter head, for the single supply of services/short term supply of services.
- 30.1.2 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.
- 30.1.3 Bidder shall note that the GST Tax Invoice complying with GST Invoice Rules wherein the 'Bill to' details will be as below:

BHEL GSTN - 33AAACB4146P2ZL
GM & PROJECT DIRECTOR / ENNORE SEZ



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

**BHARAT HEAVY ELECTRICALS LIMITED,
2X660 MW ENNORE SEZ STPP,
VOYALUR PO MINJUR PONNERI TALUK
TAMIL NADU – 601 203**

- 30.1.4 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.
- 30.1.5 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.
- 30.1.6 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.
- 30.1.7 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.
- 30.1.8 TDS under GST (if/ as & when applicable) shall be deducted at prevailing rates on gross invoice value from the running bills.
- 30.1.9 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.
- 30.1.10 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.
- 30.1.11 Bidder Shall submit E-Invoice as per the GST Rules, if E-Invoicing has been enabled against their GSTIN No. Otherwise a Declaration may be submitted along with Invoice certifying that E-Invoicing is not enabled against their GSTIN No.
- 30.1.12 Bidder shall note that if the service which they are going to provide to BHEL is covered under RCM, then BHEL shall discharge the liability on RCM basis and no GST Payment will be released to the Bidder in any circumstances.

30.2 All taxes and duty other than GST & Cess

- 30.2.1 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.

30.3 Statutory Variations

- 30.3.1 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,



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

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.

30.4 New Taxes/Levies

30.4.1 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.

30.5 Direct Tax

30.5.1 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.

31.0 TCS (Tax collected at Source) under Income Tax Act.

If the vendor is mandated to collect the TCS from BHEL (for sale of Goods) as per the newly inserted sub section(1H) under Section 206C of the Income Tax Act, then the below conditions need to be adhered to:

- 31.1. Vendors should mention their TAN and PAN number in the Invoice submitted to BHEL.
- 31.2. Where the tender conditions do not specify any pec on financial parameters, then the reimbursement of IT TCS to the Vendor can be made only on submission of below undertaking on yearly basis. "If we have made a total sale, gross receipts or turnover from our business carried exceeds ten crore rupees during the financial year_ (should be immediate preceding financial year)" And on submission of TCS paid challan and TCS certificate for the TCS payments made in the last quarter.
- 31.3. Amount of TCS and Assessable value on which TCS has been calculated should be specified clearly in the invoice.
- 31.4. PAN No of BHEL is AAACB4146P, same need to be considered by vendor while filing their TCS returns.
- 31.5. Vendor shall issue a TCS Certificate for the amount collected at source within the due dates as per the IT Act.
- 31.6. In event of failure to comply with the provisions of the Act or proper certificate was not issued or if tax collected, not remitted to the Government or for any other reason and thereby causing loss to BHEL, the same shall be recoverable from the Vendor towards non- compliance of statutory provisions from the money's due to them with applicable interest.

32.0 GENERAL

The scope of the work will comprise of but not limited to the following:
(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

- 32.1 Successful bidder is requested to furnish the following at Site Office, BHEL – 2x660 MW Ennore SEZ STPP immediately after release of Letter of Intent (LOI)
 - i. Security Deposit.
 - ii. Unqualified Acceptance for Detailed LOI / Work Order.
 - iii. Rs.100/- Stamp Paper for preparation of Contract Agreement.
- 32.2 Successful bidder is requested to furnish the proof of documents for the following at the Site Office, BHEL 2x660 MW Ennore SEZ STPP



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- i. PF Regn No.
- ii. Labour License No.
- iii. Workmen Insurance Policy No.

32.3 In addition to the clause 2.8 of General Conditions of Contract the contractor shall comply with the following.

33.0 BOCW Act & BOCW Welfare Cess Act

33.1 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.

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

33.3 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.

33.4 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.

33.5 Contractor shall make remittance of the BOCW cess as per the 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, fees paid towards registration of Beneficiaries and Contribution of Beneficiaries remitted.

33.6 Non-compliance to Provisions of the BOCW Act & BOCW Welfare Cess Act is not acceptable. In case of any non-compliance, BHEL reserves the right to withhold any sum as 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.

34.0 PROVIDENT FUND

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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

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

35.0 OTHER STATUTORY REQUIREMENTS

35.1 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.

35.2 The contractor 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.

35.3 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 contractor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.

35.4 The Contractor shall submit copies of Final Settlement statement of disbursal of TECHNICAL CONDITIONS OF CONTRACT (TCC) Tender Specification No.: BHEL: PSSR: SCT: 2001 retrenchment benefits on retrenchment of each workmen under ID 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 Act 1948 (if applicable) to BHEL along with the Final Bill.

35.5 In case of any dispute pending before the appropriate authority under ID 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.

35.6 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.

36.0 DEPLOYMENT OF SKILLED / SEMI-SKILLED TRADESMEN

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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

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

37.0 Site Visit by the Bidder :

The bidder shall, prior to submitting his tender for the work, visit, examine and acquire full knowledge & information and 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.

38.0 General Instruction for Bidder:

- a) Offer must be submitted strictly in line with Technical specification.
- b) Incomplete offer shall not be acceptable.
- c) Duly filled & signed with seal on all documents to be submitted along with offer.
- d) BHEL Site office, Ennore STPP, Voyalur PO Minjur, Ponneri Taluk reserve the right to get the services from more than one vendor.
- e) Please quote price in figures & words both. In case the prices quoted in words and figures are different, the value indicated in words will be considered for evaluation and establishing L1 status. Offers with deviations from terms and conditions of the tender may not be considered. Bidders shall also furnish 'No Deviation Certificate' (Format attached).
- f) BHEL reserves the right to accept or reject any of the bid/all bids with or without deviation, or cancel/withdraw the invitation for bid without assigning any reason whatsoever and in such case no bidder shall have any claim arising out of such action by BHEL.
- g) In case you are not quoting, please send your regret letter positively for our reference.
- h) Tender received after the specified time of their "SUBMISSION" will be treated as late tender and shall not be considered under any circumstances.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- i) Supplier shall quote for all the items in the enclosed price bid format.
- j) The Vendor should have registration under GST Act and should submit the registration certificate along with Quotation.
- k) Tenderers are requested to sign and put seal on all pages of tender documents and submit else their offer shall be liable for rejection.
- l) Bidders are required to ensure that all columns of the bid are duly filled in. If any incorrect rates or unusually low rates are quoted, offer is liable for rejection and no correspondence will be entertained in this regard.

For and on behalf of BHARAT HEAVY ELECTRICALS LTD

Sd/-

DGM / MM, SCT & Purchase, HR & FEX
BHEL / 2 x 660 MW ENNORE SEZ STPP



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Enclosure:

- (i) Annexure-1: Check List.
- (ii) Annexure-2: Offer Forwarding Letter
- (iii) Annexure-3: Declaration by Authorized Signatory
- (iv) Annexure-4: No Deviation Certificate
- (v) Annexure-5: Declaration confirming knowledge about Site Conditions
- (vi) Annexure-6: Declaration for relation in BHEL
- (vii) Annexure-7: Non-Disclosure Certificate
- (viii) Annexure-8: Bank Account Details for E-Payment
- (ix) Annexure-9: Undertaking Regarding Insolvency/ Liquidation/ Bankruptcy Proceedings
- (x) Annexure-10: Declaration regarding Details of related firms and their area of activities
- (xi) Annexure-11: Declaration regarding One Bid per Bidder (as per Clause No 34 A)
- (xii) Annexure-12: Declaration regarding Minimum Local Content In Line With Revised Public Procurement (Preference To Make In India), Order 2017 Dated 04th June, 2020) And Subsequent Order(s)
- (xiii) Annexure-13: Reverse Auction Process Compliance Form
- (xiv) Annexure-14: Authorization of representative who will participate in the online Reverse Auction Process
- (xv) Annexure-15: RA price confirmation and breakup
- (xvi) Annexure-16: Integrity Pact



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

ANNEXURE - 1

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: Fax No:		
3b	Details of alternate Contact person for this Tender: Name: Mr. / Ms. Designation: Telephone No: Mobile No: E-mail ID: Fax No:		
4	EMD DETAILS Remittance of EMD should be in line with Mode of Deposit as detailed in above clause 3.0 of NIT.	a. Mode of Remittance: Ref No: Date : Amount :	
5	Validity of Offer	To be valid for six months from due date	
		Applicability (By BHEL)	Bidder's reply
8	Submission of Copy of PAN Card	Applicable	Yes / No
9	Submission of Copy of GST Certificate	Applicable	Yes / No
10	Whether all pages of the Tender documents including annexures, appendices etc., are read understood and signed	Applicable	Yes / No
11	Whether all pages of the offer documents are signed by the person authorized to sign this offer	Applicable	Yes / No
12	Submission of Offer Forwarding Letter (as per Annexure – 2)	Applicable	Yes / No



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

13	Submission of Declaration by Authorized Signatory (as per Annexure – 3)	Applicable	Yes / No
14	Submission of No Deviation Certificate (as per Annexure – 4)	Applicable	Yes / No
15	Submission of Declaration confirming knowledge about Site Conditions (as per Annexure – 5)	Applicable	Yes / No
16	Submission of Declaration for relation in BHEL (as per Annexure – 6)	Applicable	Yes / No
17	Submission of Non-Disclosure Certificate (as per Annexure – 7)	Applicable	Yes / No
18	Submission of Bank Account Details for E-Payment (as per Annexure – 8)	Applicable	Yes / No
19	Submission of Undertaking regarding Insolvency/ Liquidation/ Bankruptcy Proceedings (as per Annexure - 9)	Applicable	Yes / No
20	Submission of Declaration regarding Details of related firms and their area of activities (as per Annexure-10)	Applicable	Yes / No
21	Submission of Declaration regarding One Bid per Bidder (as per Clause No 28 A of NIT, Annexure-11)	Applicable	Yes / No
22	Submission of Declaration regarding Minimum Local Content In Line With Revised Public Procurement (Preference To Make In India), Order 2017 Dated 04th June, 2020) And Subsequent Order(s) (as per Annexure-12)	Applicable	Yes / No
23	Submission of Reverse Auction Process Compliance Form (as per Annexure-13)	Applicable	Yes / No
24	Submission of Authorization of representative who will participate in the online Reverse Auction Process (as per Annexure-14)	Applicable	Yes / No
25	Submission of RA price confirmation and breakup by Successful bidder only (as per Annexure-15)	Applicable	Yes / No
26	Submission of Integrity Pact (as per Annexure-16)	Applicable	Yes / No
27	Submission of Power of Attorney for Submission of Tender / Signing Contract Agreement	Applicable	Yes / No
28	Submission of unquoted Price Bid Volume –II without disclosing rates / price	Applicable	Yes / No

NOTE:

1. Strike Off 'YES' OR 'NO', as applicable.
2. Formats for Annexure 1 to 16 mentioned at Sl. No.12 to 26 above, are enclosed with NIT
3. Tender not accompanied by the prescribed above applicable documents are liable to be summarily rejected.

DATE:

AUTHORISED SIGNATORY

(With Name, Designation and Company seal)



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024
Annexure-2

OFFER FORWARDING LETTER / TENDER SUBMISSION LETTER
(To be typed and submitted in the Letter Head of the Company / Firm of Bidder)

Offer Reference No:

Date :

To,

**GENERAL MANAGER & PROJECT DIRECTOR,
SITE OFFICE: BHEL, PSSR, 2X660 MW ENNORE SEZ STPP,
VOYALUR PO MINJUR PONNERI TALUK
TAMIL NADU – 601 203**

Dear Sir,

Sub : Submission of Offer against tender Specification No. **BHEL:PSSR: ENR-SEZ : 2024-25 : SCT : 081 dt 15.04.2024**

I / We hereby offer to carry out the work detailed in the Tender Specification issued by Bharat Heavy Electricals Limited, Power Sector Southern Region, Ennore SEZ, in accordance with the terms and conditions thereof.

I/We have carefully perused the following listed documents connected with the above work and agree to abide by the same.

1. Amendments/Clarifications/Corrigenda/Errata/etc issued in respect of the Tender documents by BHEL.
2. Notice Inviting Tender (NIT)
3. Price Bid
4. Technical Conditions of Contract
5. Special Conditions of Contract
6. General Conditions of Contract
7. Forms and Procedures

Should our Offer be accepted by BHEL for Award, I/we further agree to furnish 'Security Deposit for the work as provided for in the Tender Conditions with the stipulated time as may be indicated by BHEL.

I / We further agree to execute all the works referred to in the said Tender documents upon the terms and conditions contained or referred to therein and as detailed in the appendices annexed thereto.

I/We have deposited/depositing herewith the requisite Earnest Money Deposit (EMD) as per details furnished in the Check List.

Authorised Representative of Bidder

Signature : _____

Name : _____

Address : _____

Place: _____



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Date: _____

Annexure-3

DECLARATION BY AUTHORISED SIGNATORY OF BIDDER

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

GENERAL MANAGER & PROJECT DIRECTOR,
SITE OFFICE: BHEL, PSSR, 2X660 MW ENNORE SEZ STPP,
VOYALUR PO MINJUR PONNERI TALUK
TAMIL NADU – 601 203

Dear Sir,

Sub : **Declaration by Authorised Signatory**

Ref : 1) NIT/Tender Specification No: BHEL:PSSR: ENR-SEZ : 2024-25 : SCT : 081 dt 15.04.2024,
2) All other pertinent issues till date

I/We, hereby certify that all the information and data furnished by me with regard to the above Tender Specification are true and complete to the best of my knowledge. I have gone through the specifications, conditions, stipulations and all other pertinent issues till date, and agree to comply with the requirements and Intent of the specification.

I further certify that I am authorised to represent on behalf of my Company/Firm for the above mentioned tender and a valid Power of Attorney to this effect is also enclosed.

Yours faithfully,

(Signature, Date & Seal of Authorized
Signatory of the Bidder)

Date:



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024
Annexure-4

NO DEVIATION CERTIFICATE

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,
GENERAL MANAGER & PROJECT DIRECTOR,
SITE OFFICE: BHEL, PSSR, 2X660 MW ENNORE SEZ STPP,
VOYALUR PO MINJUR PONNERI TALUK
TAMIL NADU – 601 203

Dear Sir,

Sub : **No Deviation Certificate**

Ref : 1) NIT/Tender Specification No: BHEL:PSSR: ENR-SEZ : 2024-25 : SCT : 081 dt 15.04.2024,
2) All other pertinent issues till date

We hereby confirm that we have not changed/ modified/materially altered any of the tender documents as downloaded from the website/ issued by BHEL and in case of such observance at any stage, it shall be treated as null and void.

We also hereby confirm that we have neither set any Terms and Conditions and nor have we taken any deviation from the Tender conditions together with other references applicable for the above referred NIT/Tender Specification.

We further confirm our unqualified acceptance to all Terms and Conditions, unqualified compliance to Tender Conditions, Integrity Pact (if applicable) and acceptance to Reverse Auctioning process.

We confirm to have submitted offer in accordance with tender instructions and as per aforesaid references.

Thanking you,

Yours faithfully,

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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Annexure-5

DECLARATION CONFIRMING KNOWLEDGE ABOUT SITE CONDITIONS

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

GENERAL MANAGER & PROJECT DIRECTOR,
SITE OFFICE: BHEL, PSSR, 2X660 MW ENNORE SEZ STPP,
VOYALUR PO MINJUR PONNERI TALUK
TAMIL NADU – 601 203

Dear Sir,

Sub : **Declaration confirming knowledge about Site conditions**

Ref : 1) NIT/Tender Specification No: BHEL:PSSR: ENR-SEZ : 2024-25 : SCT : 081 dt 15.04.2024,
2) All other pertinent issues till date

I/We, _____ hereby declare and confirm that we have visited the Project Site as referred in BHEL Tender Specifications and acquired full knowledge and information about the Site conditions including Wage structure, Industrial Climate, the Law & Order and other conditions prevalent at and around the Site. We further confirm that the above information is true and correct and we shall not raise any claim of any nature due to lack of knowledge of Site conditions.

I/We, hereby offer to carry out work as detailed in above mentioned Tender Specification, in accordance with Terms & Conditions thereof.

Yours faithfully,

(Signature, Date & Seal of Authorized
Representative of the Bidder)

Date : _____

Place: _____



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Annexure-6

DECLARATION FOR RELATION IN BHEL

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder failing which the offer of Bidder is liable to be summarily rejected)

To,
GENERAL MANAGER & PROJECT DIRECTOR,
SITE OFFICE: BHEL, PSSR, 2X660 MW ENNORE SEZ STPP,
VOYALUR PO MINJUR PONNERI TALUK
TAMIL NADU – 601 203

Dear Sir,

Sub : **Declaration for relation in BHEL**

Ref : 1) NIT/Tender Specification No: BHEL:PSSR: ENR-SEZ : 2024-25 : SCT : 081 dt 15.04.2024,

I/We hereby submit the following information pertaining to relation/relatives of Proprieter/Partner(s)/Director(s) employed in BHEL

Tick(✓) any one as applicable:

1. The Proprieter, Partner(s), Director(s) of our Company/Firm DO NOT have any relation or relatives employed in BHEL

OR

2. The Proprieter, Partner(s), or Director(s) of our Company/Firm HAVE relation/relatives employed in BHEL and their particulars are as below:

(i)

(ii)

Signature of the Authorised Signatory

Note:

1. Attach separate sheet, if necessary.
2. If BHEL Management comes to know at a later date that the information furnished by the Bidder is false, BHEL reserves the right to take suitable against the Bidder/Contractor.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Annexure-7

NON DISCLOSURE CERTIFICATE

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

NON DISCLOSURE CERTIFICATE

I/We understand that BHEL PSSR is committed to Information Security Management System as per their Information Security Policy.

Hence, I/We M/s..... who are submitting offer for providing services to BHEL PS SR against Tender Specification No: BHEL:PSSR: ENR-SEZ : 2024-25 : SCT : 081 dt 15.04.2024, hereby undertake to comply with the following in line with Information Security Policy of BHEL PS _____,

- To maintain confidentiality of documents & information which shall be used during the execution of the Contract.
- The documents & information shall not be revealed to or shared with third party which shall not be in the business interest of BHEL PSSR.

(Signature, date & seal of Authorized Signatory of the bidder)

Date:



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP,
Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024
Annexure-8

BANK ACCOUNT DETAILS FOR E-PAYMENT

(To be given on Letter head of the Company /Firm of Bidder, and **ENDORSED (SIGNED & STAMPED) BY THE BANK** to enable BHEL release payments through Electronic Fund Transfer (EFT/RTGS)

1. Beneficiary Name :
2. Beneficiary Account No. :
3. Bank Name & Branch :
4. City/Place :
5. 9 digit M ICR Code of Bank Branch :
6. IFSC Code of Bank Branch :
7. Beneficiary E-mail ID :

(for payment confirmation)

NOTE: In case Bank endorsed certificate regarding above has already been submitted earlier, Kindly submit photocopy of the same



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024
Annexure-9

UNDERTAKING

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

GENERAL MANAGER & PROJECT DIRECTOR,
SITE OFFICE: BHEL, PSSR, 2X660 MW ENNORE SEZ STPP,
VOYALUR PO MINJUR PONNERI TALUK
TAMIL NADU – 601 203

Dear Sir/Madam,

Sub: DECLARATION REGARDING INSOLVENCY/ LIQUIDATION/ BANKRUPTCY PROCEEDINGS

Ref: NIT/Tender Specification No: BHEL:PSSR: ENR-SEZ : 2024-25 : SCT : 081 dt 15.04.2024

I/We,

_____ declare that, I/We am/are not under insolvency resolution process or liquidation or Bankruptcy Code Proceedings (IBC) as on date, by NCLT or any adjudicating authority/ authorities, which will render us ineligible for participation in this tender.

Sign. of the AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

Place:

Date:



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024
Annexure-10

DECLARATION

Date: _____

To: **GENERAL MANAGER & PROJECT DIRECTOR,**
SITE OFFICE: BHEL, PSSR, 2X660 MW ENNORE SEZ STPP,
VOYALUR PO MINJUR PONNERI TALUK
TAMIL NADU – 601 203
email: tender.ennore@bhel.in

Sub: **Details of related firms and their area of activities**

Dear Sir/ Madam,

Please find below details of firms owned by our family members (" Family " shall mean: (a). parent, (b). husband/wife, (c). sons/daughters (including adopted children) and their spouse, (d). full blood siblings (brothers & sisters from common parents) and their spouse)
that are doing business/ registered for same item with BHEL, _____ (NA, if not applicable)

1	Material Category/ Work Description	
	Name of Firm	
	Address of Firm	
	Nature of Business	
	Name of Family Member	
	Relationship	
2	Material Category/ Work Description	
	Name of Firm	
	Address of Firm	
	Nature of Business	
	Name of Family Member	
	Relationship	
...		

Note: I certify that the above information is true and I agree for penal action from BHEL in case any of the above information furnished is found to be false.

Regards,

(_____)
From: M/s _____
Supplier Code: _____
Address: _____



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP,
Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024
Annexure-11

DECLARATION

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

**GENERAL MANAGER & PROJECT DIRECTOR,
SITE OFFICE: BHEL, PSSR, 2X660 MW ENNORE SEZ STPP,
VOYALUR PO MINJUR PONNERI TALUK
TAMIL NADU – 601 203**

Dear Sir/Madam,

Sub: One Bid per Bidder w.r.t. Clause No. 28A of NIT – reg.

Ref: NIT/Tender Specification No: **BHEL:PSSR: ENR-SEZ : 2024-25 : SCT : 081 dt 15.04.2024**

I/ We, M/s (Name of the bidder) certify the following with reference to the subject Tender.

1) I/ We have not submitted multiple bids, in any of the two formats given below:

- a) individual or proprietorship format and/or
 - b) a partnership or association of persons format and/or
 - c) a company format
- wherein,

- A company shall for this purpose include any artificial person whether constituted under the Indian laws or of any other country.
- A person shall be deemed to have bid in a partnership format or in association of persons format if he is a partner of the firm which has submitted the bid or is a member of any association of persons which has submitted a bid.
- A person shall be deemed to have bid in a company format if the person holds:
 - i. more than 10% (ten percent) of the voting share capital of the company which has submitted a bid, or
 - ii. is a Director and / or Key Managerial Personnel of the company which has submitted a bid, or
 - iii. holds more than 10% (ten percent) of voting share capital in and/or is a director and/or Key Managerial Personnel of a holding company of that company which has submitted the bid.

2) None of our Sister/ Associated/ Allied concerns (i.e., a company, society, partnership firm or proprietorship firm having one or more common persons as Director/ Partner/ Member/ Owner) have submitted any other bid for this Tender.

I/We understand that all the bids of a bidder who has submitted multiple bids, in terms of Clause No. 34A of NIT, shall be rejected.

Signature of the AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

Place:

Date:



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Annexure-12

**DECLARATION REGARDING MINIMUM LOCAL CONTENT IN LINE WITH
REVISED PUBLIC PROCUREMENT (PREFERENCE TO MAKE IN INDIA), ORDER 2017
DATED 04TH JUNE, 2020) AND SUBSEQUENT ORDER(S)**

(To be typed and submitted in the Letter Head of the Entity/Firm providing certificate as applicable)

To,

**GENERAL MANAGER & PROJECT DIRECTOR,
SITE OFFICE: BHEL, PSSR, 2X660 MW ENNORE SEZ STPP,
VOYALUR PO MINJUR PONNERI TALUK
TAMIL NADU – 601 203**

Dear Sir,

Sub: Declaration reg. minimum local content in line with Public Procurement (Preference to Make in India), Order 2017-Revision, dated 04th June, 2020 and subsequent Order(s)

Ref : 1) NIT/Tender Specification No: **BHEL:PSSR: ENR-SEZ : 2024-25 : SCT : 081 dt 15.04.2024,**

2) All other pertinent issues till date

We hereby certify that the items/works/services offered by _____ (specify name of the organization here) has a local content of _____ % and this meets the local content requirement for '**Class-I local supplier**' / '**Class II local supplier**' ** as defined in Public Procurement (Preference to Make in India), Order 2017-Revision dated 04.06.2020 issued by DPIIT and subsequent order(s).

The details of the location(s) at which the local value addition is made are as follows:

1. _____	2. _____
3. _____	4. _____

...

...

Thanking you,

Yours faithfully,

**(Signature, Date & Seal of
Authorized Signatory of the Bidder)**

**** - Strike out whichever is not applicable.**

Note:

- Bidders to note that above format Duly filled & signed by authorized signatory, shall be submitted along with the techno-commercial offer.
- In case the bidder's quoted value is in excess of Rs. 10 crores, the authorized signatory for this declaration shall necessarily be the statutory auditor or cost auditor of the company (in the case of companies) or a practising cost accountant or practicing chartered accountant (in respect of suppliers other than companies).

In the event of false declaration, actions as per the above order and as per BHEL Guidelines shall be initiated against the bidder.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Annexure-13

Reverse Auction Process Compliance Form

(The bidders are required to print this on their company's letterhead and sign, stamp before RA)

To

M/s. {Service provider

Postal address}

Sub: Agreement to the Process related Terms and Conditions

Dear Sir,

This has reference to the Terms & Conditions for the Reverse Auction mentioned in the RFQ document for {Items} against BHEL enquiry/ RFQ no : **BHEL:PSSR: ENR-SEZ : 2024-25 : SCT : 081 dt 15.04.2024**

This letter is to confirm that:

- 1) The undersigned is authorized official/ representative of the company to participate in RA and to sign the related documents.
- 2) We have studied the Reverse Auction guidelines (Guidelines for Reverse Auction – 2021) as available in Volume-ID, "Forms and Procedures" of this tender), and the Business rules governing the Reverse Auction as mentioned in your letter and confirm our agreement to them.
- 3) We also confirm that we have taken the training on the auction tool and have understood the functionality of the same thoroughly.
- 4) We also confirm that, in case we become L1 bidder, we will FAX/ email the price confirmation & break up of our quoted price as per Annexure - 6 within **two** working days (of BHEL) after completion of RA event, besides sending the same by registered post/ courier both to M/s. BHEL and M/s. {Service provider.}

We, hereby confirm that we will honor the Bids placed by us during the auction process.

With regards

Signature with company seal

Name:

Company / Organization:

Designation within Company / Organization:

Address of Company / Organization:

Sign this document and FAX/ email it to M/s {Service provider} at {.....} prior to start of the Event.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Annexure-14

Authorization of representative who will participate in the online Reverse Auction Process

1	NAME OF THE BIDDER	
2	NAME & DESIGNATION OF OFFICIAL	
3	POSTAL ADDRESS (COMPLETE)	
4	TELEPHONE NOS. (LAND LINE & MOBILE BOTH)	
5	E-MAIL ADDRESS	
6	NAME OF PLACE/ STATE/ COUNTRY, WHEREFROM S/HE WILL PARTICIPATE IN THE REVERSE AUCTION	



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP,
Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024
Annexure-15

RA price confirmation and breakup
(To be submitted by L1 bidder after completion of RA)

To

M/s. Service provider

Postal address

CC: **GENERAL MANAGER & PROJECT DIRECTOR,**
SITE OFFICE: BHEL, PSSR, 2X660 MW ENNORE SEZ STPP,
VOYALUR PO MINJUR PONNERI TALUK
TAMIL NADU – 601 203

Sub: **Final price quoted during Reverse Auction and price breakup**

Dear Sir,

We confirm that we have quoted.

Rs.{_____in value & in words_____} for item(s) covered under tender enquiry No. BHEL:PSSR: ENR-SEZ : 2024-25 : SCT : 081 dt 15.04.2024

Total price of the items covered under above cited Tender Specification as our final landed prices as quoted during the Reverse Auction conducted today _____{date} which will be valid as per tender Specification.

Total

- Rs. in value & in words

Yours sincerely,

For _____

Name:

Company:

Date:

Seal:



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Annexure-16

INTREGITY 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: ENR-SEZ:2024-25:SCT : 081 - BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203** (hereinafter referred to as "Contract"). 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 panel of Independent External Monitor(s) (IEMs), 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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

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. The Bidder(s)/ Contractor(s) commits himself to observe the following principles during 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.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- 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 shall 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 , terminate the contract, if already awarded, exclude from future business dealings and/ 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 (s) from the tender process before award/ order acceptance according to Section 3, the Principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit/ Bid Security.
- 4.2 If the Principal is entitled to terminate the Contract according to Section 3, or terminates the Contract in application of Section 3 above, the Bidder(s)/ Contractor (s) transgression through a violation of Section 2 above shall be construed breach of contract and the Principal shall be entitled to demand and recover from the Contractor an amount equal to 5% of the contract value or the amount equivalent to Security Deposit/ Performance Bank Guarantee , whichever is higher, as damages, in addition to and without prejudice to its right to demand and recover compensation for any other loss or damages specified elsewhere in the contract.

Section 5 - Previous Transgression

- 5.1 The Bidder declares that no previous transgressions occurred in the last 3 (three) 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 or



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

action can be taken as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors", framed by the Principal.

Section 6 - Equal treatment of all Bidder (s)/ Contractor (s) / Sub-contractor (s)

- 6.1 The Principal will enter into Integrity Pacts with identical conditions as this Integrity Pact with all Bidders and Contractors.
- 6.2 In case of Sub-contracting, the Principal Contractor shall take the responsibility of the adoption of Integrity Pact by the Sub-contractor(s) and ensure that all Sub-contractors also sign the Integrity Pact.
- 6.3 The Principal will disqualify from the tender process all Bidders who do not sign this Integrity 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 panel of Independent External Monitor (s) (IEMs) for this Integrity Pact. The task of the IEMs is to review independently and objectively, whether and to what extent the parties comply with the obligations under this Integrity Pact.
- 8.2 The IEMs are 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 IEMs shall be provided access to all documents/ records pertaining to the Contract, for which a complaint or issue is raised before them as and when warranted. However, the documents/records/information having National Security implications and those documents which have been classified as Secret/Top Secret are not to be disclosed.
- 8.4 The Principal will provide to the IEMs 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 IEMs the option to participate in such meetings.
- 8.5 The advisory role of IEMs is envisaged as that of a friend, philosopher and guide. The advice of IEMs would not be legally binding and it is restricted to resolving issues raised by a Bidder regarding any aspect of the tender which allegedly restricts competition or bias

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- 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 or during execution of Contract, the matter should be examined by the full panel of IEMs jointly, 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 the CMD, BHEL at the earliest. They may also send their report directly to the CVO, in case of suspicion of serious irregularities requiring legal/ administrative action. Only in case of very serious issue having a specific, verifiable Vigilance angle, the matter should be reported directly to the Commission. IEMs will tender their advice on the complaints within 30 days.
- 8.8 The CMD, BHEL shall decide the compensation to be paid to the IEMs and its terms and conditions
- 8.9 IEMs 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 Principal should be looked into by the CVO of the Principal.
- 8.10 If the IEMs have 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 IEMs may also transmit this information directly to the Central Vigilance Commissioner, Government of India.
- 8.11 After award of work, the IEMs shall look into any issue relating to execution of Contract, if specifically raised before them. As an illustrative example, if a Contractor who has been awarded the Contract, during the execution of Contract, raises issue of delayed payment etc. before the IEMs, the same shall be examined by the panel of IEMs. Issues like warranty/ guarantee etc. shall be outside the purview of IEMs.
- 8.12 However, the IEMs may suggest systemic improvements to the management of the Principal, if considered necessary, to bring about transparency, equity and fairness in the system of procurement.
- 8.13 The word 'Monitor' would include both singular and plural.

Section 9 - Pact Duration



NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- 9.1 This Integrity Pact shall be operative from the date this Integrity Pact 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. Any violation of the same would entail disqualification of the bidders and exclusion from future business dealings.
- 9.2 If any claim is made/ lodged during currency of this Integrity Pact, 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 Integrity Pact is subject to Indian Laws and exclusive jurisdiction shall be of the competent Courts as indicated in the Tender or Contract, as the case may be.
- 10.2 Changes and supplements as well as termination notices need to be made in writing.
- 10.3 If the Bidder(s)/ Contractor(s) is a partnership or a consortium or a joint venture, this Integrity Pact shall be signed by all partners of the partnership or joint venture or all consortium members.
- 10.4 Should one or several provisions of this Integrity Pact turn out to be invalid, the remainder of this Integrity Pact 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 Integrity Pact with the Principal would be competent to participate in the bidding. In other words, entering into this Integrity Pact would be a preliminary qualification.
- 10.6 In the event of any dispute between the Principal and Bidder(s)/ Contractor(s) relating to the Contract, in case, both the parties are agreeable, they may try to settle dispute through Mediation before the panel of IEMs in a time bound manner. In case, the dispute remains unresolved even after mediation by the panel of IEMs, either party may take further action as the terms & conditions of the Contract. The fees/expenses on dispute resolution through mediation shall be shared by both the parties. Further, the mediation proceedings shall be confidential in nature and the parties shall keep confidential all matters relating to the mediation proceedings including any settlement agreement arrived at between the parties as outcome of mediation. Any views expressed, suggestions, admissions or proposals etc. made by either party in the course of mediation shall not be relied upon or introduced as evidence in any further arbitral or judicial proceedings, whether or not such proceedings relate to the dispute that is the subject of mediation proceedings. Neither of the parties shall present IEMs



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP,
Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

as witness in any Alternative Dispute Resolution or judicial proceedings in respect of
the dispute that was subject of mediation.

For & On behalf of the Principal
(Office Seal)

For & On behalf of the Bidder/Contractor
(Office Seal)

Place Chennai

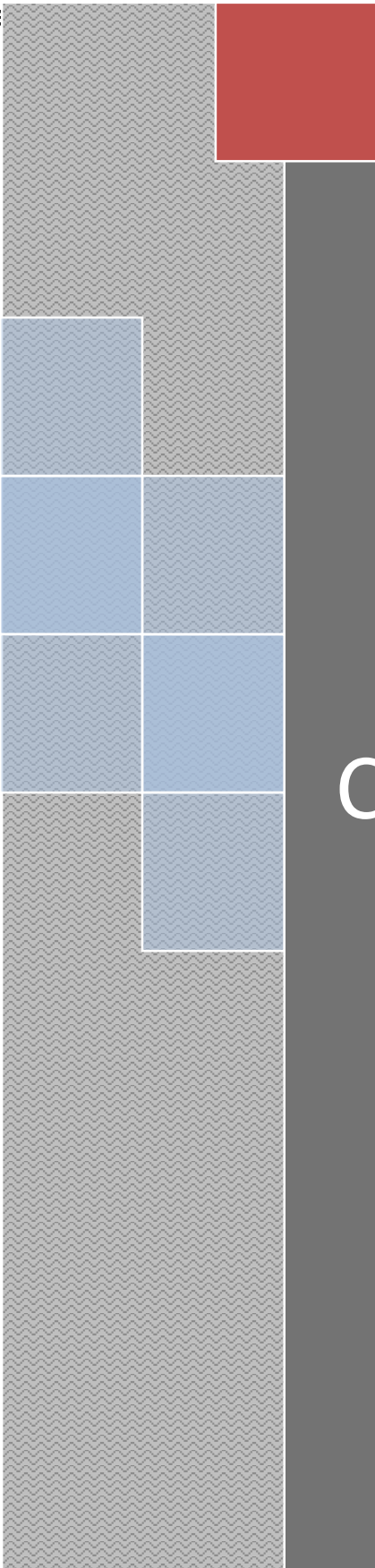
Date _____

Witness: _____
(Name & Address) _____

Witness: _____
(Name & Address) _____

NIT Re

4



VOLUME – IA

Part I & II

TECHNICAL CONDITIONS OF CONTRACT (TCC)



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

ANNEXURE-1

CONTENTS

Sl. No.	DESCRIPTION	Chapter
Vol I A	Part-I: Contract specific details	
1	Project Information	Chapter-I
2	Scope of works	Chapter-II
3	Facilities in Scope of Contractor / BHEL (Scope Matrix)	Chapter-III
4	T&Ps and MMEs to be deployed by Contractor	Chapter-IV
5	T&Ps and MMEs to be deployed by BHEL	Chapter-V
6	Time Schedule	Chapter-VI
7	Terms of Payment	Chapter-VII
8	Taxes and Duties	Chapter-VIII
9	Bill of Quantity	Chapter-IX
10	General	Chapter-X
11	Progress of work	Chapter-XI
12	Material Handling	Chapter-XII
13	Accounting of materials	Chapter-XIII
Vol IA	Part-II: Technical specifications	
1	Technical Specifications	



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Vayalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME-IA PART – I CHAPTER – I

PROJECT INFORMATION

INTRODUCTION

ENNORE SEZ SUPERCRITICAL TPS UNITS- 1 & 2 [2 x 660 MW] is being set up by **TAMILNADU GENERATION AND DISTRIBUTION CORPORATION** at a site in Vayalur Village Near Ennore Port, Tamilnadu, India. Plant will be set up in existing Ash Dyke of NCTPS by reclamation of some portion of the Ash Dyke. 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.

APPROACH TO SITE

The proposed plant will be located at Ash dyke of North Chennai Thermal Power, approximately 35 km from Chennai, in the state of Tamilnadu, India. The site is occupying a coastal site near the village of Vayalur. The nearest commercial airport is at Chennai located at a distance of 60 km from the project site.

Nearest Airport – Chennai

Nearest Airstrip – Chennai

Nearest Seaport – Ennore

A. Project Information & Location



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Vayalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Project Title: Ennore SEZ project of 2 x 660 MW Coal Based Super Critical Thermal Power

Project at ash dyke of NCTPS

Plant Capacity: 1320 MW (2 units of 660 MW each)

Type of Project: Green field

Owner: Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)

Plant site location: Ash dyke of North Chennai Thermal Power Station (NCTPS)

Location co-ordinates: 80o 18' E to 80o 19' E Longitude

13o 17' N to 13o 18' N Latitude

Nearest Village: Vayalur

Nearest Town & City: Chennai (35 Km)

State Capital: Chennai (35 Km)

Nearest Railway Station: Athipattu Pudunagar (~5 Km)

Nearest Airport: Chennai (~60 Km)

Nearest Seaport: Ennore (~5 Km)

Nearest Road access: All weather road from Pattamandri on the Thiruvottiur – Ponneri district highway.

B. Meteorological Condition

Owner: Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)

Owner Consultant: DESEIN, DELHI,



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Site Elevation: (+) 10.0 m above Mean Sea Level

Ambient Temperature: a. Maximum 32.0 Deg. C

b. Minimum 24 Deg. C

c. Design ambient temperature 35 Deg. C

Relative Humidity: a. Maximum 100%

b. Minimum 36%

c. Design 75%

Annual Rainfall: a. Maximum 2540 mm

b. Average 1600 mm

c. Minimum 1175 mm

Wind Data: a. Basic wind speed at 10m height: 50 m/sec

b. Wind pressure As per IS: 875 Part III-1984

Seismic Zone: Zone III as per IS: 1893-2002

Design ambient temperature: 50 Deg. C (For electrical Equipments)



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME-IA PART – I CHAPTER – II

SCOPE OF WORKS

2.1 The scope of works covers mainly Balance Civil, Structural and Architectural works of Main plant at 2 X 660 MW Ennore SEZ Supercritical Thermal Power Project (Unit-1 & 2) at Ash Dyke of North Chennai TPS, Tamil Nadu, as mentioned below, including supply of all materials (excluding MS round for earthing, Reinforcement steel & Structural Steel, Cement), labour, tools and plants and hand over the structures to TANGEDCO in all respect as per BOQ, Specifications and drawings.

The scope of work is indicative but not limited to the following The scope includes the balance works in following areas: -

1. Civil works of TDBFP & MDBFP, ID, PA, FD Fan foundations & deck Unit - 1 & 2
2. Balance civil works of ID Duct foundations
3. Balance civil works of Seal Air Fan foundations
4. Civil works of Boiler area paving slab and other equipment foundation, other machine foundations around Mill area Unit – 1
5. Civil works of Paving and column encasing and other machine foundations around Mill area Unit – 1 & 2
6. Balance civil works of ESP Control Room Unit-1.

Note:

- The above provided list is indicative only for the bidder's guideline. Any other work 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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

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.

- Reinforcement steel, structural steel for civil & structural works (applicable, if any) shall be provided by BHEL free of cost. Embedments/ inserts required, if any, for the works in general shall be supplied by the bidder and payment shall be made as per corresponding item in BOQ. If BHEL provides Structural Steel from scraps (if available) for inserts, payment shall be made as per corresponding item in BOQ.
- The preparatory and support works such as transportation and placing of springs and dampers are in contractor scope.
- The excavated earth has to be heaped in the desired location and the same should be utilized for further filling works. No additional lead shall be given.

2.2 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, concrete, earthwork other allied works, preparation of bar bending schedules on the basis of construction drawings, etc. are included in the rates of items of work.

2.3 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. No separate payment for these operations shall be made. The cost of all these operations shall be deemed to have been included in the unit rates rendered for the different items under bill of quantities.

2.4 All the works areas shall be adequately flood lighted to the satisfaction of the Engineer-in-Charge when the work is in progress during the night shifts.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

2.5 The unit rates shall include all materials, equipment, fixtures, labour charges, required temporary works and everything whether of permanent or temporary in nature necessary for the completion of job in all respects.

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

2.7 Drawings showing enough details for the construction as per the specification shall be furnished to the contractor in a phased manner.

2.8 The bidder should fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, local conditions, soil strata and site specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may have not been specifically brought out in the specifications.

2.9 Fusion bonded epoxy coating for the reinforcement steel issued by BHEL:

Scope of work also consists of providing fusion bonded epoxy coating by mechanized & qualified process including blast cleaning to white metal as per Swedish code, heating in induction heater, electrostatically spraying the epoxy powder, complete fusion to give minimum coating thickness of 200-300 microns, gradual cooling without affecting the properties of steel, testing as per ASTM 775 and IS:13620, flexibility & holiday test, proper packing, safe transportation, touchup at site, etc. complete to ensure proper resistance of FBE against corrosive environment including transport of the steel from BHEL site store to vendor plant and bringing back to site and special handling during straightening, cutting, bending, placing and providing PVC coating on binding wire. Payment for this work shall be made against relevant item of BOQ.

2.10 Bidder shall visit site for better clarification against present status of civil works in various area for proper assessment of pending works. The work covered under scope shall be taken up on AS IS WHERE IS basis, as applicable in site as per the instructions of BHEL Engineer in charge.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

2.11 Special arrangements to be made for tackling COVID-19 pandemic –

2.11.1 Government order (state/ center) being issued time to time for protective measures of COVID-19 pandemic shall be complied with strictly until government (state/ center) declares end of pandemic.

2.11.2 Contractor shall make arrangements for implementation of STANDARD OPERATING PROTOCOL (SOP) as per government order. Any person violating the COVID -19 measures published vide government order time to time will be liable to be proceeded for legal action as per the government order.

2.11.3 The cement required for the work will be provided by BHEL only for the concrete works. The schedule of requirement of cement shall be provided 1 month in advance for arranging the same.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME-IA PART – I CHAPTER – III

FACILITIES & CONSUMABLES IN THE SCOPE OF CONTRACTOR / BHEL

(SCOPE MATRIX)

3.1 PART I

Sl.No	Description PART I	Scope to be taken care by		Remarks
		BHEL	Bidder	
3.1.1.0	ESTABLISHMENT			
3.1.1.1	FOR CONSTRUCTION PURPOSE:			
3.1.1.1.1	Open space for office	Yes		As provided by TANGEDCO
3.1.1.1.2	Open space for storage	Yes		
3.1.1.1.3	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	At Bidder's Own Cost
3.1.1.1.4	Bidder's all office equipments, office / store / canteen consumables		Yes	
3.1.1.1.5	Canteen facilities for the bidder's staff, supervisors and engineers etc.		Yes	
3.1.1.1.6	Firefighting equipments like buckets, extinguishers etc.		Yes	
3.1.1.1.7	Fencing of storage area, office, canteen, labour hutment, etc. of the bidder,		Yes	
3.1.1.2	FOR LIVING PURPOSES OF THE BIDDER			
3.1.1.2.1	Open space		Yes	



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
	PART I			
3.1.1.2.2	Living accommodation		Yes	At Bidder's Own Cost
3.1.2.0	ELECTRICITY			
3.1.2.1	Electricity For construction purposes (to be specified whether chargeable or free)	YES		Chargeable to bidder as provided by TANGEDCO
3.1.2.1.1	Single point source (In general) For detail, refer clause no. 3.4.1	Yes		On chargeable basis to bidder as per Prevailing rate of TANGEDCO
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
3.1.2.2	Electricity for the office, stores, canteen etc. of the bidder which include:		Yes	
3.1.2.2.1	Distribution from single point including supply of materials and service		Yes	
3.1.2.2.2	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	
3.1.2.2.3	Duties and deposits including statutory clearances for the above		Yes	
3.1.2.2.4	Living facilities for office use including charges		Yes	
3.1.2.2.5	Demobilization of the facilities after completion of works		Yes	



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Sl.No	Description PART I	Scope to be taken care by		Remarks
		BHEL	Bidder	
3.1.2.3	Electricity for living accommodation of the bidder's staff, engineers, supervisors, labour hutment etc. on the above lines. (in case BHEL provides this facility, the scope should be given without ambiguity)		Yes	
3.1.3.0	WATER SUPPLY			
3.1.3.1	For construction purposes:	Yes		Chargeable to bidder as per prevailing rate of TANGEDCO
3.1.3.1.1	Making the water available at single point	Yes		Chargeable to bidder as per prevailing rate of TANGEDCO
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
3.1.3.2	Water supply for bidder's office, stores, canteen etc.		Yes	
3.1.4.0	LIGHTING			
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
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		Yes	



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Sl.No	Description PART I	Scope to be taken care by		Remarks
		BHEL	Bidder	
3.1.5.0	COMMUNICATION FACILITIES for site operations of the bidder			
3.1.5.1	Telephone, Fax, internet, intranet, email etc.		Yes	At Bidder's Own Cost

3.2 PART II

Sl. No.	Description PART II	Scope to be taken care by		Remarks
		BHEL	Bidder	
	CONSTRUCTION FACILITIES			
3.2.1.0	Engineering works for construction			
3.2.1.1	Providing the construction drawings for all the equipment's covered under this scope	Yes		
3.2.1.2	Drawings for construction methods		Yes	In consultation with BHEL
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
3.2.1.4	Shipping lists etc. for reference and planning the activities	Yes	Yes	In consultation with BHEL
3.2.1.5	Preparation of site construction schedules and other input requirements		Yes	In consultation with BHEL
3.2.1.6	Review of performance and revision of site construction schedules in order to achieve the end dates and other commitments		Yes	



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

SI. No.	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
	PART II			
3.2.1.7	Weekly construction schedules based on SI No 3.2.1.5		Yes	
3.2.1.8	Daily construction / work plan based on SI No 3. 2.1.7		Yes	For daily monitoring meeting at site
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	

3.3 OPEN SPACE:

Open space will be provided to the bidder free of cost as provided by TANGEDCO. 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 batching plant, fabrication yard, office, 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. Contractor has to make his own arrangements for labour colony at their own cost. The contractor to construct labour colony/ hutment as per his requirements after obtaining approval of formalities from statutory body. The contractor shall provide adequate water



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

arrangement for drinking/washing/bathing with required toilets, drainage system, lighting facilities etc. in labour colony at their own cost. Suitable paved area to be provided in the labour colony at their own cost.

3.4 ELECTRICITY:

3.4.1 In general, Construction power will be provided to the contractor on prevailing rates of TANGEDCO on **chargeable basis** at one single point WITHIN THE PLANT AREA by BHEL. The contractor to Provide necessary energy meter for measuring the power consumption. The contractor shall make his own arrangement for further distribution with necessary isolator/LCB etc. 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), for smooth execution of the work at site. If, BHEL provides electricity at more than one point (as close to work area as possible), it will be responsibility of the contractor to provide all the support necessary for enabling BHEL for extending such provision to contractor. However, the Construction power provided to the contractor shall be on chargeable basis at prevailing rates of TANGEDCO. 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. Any dispute, BHEL engineer's decision shall be final and binding on contractor.

Construction power prevailing charges are as below,

The present LT tariff VI rate of TANGEDCO is

- a) Consumption charges at Rs.12.00 per unit
- b) Maximum demand (MD) charges as applicable per month
- c) Low Power Factor (LPF) charges
- d) Electricity Tax on total amount



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- e) Any other miscellaneous charges charged by M/s TANGEDCO pertaining to construction power supply.

Note - The TANGEDCO tariff and tax may vary from time to time and the same is applicable for the bidder.

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

3.5 WATER:



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- 3.5.1 Water (Raw water) required for construction purposes will be provided at one single point WITHIN THE PLANT AREA on chargeable basis to contractor at the prevailing rates of TANGEDCO. The contractor to Provide necessary meter for measuring the water consumption. 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.
- 3.5.2 Successful Bidder to make his own arrangements for drinking water / water for sanitation for their labourer & staff at bidders cost.
- 3.5.3 The water charges may vary from time to time as per TANGEDCO/ Metro conditions. However, the prevailing water charge is Rs 191.00 per Kilo litres and may be liable to changes. Any dispute regarding consumption, the BHEL engineer decision will be final. The TANGEDCO tariff and tax may vary from time to time and the same is applicable for the successful bidder.
- 3.5.4 Incase non-availability of water or the TANGEDCO is not able to supply the 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, due to delay / failure for providing water supply. Contractor has to make his own arrangements for their water requirement for their labour colony at their own cost.

3.6 MATERIAL SUPPLY:

Supply / providing- aggregate (Coarse, fine) and all other materials required (except free supply materials i.e. reinforcement steel, Cement, structural steel for structural works, structural steel from scraps for inserts (if available), foundation bolts & inserts/ embedments supplied by manufacturing units of BHEL) for the work are in the scope of the contractor. BHEL shall provide reinforcement steel for civil works and structural steel (applicable, if any) for structural works only for incorporation in the permanent



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

work AS FREE SUPPLY. In general, structural steel required for embedment/ inserts shall be supplied by the bidder and payment shall be made as per the relevant items of BOQ.

- 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. In some instances, for 8mm, 10mm & 12mm dia reinforcement steel will be supplied in coil form. No extra claims will be entertained against issue of Non-standard lengths of steel and de coiling of 8mm, 10mm & 12mm dia. steel.

If any matching sections of steel are not available with BHEL, contractor may arrange these sections from Customer approved agencies only on certification of BHEL and the same shall be paid against relevant BOQ item in the price bid.

3.6.1 Ordinary Portland Cement (OPC) shall be used for all structures except for foundations, underground structures & structures coming in contact with sea water including trenches & channels, wherein sulphate resistant cement with C3A content limited to 5% or Ordinary Portland cement with C3A content 5% to 8% shall be used depending on the presence of sulphate and chlorides in water/ soil. Grade of cement shall be 43 conforming to IS:269 (latest version).

3.6.2 Fine aggregate source shall be manufactured crushed stone or rock sand commonly known as M-sand, excluding fines which are by products/rejects of coarse aggregate production. The crushed stone sand shall be graded from fine to coarse with the coarse sizes predominating to give maximum density.

The amount of fine particles as ascertained by the laboratory sedimentation method shall not exceed 10% for crushed stone nor 4% for natural sand. The amount of material passing a 75 micron sieve (IS test sieve) shall not exceed the following limits:



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

a) Crushed stone sand concrete subject to abrasion 1% by weight

b) All other concrete 3% by weight.

There shall be no clay or fine silt present. The amount of hollow shells like to form voids or remain partially unfilled and present in material retained on a IS 2.36 mm sieve, determined by direct visual separation, shall not exceed 3% by weight of the entire sample. Fine aggregate shall not contain appreciable amounts of flaky and/or elongated particles. The water absorption of fine aggregate, determined in accordance with BS 812 shall not exceed 2.0% by weight. Fine aggregate subjected to five cycles of the soundness test, specified in IS:2386 (Part-5), shall not show a loss exceeding 10% when sodium sulphate solution is used and 15% when magnesium sulphate solution is used, except where approved otherwise. Tests are to be executed in accordance with IS:2386. The grading of fine aggregate for concrete work shall comply with the requirements of IS:383. The grading of the aggregates should be such as to produce a concrete of the specified proportions which will work readily into position without segregation and without the use of an excessive water content. The grading should be controlled throughout the work so that it conforms closely to that used for the preliminary tests. A check on the moisture content of sand should be made at least once a day before concreting. The amount of water to be added to the concrete mix should be adjusted accordingly. Any washing, screening, classifying and other operations on the fine aggregate required to meet this specification shall be done by the Contractor. Washing is required if the content of salt adhering to the aggregate is found to be unacceptably high.

3.7 CONSUMABLE

All consumables, like gas, electrodes, chemicals, lubricants etc. required for the scope of work, shall be arranged by the contractor at his cost unless otherwise specifically mentioned in the contract. Prior approval from Engineer In-Charge shall be obtained



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

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.

3.8 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 cost.

3.9 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 cost. In the event of his failure to do so, same shall be carried out by BHEL and the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

3.10 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 dewatering method (if any carried out for foundation or sub-structure work to maintain water table below the founding level as per the requirement of relevant drawing/ specification) shall be paid in relevant item of BOQ.

3.11 BID DRAWINGS



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Bid drawings enclosed for information and this may get revised during execution.

3.12 PILE HEAD CHIP-OFF

If required, Pile head shall be chipped off by this package contractor and related excavation and dewatering also shall be carried out by this package contractor. If required, pile built-up shall also be carried out by this package contractor. Item no. A2509 (of BOQ cum price bid) shall be operated for payment of pile head chipping & relevant item of concreting, reinforcement placement (if any required) and formwork shall be operated for pile built-up.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME-IA PART – I CHAPTER – IV

T&Ps TO BE DEPLOYED BY CONTRACTOR

- 4.1 All the tools and plants required for satisfactory completion of the work have to be arranged by the contractor.
- 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

Sr No	Major T&P	Mobilizing time from the date of commencement of work
A	<u>STRUCTURAL WORKS</u>	
A1	1 Nos. 150 T capacity crawler crane for erection.	As per BHEL requirement at site.
A2	1 Nos. 75 T capacity crawler crane for Fabrication (or) 1 No 40MT Capacity gantry crane with 150m length rails for movement	As per BHEL requirement at site.
Sr No	Other T&Ps	Mobilizing time from the date of commencement of work
A3	4 nos. pick & carry cranes (10/ 12 T cap)	As per BHEL requirement at site.
A4	2 Nos. Radial drill machine	As per BHEL requirement at site.
A5	2 nos. magnetic base drill machine	As per BHEL requirement at site.
A6	1 no. Plasma Cutting machine	As per BHEL requirement at site.
A7	2 nos. SS Welding rectifier	As per BHEL requirement at site.
A8	1 no. Plate bending machine	As per BHEL requirement at site.
A9	10 nos. MIG machine	As per BHEL requirement at site.
A10	10 nos. welding rectifier	5 Nos. within 30 days, Balance as per BHEL requirement at site.
A11	1 no. trailer – 15T	As per BHEL requirement at site.
A12	2 no. power driven HSEFG bolt tightening m/c	As per BHEL requirement at site.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

A13	2 no. torque tightening m/c. (2 no. Capacity up to 30mm dia HSFG bolt tightening)	As per BHEL 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 BHEL requirement at site.
A15	Power winch — 3T — 4 nos. for structural erection	As per BHEL requirement at site.
A16	Power winch — 5T — 2 nos. for structural erection	As per BHEL requirement at site.
A17	1 no ultra-sonography testing machine with recording device for structural work.	As per BHEL 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 BHEL requirement at site.
A19	Mother oven — 2 nos. for fabrication and 2 nos. for erection	As per BHEL requirement at site
A20	Portable oven — 25 nos. (10 nos. for fabrication and 15 nos. for erection)	As per BHEL requirement at site
B	<u>CIVIL WORKS</u>	
Sr No	Major T&P	Mobilizing time from the date of commencement of work
B1	2 No. excavator equivalent to capacity of Poclain CK90 or higher to suit the requirement of work at site	As per BHEL requirement at site.
B2	1 no. automatic concrete batching plant with printing facility (minimum capacity of 30 Cum/Hr each) with DG backup. With minimum 2 Nos of silo per batching plant (100MT each)	1 no. to be commissioned within 30 days
B3	1 no. Portable automatic concrete batching plant (Output 15 cum/ hr) with printing facility and independent DG Backup as a Standby arrangement	1 no. within 15 days



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

B4	1 Nos Truck mounted concrete mixer cum pump along with placing boom minimum 36 m high i.e. Concrete boom placer (36m)	As per BHEL requirement at site.
B5	1 nos. concrete pump (60 cum/ hr min capacity & lift 90M)	As per BHEL requirement at site
B6	7 nos. transit mixer (5/6 M3 capacity) including standby 1 nos.	Progressively as per BHEL requirement at site.
Sl. No	<u>Other T&Ps</u>	Mobilizing time from the date of start of work
B7	3 No. back hoe cum loader like JCB	As per BHEL requirement at site.
B8	4 nos. dumper (Min 15 cum each)	As per BHEL requirement at site.
B9	2 nos. diesel Mixer machine of 0.5 cum capacity	As per BHEL requirement at site.
B10	3 nos. self-priming dewatering pump 5 HP (diesel)	As per BHEL requirement at site
B11	3 nos. self-priming dewatering pump 10 HP (electric)	As per BHEL requirement at site
B12	4 nos. curing pump – 1.5 /2 HP (pump for curing at heights)	As per BHEL requirement at site
B13	6 nos. reinforcement bending machine	As per BHEL requirement at site
B14	1 no. vibro earth compactor or Vibromax or equivalent	As and when required at site.
B15	4 nos. reinforcement cutting machine	As per BHEL requirement at site
B16	MS scaffolding pipe / ACROW PIPE	As per BHEL requirement at site
B17	1 nos. power driven earth rammer (Roller Type 1/2 T)	As per BHEL requirement at site
B18	Civil laboratory equipment's as per list IN SI 4.4.2 with temporary building one AC lab	As per BHEL requirement at site



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

	size 4.5mtr x 6mtr and 1 non AC lab 4.5 mtr x 4.5 mtr.	
B19	2 nos total station with adequate arrangement for Surveyors.	1 no. Within 15 days
B20	3 or more nos auto level & staff	2 nos. Within 15 days and balance as per BHEL requirement at site. No. of auto level shall be mutually agreed between bidder & Engineer In-charge.
B21	120 nos concrete cube moulds	As per BHEL requirement at site
B22	Adequate no. of small trucks 10T/15T for shifting of reinforcement/cement/shuttering etc. within site	2 nos. Within 15 days. Balance as per BHEL requirement at site
B23	3 nos. drinking water tank – 5000 lit.	1 nos. Within 20 days. Balance as per BHEL requirement at site
B24	4 nos. mobile toilet for labour use.	Within 20 days
B25	1 nos. truck mounted 125 KVA DG set	Within 15 days
B26	Construction power cable	Within 15 days
B27	Construction water Pipeline	Within 15 days
B28	1 no. trailer for shifting of crawler mounted equipment's like Poclain, Dozer	As per BHEL requirement at site
B29	Concrete vibrator with adequate needle (Minimum 10 nos diesel/electric nos.)	As per BHEL requirement at site
B30	Portable fire extinguishers as below: Soda acid – 8 sets. Dry chemical powder – 10 sets CO2 – 10 sets. Water & sand bucket (4 buckets in one stand) – 10 sets. Fire hose with nozzle (50 M length) – 5 sets.	25% within 30 days and balance progressively within 50 days.
B31	1 no. compression testing machine (200 T cap)	As per BHEL requirement at site
B32	2 nos. pick & carry crane (10/ 12 T cap)	As per BHEL requirement at site



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

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/ 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 enclosed in Volume I Book I TCC- Volume 1A Part II) 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 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. 6.1 of this specification (i.e. TCC) shall be referred for date of start of work.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

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

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.

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

4.4.2 Field and laboratory testing procedures for materials follow Indian Standard Specifications with necessary equipment's like as given in table below:

CONCRETE TESTING EQUIPMENT				
SL NO	NAME OF TEST	NAME OF EQUIPMENT	SIZE OF EQUIPMENT	IS REF.
1	Initial & final setting time, Consistency of cement	Vicat Apparatus with desk pot	Standard	IS 5513
2	Shrinkage of cement, Auto Clave Test	Le Chatelier's apparatus Auto Clave Equipment	Standard	IS 5514
3	Abrasion value test	Los Angles Abrasion testing machine	Standard	IS 2386
4	Aggregate Impact value test	Aggregate Impact value testing machine with blow counter	Standard	IS 9377
5	Aggregate crushing value test	Crushing value apparatus	Standard	IS 2386



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

6	Flakiness index	Thickness gauge for measuring flakiness index	Standard	IS 2386
7	Elongation Index	Elongation gauge	Standard	IS 2386
8	Bulk density, voids and bulking apparatus	Measuring cylinders	3, 5,10 & 15 liters cylinders	
9	Workability of concrete	Slump cone	Standard, at least 04 no's	IS 456
10	Specific gravity of aggregates	Pycnometer	Standard, at least 02 no's	IS 383
11	Cement mortar cube vibrating	Motorized vibration machine for cement testing	Standard	IS 4031
12	Course aggregate Sieve analysis (Concrete & Road Works)	Sieve set	450mm dia GI Frames Size: 125 mm, 90 mm, 75 mm, 63 mm, 53 mm, 40 mm, 20 mm, 16 mm, 12.5 mm, 10 mm, 4.75 mm, Pan and cover	IS 383
13	Fine aggregate sieve analysis	Sieve set	200 mm dia Brass sieves; Size 4.75 mm, 2.36 mm, 1.18 mm 600 micron, 300 micron, 150 micron, 75 micron, 75 micron, Pan and cover	IS 383
14	Sieve Shaker	Motorized Sieve shaker	Mfg. Catalogue	
15	Silt content check	Sand silt content beaker	Standard	



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Soil Testing Equipment				
SL NO	NAME OF TEST	NAME OF EQUIPMENT	SIZE OF EQUIPMENT	IS REF.
1	Liquid limit test	Liquid limit apparatus	Standard	IS 2720
2	Core Cutter test	core cutter apparatus	Rammer, 6 no's of std. core cutter mould, dolly	IS 2720
3	Proctor density test	Std proctor Compaction apparatus	Standard	IS 2720
4	Moisture Content	Rapid moisture meter	Standard, at least 04 no's	IS 2720

4.5 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.

4.6. 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, construction of Temporary approach road for all their working area etc. for safe operation / movement of equipment including cranes / trailers etc. shall be the responsibility of the contractor at his cost. No compensation on this account shall be payable.

4.7 In case the contractor fails to provide any T&P which is in the scope of contractor and if BHEL provides such T&P available with BHEL, hire charges prevailing (as per BHEL norms) as on that day will be recovered from the contractor as per the prevailing BHEL Corporate Crane hire charges (may vary from time to time). Corresponding pages of Corporate Crane hire charges are enclosed in relevant chapter of Part II of Technical Conditions of Contract (Volume-I Book-I). This may get revised further as per the BHEL corporate guidelines.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

However, prevailing rates as on date of execution may be applicable. Crane operators deployed by the contractor shall be tested by BHEL before they are allowed to operate the cranes.

4.8 The age of the contractor deployed cranes upto 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.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME-IA PART – I CHAPTER – V

T&Ps PROVIDED BY BHEL

5.1 BHEL shall not provide any T & Ps. However, if in any unforeseen circumstances, requirement of any T&Ps (available with BHEL at site) arises, on request of bidder the same may be provided on chargeable basis but BHEL reserves the right of provision of such T&Ps. Charges shall be applied as per BHEL norms and guidelines and direction of engineer in-charge.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME-IA PART – I CHAPTER-VI

TIME SCHEDULE

- 6.1 The date of commencement of work at site shall be mutually agreed between bidder and BHEL site in-charge.
- 6.2 The entire scope of work for as detailed in the Tender Specification shall be completed within **6 Months (SIX months)** from the date of commencement of work with intermediate milestones as mentioned in clause 6.8.2.
- 6.3 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.
- 6.4 The contractor is required to refer Form 15 in Volume 1- BOOK 2 for all the instructions to be taken immediately after receipt of LOI.

6.5 MOBILISATION

- 6.5.1 The Contractor has to subsequently augment his resources in a prudent manner to achieve the COMPLETION SCHEDULES:
- 6.5.2 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 successful bidder taking in to consideration of the COMPLETION SCHEDULES /site decision on drawings flow (latest) and submitted for BHEL's approval.
- 6.5.3 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.
- 6.5.4 In case the project is to be advanced, the civil 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.

6.6 SUBMISSION OF L3 SCHEDULE



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

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 6.8. The detailed L3 schedule shall be approved by BHEL and same shall be implemented. Bidder 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 mile stone targets/schedule.

6.7 **GUARANTEE PERIOD FOR THE PACKAGE**

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

6.8 **CONSTRUCTION SCHEDULE**

6.8.1 Tentative construction schedule for the scope of works is as mentioned below

Sl.No	Area	Completion from Date of commencement of work
1.	Completion of balance Civil works of Boiler area paving slab and other equipment foundation	Progressively by 4 th month
2.	Completion of Balance civil works of Seal Air fan foundations	Progressively by 2 nd month
3.	Completion of Balance civil works of ID duct foundations and Balance Fans foundations (PA,FD,ID)	Progressively by 3 rd month (Unit # 1) & Progressively by 5 th month (Unit # 2)
4.	Completion of Balance civil works of ESP Control Room Unit-1	Progressively by 6 th month



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Sl.No	Area	Completion from Date of commencement of work
5.	Completion of Civil works of TDBFP & MDBFP foundations & deck Unit - 1 & 2	Progressively by 4 th Month for MDBFPs & Progressively by 6 th for TDBFPs
6.	Handing over of structure after attending the punch points, Documentation, final reconciliation and submission of final bill	Progressively by 6 th Month

6.8.2 INTERMEDIATE MILESTONES

Intermediate milestones are as below.

S No	Description	Completion month from the contractual date of start of the work	Intermediate Milestone
1	Completion of Balance civil works of ID duct foundations and Balance Fans foundations (PA,FD,ID) Unit # 1	3 rd Month	M1
2	Completion of Civil works of MDBFP foundations Unit - 1 & 2	4 th Month	M2

6.8.3 Penalty for Intermediate Milestones

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

6.8.3.2 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.

6.8.3.3 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.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- 6.8.3.4 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.
- 6.8.3.5 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.
- 6.8.3.6 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.
- 6.8.3.7 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.
- 6.8.3.8 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.
- 6.8.3.9 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.
- 6.9 The above schedule is tentative. In case the project is to be advanced, 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. 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.
- 6.10 The foundations, pedestals, floors, etc., required for the mechanical equipment erection/ structural erection shall be handed over to BHEL progressively within the scheduled period



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

given in the above table, as per the BHEL site requirement. Detailed area handing over plan shall be mutually discussed and agreed upon with BHEL site in-charge.

- 6.11 The left out minor finishing works shall also be completed and handed over to BHEL within the contract period.
- 6.12 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.
- 6.13 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.
- 6.14 The bidder must submit a detail schedule (area wise) for completion of work to meet civil work schedule given in Clause 6.8 within 15 days from the date of issue of LOI.
- 6.15 The major activities as mentioned against the work schedule given in clause No.6.8 are to be indicated in detailed schedule which shall be prepared by the bidder.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME-IA PART – I CHAPTER-VII

TERMS OF PAYMENT

7.1 Secured Advance

Not applicable

7.2 Advance for Mobilization

Not applicable

7.3 Interim Payment

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.

7.3.2 95% item rate shall be released after completion of works certification by Engineer in charge.

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.

7.3.4 Retention Amount shall be as per GCC.

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

7.3.6 Royalty for construction materials:

Payment of royalty for construction materials viz. coarse aggregates, fine aggregates, borrowed earth, etc. is to be made by contractor and challan of deposit of royalty/ seigniorage fee shall be submitted to BHEL along with RA bill.

In absence of production of challan following methodology shall be adopted:

Sl. No.	Construction Material	Rate of seigniorage/ royalty per cum (In rupees) to be withheld in RA bill	Volume to be considered for calculation	Remarks



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

1	Coarse aggregate	59.00	A. For RCC: (As per approved design mix proportion + wastage as specified in IS 383) x (Total volume of concrete claimed in RA bill) B. For PCC: (As per DSR recommendation + wastage as specified in IS 383) x (Total volume of concrete claimed in RA bill)	Rate mentioned herein is indicative and for information. Actual prevailing rate for seigniorage fee / royalty fee shall be considered for operation in RA bills/ Final bill. The amount so calculated shall be withheld from RA bill and on production of challan, payment of relevant portion will be released.
2	Fine aggregate	59.00		
3	Borrowed earth	26.00	Actual volume of filling shall be considered	
4	Murram	30% (thirty per cent of the local market value of the murram at pit mouth) or as applicable as per latest Tamilnadu govt. order	Actual volume of filling shall be considered	

7.4 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.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Measurement guidelines as a ready reference is also available in the technical specification.

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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Vayalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME 1A PART-1 CHAPTER VIII

TAXES AND DUTIES

8.1 Goods and service Tax (GST) & Cess

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.

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.

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 : 33AAACB4146P2ZL

NAME : BHARAT HEAVY ELECTRICALS LIMITED ADDRESS : BHEL- PSSR SITE OFFICE, 2 X 660 MW ENNORE SEZ STPP, VAYALUR BR PO MINJUR PO, TAMILNADU – 601203

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.

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.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Vayalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

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.

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.

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

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

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.

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.

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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

paid/ adjusted from the date of respective variation. The bidder shall give the benefit of downward revision in favor of BHEL. No other variations shall be allowed during the tenure of the contract.

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.

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.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME-IA PART – I CHAPTER - IX

BILL OF QUANTITY

1.9.1 As mentioned in the Volume II, Price bid, Part C

NOTE TO BOQ:

1. 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.
2. 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.
3. Bidders shall refer Volume II, Price Bid, Part –A for Instructions regarding quoting.
4. The quantities given in the contract are tentative and may change to any extent (both in plus side and minus side). The derived item rates (as mentioned above) 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.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Vayalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME 1A PART-1 CHAPTER X

GENERAL

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

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

- 10.1 Successful Bidder is requested to furnish the following at PSSR-HQ Chennai immediately after release of Letter of Intent (LOI)
 - i) Security Deposit
 - ii) Unqualified Acceptance for LOI, Detailed LOI / Work Order.
 - iii) Rs.100/- Stamp Paper for preparation of Contract Agreement.
- 10.2 Successful Bidder are requested to furnish the proof of documents for the following at the respective PSSR- Site
 - i) PF Regn No.
 - ii) Labour License No.
 - iii) Workmen Insurance Policy No.
- 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.**
 - 10.3.1 **BOCW Act & BOCW Welfare Cess Act**
 - 10.3.1.2 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.
 - 10.3.1.2 The Contractor should comply with the provisions of BOCW Welfare Cess Act 1996 in respect of the work awarded to them by BHEL.
 - 10.3.1.3 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



NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

committee, issue of Personal protective equipments, canteen, rest room, drinking water, Toilets, ambulance, first aid centre etc.

10.3.1.4 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.

10.3.1.5 Contractor shall make remittance of the BOCW cess as per the 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, fees paid towards registration of Beneficiaries and Contribution of Beneficiaries remitted.

10.3.1.6 Non-compliance to Provisions of the BOCW Act & BOCW Welfare Cess Act is not acceptable. In case of any non-compliance, BHEL reserves the right to withhold any sum as 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

10.4 PROVIDENT FUND

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

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

10.5 OTHER STATUTORY REQUIREMENTS

10.5.1 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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

and Valid WC Insurance copy or ESI Code (if applicable) and PF code no. along with the first running bill.

- 10.5.2 The contractor 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.
- 10.5.3 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 contractor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.
- 10.5.4 The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workmen 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 Act 1948 (if applicable) to BHEL along with the Final Bill.
- 10.5.5 In case of any dispute pending before the appropriate authority under ID 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.
- 10.5.6 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.

10.6 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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

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.

10.7 Site Visit by the Bidder

The bidder shall, prior to submitting his tender for the work, visit, examine and acquire full knowledge & information and 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.

10.7.1 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.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- 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.
- 10.7.2 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.
- 10.7.3 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.
- 10.7.4 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.
- 10.7.5 The work covered under this specification is of highly sophisticated nature, requiring the best quality workmanship, engineering and construction management. The contractor must have adequate quantity of tools, construction aids, equipments etc.,



NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- in his possession. He must also have on his rolls adequate trained, qualified and experienced supervisory staff and skilled personnel.
- 10.7.6 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.
- 10.7.7 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.
- 10.7.8 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.
- 10.7.9 The contractor shall carry out additional tests, if any, which the Engineer feels necessary because of site conditions and also to meet system specification.
- 10.7.10 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.
- 10.7.11 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.
- 10.7.12 Wherever Construction sequences are furnished by BHEL, the contractor shall follow the same sequence. 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.
- 10.7.13 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.
- 10.7.14 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.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- 10.7.15 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.
- 10.7.16 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.
- 10.7.17 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.
- 10.7.18 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.
- 10.7.19 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. Surplus materials including steel item brought at site by the contractors with proper documentation and Gate pass, shall be allowed to taken out of the project premises after completion of relevant works, on certification by BHEL in charge.
- 10.7.20 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.
- 10.7.21 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.



NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- 10.7.22 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.
- 10.7.23 No member of the already erected structure / buildings, other component and auxiliaries should be removed / modified without specific approval of BHEL engineer.
- 10.7.24 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on latest ISO 9001 Standards.
- 10.7.25 Sometimes, 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.
- 10.7.26 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.
- 10.7.27 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.
- 10.7.28 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.
- 10.7.29 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.
- 10.7.30 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.
- 10.7.31 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



NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

the landscape contractor's team to such utilities will be penalized and contractor shall be responsible for cost for such damages.

10.7.32 The contractor will be responsible for the safe custody and proper accounting of all materials in connection with the work. If the contractor has drawn materials in excess of design requirements, recoveries will be effected for such excess draws at the rate prescribed by manufacturing units.

10.7.33 Contractor has to clear the front, expeditiously and promptly as instructed by BHEL Engineer for other agencies, like Boiler, piping, Turbine, Generator erection, Cabling, instrumentation, insulation etc., to commence their work from / on the equipments coming under this scope.

10.7.34 For the purpose of planning, contractor shall furnish the estimated requirement of power (month wise) for execution of work in terms of maximum KW demand.

10.7.35 **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.

- (i) Hindrance Register
- (ii) Site Order Book.
- (iii) Test Check of measurements.
- (iv) Steel & Cement Supply and Consumption Daily Register
- (v) Records of Test reports of Field tests.
- (vi) Records of manufacture's test certificates.
- (vii) Records of disposal of scraps generated during and after the work completion.

10.8 **SITE INSPECTION**

10.8.1 The Owner 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 or his authorized agents without any extra cost to the Owner or his authorized agents. No cost whatsoever such duplication of inspection of work be entertained.

10.8.2 BHEL / Owner 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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

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 Owner / BHEL.

10.8.3 The contractor shall maintain at site a joint protocol for recording actual measurement of work carried out at site, inspection and witnessing of various tests conducted by the contractor.

10.8.4 Field Quality Assurance (FQA) Formats: -

It is the responsibility of the contractor to collect and fill up the relevant FQA log sheets of BHEL and present the same to BHEL after carrying out the necessary checks as per the log sheets and obtaining the signature of BHEL and Owner as token of their acceptance. Payment to the contractor will be inked with the submission of these FQA log sheets.

10.8.5 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.

10.8.6 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

10.9 DOCUMENTATION

10.9.1 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.

10.9.2 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.

10.10 RECORDS TO BE MAINTAINED AT SITE:

10.10.1 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.

10.10.2 The under mentioned Records/ Log-books/ Registers applicable to be maintained.
a. Hindrance Register.
b. Site Order Book.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- c. Test Check of measurements.
- d. Supply and Consumption Daily Register of Cement and Steel
- e. Records of Test reports of Field tests.
- f. Records of manufacture's test certificates.
- g. Records of disposal of scraps generated during and after the work completion.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME 1A PART-1 CHAPTER XI

PROGRESS OF WORK

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

11.0 PROGRESS AND MONITORING OF WORK

- 11.1 Refer forms F -14 to F-15 of volume I D of volume -I book-II. Plan and review will be done as per the formats.
- 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.
- 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.
- 11.4 The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

11.5 The monthly report at the end 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.

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

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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

progress and recover all charges incurred on this account including all expenses together with BHEL overheads from contractor's bills.

- 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.
- 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 program.
- 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

- 12.1 Open land as available shall be provided by BHEL on free of cost basis as provided by TANGEDCO. Contractor shall maintain one centralized fenced store cum bar bending 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. Batching plant area, shall be provided nearer plant premises and contractor shall make use of the area for installation and operation of the Batching Plant at his own cost. The bidder shall make complete arrangement of necessary security personnel, to safeguard all such materials in his custody at his own cost. 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 at his own cost.
- 12.2 The system for receipt, storage & issue of materials shall be available with vendors for easy traceability.
- 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.
- 12.4 The contractor shall construct waterproof cement store (capacity 400MT or as directed by engineer in-charge based on requirement at site) for initial period for storing and stacking of cement at his own cost, CGI/ asbestos roofing (slope) with brick masonry wall, PCC flooring. Materials required for the same shall be provided by contractor at his own cost. Cement has to be kept over wooden raised platform. Stacking of cement is to be done as per IS codes with proper illumination and locking arrangements.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- 12.5 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.
- 12.6 Clotting of cement and 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 cement steel shall be recovered from the interim payment at the penal rate specified in the tender.
- 12.7 The contractor shall maintain proper store account for all the BHEL issued materials and shall give three copies of computerized reconciliation statement of such account to the BHEL with each running bill.
- 12.8 All TMT shall be stacked over sleeper's diameter wise.
- 12.9 All structural steel shall be stacked plate size wise and thickness wise beams, channels and angles shall be stacked separately on sleepers.
- 12.10 Materials shall not under any circumstances taken out of the project site unless otherwise permitted by BHEL.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Vayalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME-IA PART –I CHAPTER -XIII

ACCOUNTING OF MATERIALS ISSUE

1.13.1 ISSUE OF CEMENT, CONSUMPTION, WASTAGE & RETURN OF MATERIALS

Please refer SPECIAL CONDITIONS OF CONTRACT (SCC)- Civil & Structural Chapter – VI: Material Handling, Storage & Preservation

1.13.2 ISSUE OF STEEL, CONSUMPTION, WASTAGE & RETURN OF MATERIALS

Please refer SPECIAL CONDITIONS OF CONTRACT (SCC)- Civil & Structural Chapter – VI: Material Handling, Storage & Preservation

1.13.3 SCRAP & SERVICEABLE MATERIALS

Please refer SPECIAL CONDITIONS OF CONTRACT (SCC)- Civil & Structural Chapter – VI: Material Handling, Storage & Preservation

1.13.4 RECONCILIATION OF MATERIALS

Please refer SPECIAL CONDITIONS OF CONTRACT (SCC)- Civil & Structural Chapter – VI: Material Handling, Storage & Preservation

1.13.5 RECOVERY OF MATERIAL

Recovery of wastages shall be made from the bills of contractor at the penal rate mentioned in the table below for the following cases:

- If wastage exceeds the specified limit
- If the wastage not exceeded specified limit, but not returned to BHEL store except invisible wastage
- For not returning the surplus serviceable materials.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

13.2.1 PENAL RATE OF MATERIALS

A	REINFORCEMENT STEEL Cold rolled steel, high strength, deformed bar or mild steel round bars including earthing rod	Rs. 52,395/- per MT + GST and/or other taxes & duties
B	CEMENT OPC 43 GRADE	Rs. 5,693/- per MT + GST and/or other taxes & duties



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME-IA PART-II CHAPTER-1

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

Following Clauses from S. No.1 to S.No.2 are modified in the Special Conditions of Contract (SCC):

S.No. 1

Clause no. 6.3.4.1 is revised as under:

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

i.	Reinforcement Steel and Earthing Rod	Weighment basis (Unit – MT)

S.No. 2

Clause no. 6.4.4.5, 6.4.4.6 stands deleted

S. No.3

Following Clauses are added in the Special Conditions of Contract (SCC):

6.3.4.9 Bidder to note that steel materials required for embedded items other than those supplied by BHEL shall be supplied by the bidder. However, Bidder shall use the scrap materials for their use in the permanent works as embedment/inserts etc. after necessary store issue formalities and shall be accounted for monthly reconciliation.

6.3.4.10 Following shall be limit for the maximum quantity of BHEL issue materials that would be with the contractor at any point of time when work is in progress (excluding what has already been incorporated in the works).

SL NO	ISSUE OF MATERIALS	MAX. QTY IN CONTRACTOR'S STORE
1.	Reinforcement Steel	Requirement of one month

6.3.5 ISSUE OF CEMENT:



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- 6.3.5.1 Cement as received from the manufacturer/ stockiest will be issued free of cost to the contractor. The cement shall be provided normally in bulkers and shall be unloaded in the silos (2 numbers cement silos 100MT capacity each of cumulative capacity of 200 MT per 30 CUM batching plant) to be installed by the bidder nearer to their batching plants. Cement unloading arrangements to silo and required manpower support shall be provided by the successful bidder at his own cost.
- 6.3.5.2 On advance request of the bidder, the cement shall be supplied in 50kg tamper proof sealed Bags for other than RCC works like masonry, flooring works etc. The theoretical weight of each bag of cement for issued purposes will be considered as 50 kg, the contractor shall be accountable for the cement issued to him on this notional weight only. No claim whatsoever will be entertained because of difference between theoretical and actual weight of the bags of cement. The empty cement bags duly accounted for against issue shall be in the custody of the contractor and the same shall be disposed by the contractor as per statutory regulation prevailing in the project.
- 6.3.5.3 The contractor shall submit to the engineer, a statement indicating estimated quantity of cement required during a quarter, at least two months in advance of the quarter. In addition, the contractor shall also furnish the estimated requirement of cement during a month by the third week of the previous month indicating his requirement.
- 6.3.5.4 Bidder is responsible for unloading the cement as soon as the arrival of cement, either in silo, if received in bulker or in the weather proof cement storage sheds, if received bags. Bagged cement shall be stored in a weatherproof sheds having dense impervious bituminous or concrete floors which shall be kept swept clean at all times. The storage arrangements shall be fully completed and approved by the owner before any cement is delivered to site. The construction of cement storage sheds as per the requirement of BHEL, unloading of cement bags, stacking properly in the storage sheds, removal of the sheds after the completion of the work is in the scope of bidder.
- 6.3.5.5 Bidder is responsible for sampling and testing of cement as per Indian Standard/ Specification/ approved quality plan in the testing laboratory established by the bidder.
- 6.3.5.6 Bidder is responsible for carrying out design mix as per IS 456/10262 Latest revision and specification, using the cement provided by BHEL and submit the design mix proportions for the approval of BHEL/TANGEDCO. The design/trial mix shall be carried out time to time on change of brand/type of cement supplied by BHEL and suitable adjustments on the quantity of ingredients (sand, aggregates, admixture) of the concrete to get the



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

required workability and durability, shall be the responsibility of the bidder without any extra cost to BHEL.

6.3.5.7 Following shall be limit for the maximum quantity of BHEL issue materials that would be with the contractor at any point of time when work is in progress (excluding what has already been incorporated in the works).

SL NO	ISSUE OF MATERIALS	MAX. QTY IN CONTRACTOR'S STORE
1.	Cement	Requirement of one month

6.3.6 Issue, Consumption and Wastage of Bought Out Construction Material (Cladding sheet)

6.3.6.1 Material shall be issued in available lengths/ shapes and no claims for extra payment on account of issue of non-standard lengths/ shapes will be entertained. The theoretical consumption of construction materials (Issued by BHEL as free of supply) required for the work will be calculated on the basis of approved drawings, Joint Measurements.

6.3.6.2 The permissible wastage for cladding sheets over the theoretical quantity / consumption incorporated in the works shall be 3%.

S.No.:4

Following Clause is modified in the General conditions of contract (GCC):

Clause no. 2.14.1 of GCC is revised as under:

2.14.1 Variation in Final Executed Contract Value

The quantities given in the contract are tentative and may change to any extent (both in plus side and minus side). No compensation becomes payable in case the variation of the final executed contract value is within the limits of Minus (-) 30% of awarded contract value. Also, no compensation becomes payable in case the contract gets partially executed/ short closed/terminated/ work withdrawn under Rights of BHEL mentioned in Clause 2.7 of GCC. In case of work terminated / short closed under clause 2.7.4 of GCC, compensation may be considered only if BHEL receives compensation from customer.

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



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

- i) In case the finally executed contract value reduces below the lower limit of awarded
Contract Value due to quantity variation specified above, the Contractor will be eligible for compensation @ 15% of the difference between the lower limit of the awarded contract value and the actual executed contract value.
- ii) In case the finally executed contract value increases above the awarded Contract Value due to quantity variation, the Contractor is not eligible for any compensation.

Sl. No.: 05

Following Clauses in General Conditions of Contract (GCC) are modified/ revised/ added:

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
1.	GCC Clause 1.9.1, Sl. No. (ii)	The following mode of deposit, Sl. No. (e) is added: e) Insurance Surety Bonds
2.	GCC Clause 1.10.3, Sl. No. (vi)	The following Clause, Sl. No. (vi) is deleted: Security deposit can also be recovered at the rate of 10% of the gross amount progressively from each of the running bills of the contractor till the total amount of the required security deposit is collected. However, in such cases at least 50% of the required Security Deposit, including the EMD, should be deposited in any form as prescribed before start of the work and the balance 50% may be recovered from the running bills as described above
3.	GCC Clause 1.10.3, Sl.No.(vii)	The following mode of deposit, Sl. No. (vii) is added: e) Insurance Surety Bonds
4.	Note mentioned under the GCC Clause 1.10.3	Note mentioned under GCC Clause 1.10.3 is revised as below: Note: (1) 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.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		(2) In case of delay in submission of security deposit, enhanced security deposit which would include interest (Repo rate +4%) for the delayed period, shall be submitted by the bidder.
5.	GCC Clause 1.10.8	GCC Clause 1.10.8 is revised as below: Bidder agrees to submit security deposit required for execution of the contract within the time period mentioned. In case of delay in submission of security deposit, enhanced security deposit which would include interest (Repo rate+4%) for the delayed period, shall be submitted by the bidder. Further, if security deposit is not submitted till such time the first bill becomes due, the amount of security deposit due shall be recovered as per terms defined in NIT / contract, from the bills along with due interest
6.	GCC Clause 2.13.6	GCC Clause 2.13.6 is revised as: The rate of interest applicable for the above advances shall be the repo rate prevailing on the date of release of advance plus 4%, and such rate will remain fixed till the total advance amount is recovered
7.	GCC Clause 2.22.1	GCC Clause 2.22.1 is revised as: Retention Amount shall be 5% of the Contract Value and shall be furnished through BG in line with clause 1.12 of GCC before payment of first RA Bill. The validity of the said BG shall be initially for the contract period & shall be extended, if so required, up to acceptance of final bill. In case of increase in contract value, additional BG for 5% of differential amount shall be submitted by Contractor before payment of next RA Bill due. Retention Amount can also be recovered at the rate of 10% of the gross amount progressively from each of the running bills of the contractor till the total amount of the required retention amount is collected. In case, contractor opts cash deduction from RA bills in the beginning & subsequently offers to submit BG later on, then refund of deducted retention amount may be



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		permitted against submission of BG for 5% of the Contract Value.
8.	New Clause for "Breach of Contract, Remedies and Termination" is added in place of existing clause of Risk & Cost (i.e. 2.7.2.1 to 2.7.3)	Clause 2.7.2 and 2.7.3 are revised as: <u>2.7.2 Breach of Contract, Remedies and Termination</u> 2.7.2.1 BHEL shall terminate the contract after due notice of a period of 14 days in any of the following cases, which if not rectified/ improved within the time period mentioned in the notice, then, 'Breach of Contract' will be considered to have been established: - 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). Repeated failure of contractor in deploying the required resources, to comply the statutory requirements etc. even after given by BHEL is writing. - v). Strike or Lockout declared is not settled within a period of one month. - vi). Termination of Contract on account of any other reason (s) attributable to Contractor. - vii). Assignment, transfer, subletting of Contract without BHEL's written permission.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		viii). Non-compliance to any contractual condition or any other default attributable to Contractor. <u>2.7.2.2 Remedies in case of Breach of Contract is established</u> In case 'Breach of Contract' is established, Security Deposit and Retention Amount shall be encashed/ forfeited. This is without prejudice to BHEL's right to levy of liquidated damages, debarment etc. which shall be applied as per the provisions of the contract. Sequence of recovery to be made in case of breach of contract is established, is as below: - In case the value of Security Deposit & Retention Amount, available for the Contract, is less than 10% of the Contract Value, the balance amount shall be recovered from dues available in the form of Bills payable to contractor, BGs against the same contract etc. - 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. - 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: - Dues payable to contractor against other contracts in the same Region shall be considered for recovery. - 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.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		iii) In-case recoveries are not possible with any of the above available options, Legal action shall be initiated for recovery against contractor. Note: 1) In addition to above, levy of liquidated damages, debarment, termination, short-closure etc. shall be applied as per provisions of the contract. 2) If tendering is done for the balance work, the defaulted contractor (including all the members/partners in case of JV/ partnership firm) shall not be eligible for either executing the balance work or to participate in the tender(s) for executing the balance work. 2.7.3 In case Contractor fails to deploy the resources as per requirement informed by BHEL in writing to expedite the work, BHEL can deploy own/hired/otherwise arranged resources 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.
9.	GCC Clause 2.7.7	GCC Clause 2.7.7 is revised as: BHEL may permit or direct contractor to demobilize and remobilize at a future date as intimated by BHEL in case of following situations for reasons other than Force majeure conditions and not attributable to contractor: i) suspension of work(s) at a Project either by BHEL or Customer, or ii) where work comes to a complete halt or reaches a stage wherein worthwhile works cannot be executed and there is no possibility of commencement of work for a period of not less than three months In such cases, charges towards demobilization and remobilization shall be as decided by BHEL after successful



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		remobilization by contractor at site, and decision of BHEL shall be final and binding on the contractor. After remobilization, all conditions as per contract shall become applicable. In case Contractor does not remobilize with adequate resources or does not start the work within the period as intimated, then BHEL reserves the right to terminate the contract and effect remedies under Clause 2.7.2.2. Duration of the contract/time extension shall be revised suitably. In case of any conflict, BHEL decision in this regard shall be final and binding on the contractor.
10.	GCC Clause 2.11.3	GCC Clause 2.11.3 is revised as: However, if any 'Time extension' is granted to the contractor to facilitate continuation of work and completion of contract, due to backlog attributable to the contractor alone, then it shall be without prejudice to the rights of BHEL to impose penalty/LD for the delays attributable to the contractor, in addition to any other actions BHEL may wish to take under clause 2.7.2 of GCC i.e. "Breach of Contract, Remedies and Termination".
11.	GCC Clause 2.19.1	GCC Clause 2.19.1 is revised as: The contractor will be fully responsible for all disputes and other issues connected with his labour. In the event of the contractor's labour resorting to strike or the Contractor resorting to lockout and if the strike or lockout declared is not settled within a period of one month, it may be considered as 'Breach of Contract' under Clause 2.7 and the remedies under Clause 2.7.2.2 may be executed, at the discretion of BHEL.
12.	GCC Clause 2.24.1	GCC Clause 2.24.1 is revised as: Even though the work will be carried out under the supervision of BHEL Engineers the Contractor will be responsible for the quality of the workmanship and shall guarantee the work done for a period of Twelve months from the date of commencement of guarantee period as defined in Technical Conditions of Contract, for good workmanship and shall rectify free of cost all defects due to faulty erection detected during the guarantee period. In



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		the event of the Contractor failing to repair the defective works within the time specified by the Engineer, BHEL may proceed to undertake the repairs of such defective works, by itself, without prejudice to any other rights and recover the cost incurred for the same along with 5% overheads from the Security Deposit.

S.No.:6

In addition to The EARNEST MONEY DEPOSIT (EMD) clause 1.9 and The SECURITY DEPOSIT (SD) clause 1.10 published in General Conditions of Contract (Volume I Book II) following is added for FDR:

1. FDR should be Lien marked in favour of M/s BHEL.
2. Bank issuing FDR should agree to the following conditions and submit duly signed letter addressed to BHEL, confirming the following points:
 - a) There is no Lock in Period for Encashment of the Said FDR
 - b) The amount under the Said FDR would be paid to BHEL-PSSR on Demand, at any point of Time before, or upon Maturity, without any reference to the (Contractor Name).
 - c) Encashment whether premature or otherwise would not require any clearance from any other authority /Person.
 - d) FDR will be auto renewed for such period/s initially mentioned in the FDR and the intimation of Such renewal shall be sent to BHEL, PSSR and (Contractor), immediately after the renewal.
 - e) FDR will not be closed, Encashed, Changed or Discharged without the Written permission/Confirmation from M/s BHEL PSSR.
 - f) Bank to acknowledge and agree that the Lien created on the FDR shall be in Force until M/s BHEL PSSR, gives a Discharge Letter in this regard.

S. No.:7



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

Detailed Instruction for EMD / Security deposits through SBI e-collect:

Step 1: Vendors may visit SBI collect website, the URL of which is <https://www.onlinesbi.sbi/sbicollect> where they get the home page with various categories of institutions.

Step 2: Select PSU - Public Sector Undertakings – leading to a page with list of PSUs

Step 3: Type BHEL and search, they get to see all BHEL divisions wherein they shall select BHEL PSSR Chennai. The screen shot of the same is given below.

The screenshot shows the SBI Collect website interface. At the top, there's a navigation bar with 'HOME', 'TRANSACTION HISTORY', 'FAQ'S', and 'CUSTOMER SUPPORT'. Below this is a 'Payment Progress' section with a progress bar showing five steps: 'Select Payee' (active), 'Enter Payment Details', 'Verify Payment Details', 'Complete Payment', and 'Print Receipt'. The main content area is titled 'Select Payee' and shows a search for 'bhel'. The results are filtered by 'PSU-Public Sector Undertaking' and 'Tamil Nadu'. The table lists two entries: 'BHEL BAP RANIPET' and 'BHEL PSSR CHENNAI', both in 'Tamil Nadu'. The page also shows a 'Back' button and a footer with '© State Bank of India' and links for 'Privacy Statement', 'Disclosures', and 'Terms of Use'.

Step 4: Select EMD receipts. Having selected the Payee in the Payment Progress, it will lead to the payment details – a drop down list of values. From that list, vendors shall select EMD



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

receipts. Upon clicking the entry EMD receipts, a form will open asking for the remitters details and the details of the tender.

Step 5: Confirm details and pay

Fill in all the details correctly, verify the details, and complete the payment as it is leading to the payment gateway.

Step 6: Take a printout on completing the payment and enclose the copy of the same along with the bid submission. Store the copy of receipt for future reference.



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME-IA PART – II

CHAPTER 2 to 5

Next pages are as below

Chapter 2	Technical Specifications Section-C
Chapter 3	Technical Specifications Section-D
Chapter 4	T&P Hire Charges
Chapter 5	“HSE Plan for Site Operations by Subcontractor” (Document No. HSEP: 14 Rev02)



भारत हेवी इलेक्ट्रिकल्स लिमिटेड Bharat Heavy Electricals Limited

CIN: L74899DL1964GOI004281

पॉवर सेक्टर - दक्षिण क्षेत्र / Power Sector - Southern Region

२x६६० मेगा वाट - एन्नोर एस ई ज़ेड, एसटीपीपी वोयालूर पीओ, मिंजुर, पोन्नरी तालुक, तमिलनाडु - ६०१२०३)
(2X660 MW - Ennore S.E.Z STPP, Voyalur P.O. Minjur, Ponneri Taluk, Tamil Nadu - 601203)

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04 / 2024

BILL OF QUANTITY (BOQ) WITH WEIGHTAGE:

2 x 660 MW Ennore SEZ STPP

Item Code	Description of work	Unit	Quantity	Weightage %
101	Earth work in excavation in all types of soil/ash which can be excavated by any means including setting out, levelling, dewatering (but excluding special type of dewatering viz. well point method), shoring & strutting (wherever required), dressing the sides & bottom, all lifts, ramming/compacting the excavated bottom, stacking, disposal of surplus excavated materials within a lead upto 500 m, spreading/levelling of disposed materials etc all complete for following depths below ground level.			
a	Depth from ground level but not exceeding 2 m	CUM	2520.00	0.31%
b	Depth exceeding 2 m but not exceeding 4 m	CUM	2695.00	0.42%
c	Depth exceeding 4 m but not exceeding 6 m	CUM	1520.00	0.30%
107	Back filling upto any depth below ground level around foundations, plinths, trenches, drains etc to proper grade and level in layers not exceeding 250 mm thickness using/with selected materials from compulsorily excavated soil/ash available within a lead upto 500m and compacted as specified including re-excavation of stacked earth, watering, ramming/compaction by manual/mechanical means, dressing etc all complete for the following.			
a	Each layer compacted so as to achieve at least 95% maximum dry density as per IS-2720 (Part-VII)	CUM	11468.00	1.41%
111	Supplying and filling sand upto any depth under floors, around foundations, plinths etc. in layers not exceeding 250 mm thickness and compacted so as to achieve at least 80% relative density as per IS-2720 (Part-XIV) including spreading, watering, ramming/compaction by manual / mechanical means, dressing, royalty (if any) etc. all complete.	CUM	300.00	1.16%



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

A113	Providing and laying rubble soling with specified sizes of approved quality hard rock rubble or hand broken hard metal of sizes ranging from 100mm to 230mm, at all position and depths below or above finished ground floor level, below foundations, below flooring, and for providing hard standing etc. in one or more layers each of approximately 230mm thickness, hand packing, filling in interstices with quarry spalls, grits and providing a layer of 50mm. thickness (consolidated) of moorum/equivalent locally available approved material over each layer of soling including watering, thoroughly compacting each layer with 10 tonne power roller with minimum 6 passes (or with vibrating plate of approved capacity at places not approachable by power roller) all as per the direction of the Engineer and as per specification.	CUM	1700.00	3.62%
203	Concrete of grade M15 (1 part cement, 2 part sand, 4 parts of 40 mm graded aggregate by volume) as lean concrete, levelling course, mud mat under and around foundations/floors at any depth below finished floor level etc.	CUM	787.00	4.67%
A205	Providing and laying Design Mix cement concrete conforming to IS:456 & IS 10262-2009 for reinforced concrete works with coarse sand and graded hard stone aggregate of 20mm nominal size in foundations/substructure, grade slab, paving, drains, under floors etc. at any level below finished floor level, any shape, position or thickness etc. complete including use of plasticizer/ superplasticizer conforming to IS:9103 (latest) to achieve required slump in concrete all complete as per specification & drawing for the following.			
A205a	M25 Grade	CUM	250.00	1.54%
A205b	M30 Grade	CUM	2800.00	17.30%
206	Providing and laying Design Mix cement concrete conforming to IS:456 & IS 10262-2009 for reinforced concrete works with coarse sand and graded hard stone aggregate of 20mm nominal size in superstructure at any level above finished floor level, any shape, position or thickness etc complete including use of plasticizer/ superplasticizer conforming to IS:9103 (latest) to achieve required slump in concrete all complete as per specification & drawing for the following.			
206b	M30 Grade	CUM	250.00	1.56%



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

208	Providing and laying Design Mix cement concrete as per IS:456 & IS 10262-2009 of grades mentioned below for reinforced concrete works using graded aggregate in top decks of all machine foundations supported on vibration isolation system (excluding supply and installation of vibration system) at all levels including addition of suitable plastisizers conforming to IS9103 to achieve a slump more than 125 mm in concrete as per manufacturers recommendation, preparation of scheme for concreting, getting it approved by engineer, labour, materials, equipment, handling, batching, transporting, mixing, pumping, placing, leveling, vibrating, compacting, curing, testing, cleaning and rendering the exposed surface with cement sand mortar to give a smooth and even surface, maintaining and submitting records of concreting, petrographic examination and potential reactivity of aggregate etc. all complete as per specification, drawing and instructions of engineer, including UPV testing as directed by engineer in charge, rectification of the defects in concreting observed by ultra-sonic pulse velocity (UPV) testing by cement/epoxy grout etc, but excluding formwork, staging, reinforcement, embedments and temperature control of concrete. Payment terms - a) After casting 75% ; b) After receipt of ultrasonic test report - 25%.			
208b	M35 grade (with 20mm nominal size graded stone aggregate)	CUM	1210.00	10.53%
A209	Extra over St. No. 205 to 208 for controlling of temperature of fresh concrete to less than 25 degree centigrade using ice, including all related arrangements for providing, storing and mixing of ice with water, cooling of aggregates etc. All complete as per specification, drawing and instruction of engineer in charge.	CUM	1210.00	2.24%
210	Extra over ST Nos. 205 to 207 for conducting UPV test for concrete at all levels including all equipments, making necessary arrangements, staging, submission of report etc. all complete as directed by engineer in charge and as per specification.	CUM	1210.00	0.52%
218	Cutting Reinforced concrete with mechanised tools like Core drilling machine etc. for cutting pockets, holes, cores in slab, beam, column or foundation as per direction of engineer in charge.	CUDM	47.00	0.01%
301	Fairface form work with good quality water proof ply wood of required thickness and smooth surface below finished ground floor level for foundations, footings, base of	SQM	3494.00	2.67%



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

	columns, walls, columns, pilasters, beams, mass concrete, trenches etc.			
302	Fairface form work with good quality water proof ply wood of required thickness and smooth surface above finished ground floor level for columns, beams, suspended floors, roofs, lintels, cantilevers, staircases, landings, balconies, domes, arches, circular overhead tanks etc. for all heights.	SQM	4018.00	3.78%
304	Providing, fixing and removing formwork in block-outs/pockets and openings (below 0.1 sqm plan area) at all elevations including cutting, formation of all shapes and all other operations required for making the required shape and size all complete as per specification, drawing and instruction of engineer in charge.			
304a	Upto 150 mm depth	Nos.	64.00	0.02%
304b	Pockets of depths more than 150mm and upto 300 mm depth	Nos.	133.00	0.09%
304c	Pockets of depths more than 300mm and upto 600 mm depth	Nos.	205.00	0.25%
304d	Pockets of depths more than 600mm and upto 1000 mm depth	Nos.	138.00	0.27%
A402	Transportation form BHEL stores, Straightening, cutting, bending, placing in position at any level, binding in position of steel reinforcements of TMT steel of grade Fe-500 confirming to IS:1786 including cost of binding wire, labour, scaffolding, transportation to & from stores etc complete all as per specifications, drawings and as directed by Engineer. Reinforcement steel shall be provided by BHEL free of cost for incorporation in permanent work.	MT	630.00	10.65%
A404	Extra over ST No. 402 for providing fusion bonded epoxy coating by mechanised & qualified process including blast cleaning to white metal as per Swedish code, heating in induction heater, electrostatically spraying the epoxy powder, complete fusion to give minimum coating thickness of 200-300 microns, gradual cooling without affecting the properties of steel, testing as per ASTM 775 and IS:13620, flexibility & holiday test, proper packing, safe transportation, touch-up at site, etc. complete to ensure proper resistance of FBE against corrosive environment including transport of the steel from BHEL site store to vendor plant and bringing back to site and special handling during straightening, cutting, bending, placing and providing PVC coating on binding wire.	MT	630.00	8.74%



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

506	Providing and applying PU based water proofing treatment with one coat of polyurethane or any other equivalent material based primer with an application rate of minimum 6 sq.m per litre and two successive liquid coatings of high solids content urethane pre-polymers or equivalent material based finish coats as per relevant IS/ASTM standards to form an elastomeric membrane with overall dry film thickness 1.5 mm subject to minimum 500 gm/sqm/coat application rate. Item includes surface preparation by applying polymerized mortar, polyscrim cloth /fabric for edges, joints & vulnerable points etc all complete as per specifications and directions of engineer in charge.	SQM	1388.00	1.28%
A507	Providing and laying wearing course consisting of 40mm thick plain cement concrete of grade M15 (1:2:4) with graded aggregate of 12.5mm size cast in panels of maximum size 1.2mx1.2m and reinforced with 0.56 mm dia. galvanised chicken wire mesh and sealing of joints (in grooves of 6mm X 6mm) using silicon /elastomeric compound etc all complete.	SQM	1356.00	1.72%
509	Providing and applying two coats of bitumen grade 85/25 as per IS 702 (@ 1.7kg/sqm)with 1% antistripping compound conforming to IS 6241 in foundation, wall, column etc on concrete surfaces exposed to soil / ash including surface preparation etc. all complete.	SQM	4170.00	1.14%
A601	Supplying and installation of Dura board HD100 or its equivalent as approved by the Engineer, as filler material in joints including nailing, installation as per manufacturer s recommendation etc. all complete.			
A601a	12 mm wide joints	SQM	20.00	0.02%
A601b	20 mm wide joints	SQM	50.00	0.05%
A601c	25 mm wide joints	SQM	247.00	0.36%
A601d	50 mm wide joints	SQM	80.00	0.24%
606d	230 mm wide and 6 mm thick	RM	10.00	0.003%
701	Supply, Fabrication, transportation, delivery at site and erection, installation and alignment of mild steel foundation bolt assembly conforming to IS:2062 and grade 1 of IS:432 in concrete along with nuts, lock nuts (as per IS:1363, 1364 and IS:3138), washers, anchor plates, stiffner plates, protective tape, pipe sleeves, templates etc. including welding, cutting, grinding, threading, drilling etc. all complete.	MT	5.00	0.56%



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

702	Same as above with BHEL supplied material free of cost including loading, transportation, unloading etc. all complete from BHEL store to plant site.	MT	47.00	1.46%
703	Fixing of embedments, inserts, pipe sleeves, angle pieces, anchor bolts of various diameters, plates of dimensions as required etc. including scaffolding, setting in position, transportation from BHEL site stores to work spot etc. all complete.	MT	15.00	0.46%
706	Placing, locking and releasing of Vibration Isolation spring modules over the foundation at all elevations including providing all assistance under the supervision of the supplier, transportation from BHEL store, necessary staging, platforms, leveling, alignment etc. all complete.	Nos.	220.00	0.43%
805	Providing & grouting of pocket holes, pipe sleeves and under base plates of structural steel work/ machinery/ pipe supporting structures including roughening of surface, cleaning, ramming, curing, etc. all complete with Conbextra GP-2 or equivalent. (Cost of all material and cleaning of the pockets by compressed air shall be in the scope of the contractor).	CUM	12.00	0.84%
905	Providing and fixing single or double steel door shutters with 18 gauge M.S. sheets shutter presenting a flush surface on the outside and inside stiffened with semitubular edge and central stiffening rail which shall convey the lock including fixtures, Godrej or equivalent make mortice lock with handle on both sides, shop and final painting etc all complete.	SQM	26.00	0.46%
906	Providing and fixing anodized extruded aluminium doors (single or double shutter) conforming to IS:1948, IS:1949 fabricated from extruded sections of HINDALCO/JINDAL or equivalent make having minimum 3mm wall thickness as per IS:1285, IS:733 and anodized and electro color coating of required shade as per IS 1868 (minimum anodized coating of grade AC15). fixed with rawl plugs, expansion fasteners, SS screws / fixing clips necessary filling of gaps at Junctions, at top, bottom & sides with required PVC / neoprene felt for bi-metallic protection etc. Glazing shall be clear float glass of 6mm thickness including snap fit type beading, concealed screws, fixtures, Godrej or equivalent make Mortice lock with handle on both sides, etc all complete. Aluminium section shall be smooth, free of stains, straight, mitred & jointed mechanically wherever required. (Glazing shall be paid separately)	SQM	34.00	0.43%



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

907	Providing and fixing fire proof steel doors (single or double shutter) with panic devices shall be 45mm thk flush design comprising of two outer sheets of 18 gauge steel sheets rigidly connected and reinforced inside with continuous vertical 20 gauge stiffeners, spot welded in position at not more than 150mm on centers including all fittings, shop painting with approved post office/signal red color fire resistant paint and mineral wool insulation (64 kg/cum density) complete and shall be fire proof as per IS:3614, TAC requirements and as per specification. Minimum ratings shall be 2 Hrs.(Panic devices to be provided at hand over.)	SQM	17.00	0.25%
909	Providing and fixing anodised aluminium work of Jindal, Hindalco or other equivalent approved make for door frames, windows, ventilators, partitions, railing, grills etc with extruded standard tubular and other sections including all fittings & fixtures and accessories of approved make conforming to IS733 and IS1285, anodised and electro color dyed to required shade according to IS 1868 (minimum anodic coating of grade AC15), fixed with rawl plugs, expansion fasteners, SS screws or with fixing clips, including necessary filling of gaps at junctions, at top, bottom and sides with required PVC/neoprene felt for bi-metallc protection etc.including preperation of working drawings, aluminium cleat angle, aluminium snap-on-beading for glazing/panelling, stair case tread nosing, with all fittings and fixtures (like Godrej or equivalent make Mortice lock with handle on both sides, tower bolts, handles, door stopper with rubber shoes, 'L' drops, stays, floor springs, hydraulic door closures etc.), CP brass/stainless steel screws, providing and fixing hinges/pivots, and making provision for fixing of fitting wherever required including cost of PVC/neoprene gasket, all complete as per drawing, specification and instructions of engineer in charge (Glazing and panelling shall be paid seperately).Weight of aluminium section only shall be measured.	Kg	2315.00	1.62%
912	Providing and fixing pressed steel frames fabricated from 16 gauge M.S sheet mortised, reinforced drilled and tapped for hinges and locks bolts strikes, hold fasts adjustable floor anchors, floor tiles/weather bars ,paintings etc all complete as per specifications.	Kg	297.00	0.07%



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

A913	Providing and fixing in position rolling shutter of hot rolled double dipped galvanised steel lath section of 18 SWG tested mild steel strips at 75mm rolling centres interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking (with push and pull operation for hand operated only) including wire springs, top cover, primer & shop coats of approved enamel paint etc., all complete as per IS 6248 and specification of approved make of following types: The bottom lath shall be coupled to a lock plate fabricated from 3mm thick galvanised steel plate and securely riveted with stiffening angles.(partly coiled and lath/full lath).			
913 c	Electrically operated	SQM	11.00	0.15%
914	Providing and fixing PVC doors(25 thk double skin) of sintex or equivalent make including all fitting & fixtures as per specification, drawing and instructions of engineer in charge.	SQM	4.00	0.01%
915 Ag	6 mm thick clear float glass	SQM	40.00	0.05%
A1002a	Using fly ash lime/cement bricks confirming to IS 12894 with crushing strength of 75 kg/cm ²	CUM	485.00	4.96%
A1101	Providing Damp Proof Course 50mm thick 1:1.5:3 concrete (10mm and down graded aggregate) with 2% of approved admixture of water proofing compound all complete. Two layers of hot bitumen coating 85/25 grade as per IS:702 @ 1.7Kg./sqm shall be applied one before & one after the DPC.	SQM	45.00	0.02%
AA1201	Providing 20 mm thick in 2 coats, 1st coat of 12 mm thick in Cement Mortar 1:3 & 2nd coat of 8 mm thick in Cement Mortar 1:2 sand faced outside/inside the building/boundary wall finished to a smooth finish including providing 3mmx3mm size grooves at junctions of two dissimilar materials all complete.	SQM	2458.00	0.99%
A1202	Providing 12mm thick plaster inside the building/boundary wall in cement mortar 1:3 on walls finished to a smooth finish as per specification all complete.	SQM	3365.00	0.83%
A1204	Providing 6mm thick plaster on ceiling in cement mortar 1:3 finished to a smooth all complete.	SQM	3150.00	0.71%
A1304	Two or more coats of acrylic washable distemper of approved brand and manufacture to give an even shade including a priming coat with distemper primer complete.	SQM	6696.00	0.92%



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

1305	Providing and applying two or more coats of acrylic emulsion paint as per IS 5411 of approved brand, shade and manufacture to give smooth, hard, durable & glossy finish over a coat of primer over prepared plaster surface as per manufacturers guideline.	SQM	500.00	0.09%
1312	Providing and applying 2 mm thick plaster of paris punning on walls including preparation of surface, staging, etc. to achieve a smooth even surface all complete as per specification and as directed by Engineer.	SQM	170.00	0.03%
A1401	Providing and laying 50 mm thick granolithic heavy duty cement concrete in flooring with non-metallic hardener pigmented topping 12mm thick in flooring. Under layer of 38mm thick cement concrete mix 1:1:2 (1 cement: 1 sand : 2 stone aggregates 12.5mm well graded) and top layer of 12mm thick non-metallic concrete of mix 1:2 (1 cement hardner mix with approved quality non-metallic hardening compound :2 stone aggregate 6mm nominal size) by volume including cement slurry, rounding off edges, aluminium strips etc. all complete for following (Quoted item rate shall be inclusive of providing glass joint strips)	SQM	2084.00	1.77%
A1405	Providing and laying 25 mm thick wall finish with cast in situ Terrazo including provision of base and etc. all complete.	SQM	80.00	0.12%
1414	Providing and laying polished Granite stone 18-20mm thk in skirting and dado with 6mm thick projection from adjacent plaster including mortar ,cement slurry ,pigments, curing, grinding,moulding, granite polishing etc. all complete.	SQM	149.00	0.63%
A1416	Providing and laying vitrified ceramic tiles of polished variety of size 600x600 from reputed / approved manufacturer, complete including underbed of cement mortar 1:3 with neat cement slurry etc. all complete for following			
A1416 a	8 mm thick tiles In flooring	SQM	200.00	0.34%
A1419	Providing and laying granite stone slab of 12 mm thickness single piece for wash basin / sink slab /facia of black or approved colour with cutting,making corners,moulding and opening etc. all complete.	SQM	5.00	0.03%
1430	Providing and fixing dividing strips in joints of cast in situ floorings at various elevations, finishing, all labour, material etc. complete as per drawing, specification and instructions of engineer in charge.			



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

1430 a	Glass strips 40 mm wide and minimum 6 mm thick.	RM	3065.00	0.28%
1606	Providing and Fixing 12mm thick Gypsum board plain/perforated false ceiling tiles(600x600mm) of India Gypsum or equivalent make in plan or elevation with aluminium grid, metal suspension system, anchor fastener adjustable hangers etc. including one coat of primer, two or more coats of acrylic emulsion paint of approved colour to give an even shade with smooth finish all complete.as per architectural design and detail.metal suspension system as per ASTM C-635 shall be hot dipped M.S.galvanized (grade 180 as per IS:277) nominal size of T-section shall be 24 x 38 mm or 24 x 25 mm cross runners. 24mm wide exposed flange surface shall be permanently color coated.suspension system shall be as per manufacturer's specification supported over movement platform.The work to be complete as per specifications, drawings and direction of engineer.(Materials for structural platform grid for movement made up of MS Channels/ Beams / Angles shall be supplied by BHEL and shall be paid under ST No 2301)	SQM	170.00	0.35%
1708	Providing and fixing HDPE down take pipes conforming to IS:4984 as per specification of following diameters.			
1708 b	160 mm Dia	RM	105.00	0.10%
1708 d	200 mm Dia	RM	300.00	0.42%
1801	Providing and Filling in trenches, plinths, area paving and other underground structures with graded stone aggregate of size range 63 mm to 45 mm in layers not exceeding 230 mm in thickness including breaking of stone boulders to required sizes, filling the interstices with selected sand and compacting to 85 % of original volume of stone stack for all lifts etc. all complete. Payment shall be made for the measurement of the volume of the compacted fill.	CUM	445.00	1.31%
1803	Anti termite chemical treatment of soil with Chlorpyrifos/Lindane E.C. 20% with 1% concentration conforming to IS:8944 and as per IS 6313 all complete. (Plinth area of building at ground floor only shall be measured for payment)	SQM	670.00	0.21%
1812	Laying of earthing mats/rods including risers, transportation from yard stores, loading, unloading, cutting to length, welding, protective painting of joints etc. all complete. (Excavation & Back filling shall be paid separately under respective item of earth work. Earthing mats/rods shall be supplied by BHEL free of cost)	MT	23.00	0.42%



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

2106	Providing and fixing 610mmx453mmx6mm thk mirror from reputed mirror manufacturer. Mirror shall be mounted with glass adjustable revolving CP brackets with CP screws etc all complete.	EACH	103.00	0.19%
2108	Providing and fixing 25 mm diameter stainless steel towel rails (600mm X 25mm) all complete.	EACH	2.00	0.002%
2110	Providing and fixing C.P. soap holder mounted with C.P. screws etc all complete.	EACH	2.00	0.002%
A2114	Providing & fixing in position P.V.C. water tank of Syntex or approved equivalent including making all necessary inlet & outlet pipes, fixture, ball cocks, valves etc. all complete for following capacities. GI pipes shall be paid separately under ST No. 2105.			
A2114 a	1000 litres capacity	EACH	2.00	0.04%
2201	Supply and fixing glazed vitreous china Wash Basin conforming to IS:2556 part 4 of oval shape with R.S. or C.I. brackets painted white, 15mm chromium plated brass hot & cold faucets with nylon washers, chromium plated brass chain with rubber plug, 32mm chromium plated brass bottle trap and waste of standard pattern, 32mm dia chromium plated brass trap unions, plastic connection pipe with chromium plated nuts, fittings, cutting and making good the walls where required etc. all complete.			
2201 b	Colored	EACH	2.00	0.01%
2202	Providing and fixing approved vitreous china laboratory sink of size 600x400x200mm conforming to IS:2556 (part-5) with R.S. or C.I. brackets, chromium plated brass chain with rubber plug 40mm, CP brass waste and 40mm CP brass trap with necessary union complete including painting the fittings, cutting and making good the wall where required etc. all complete.	EACH	1.00	0.01%
2204	Providing and fixing colour glazed vitreous china European type water closet conforming to IS:2556 with siphon, open front solid plastic seat and plastic cover, low level 12.5 litre PVC flushing cistern (same colour as WC) with valve less fittings, necessary C.P connections etc. all complete.			
2204 b	Wall mounted	EACH	2.00	0.02%
2206	Providing and fixing white flat back glazed vitreous china urinals of size 440x265x355 mm with photo voltaic control flushing system as per IS:2556 (part 6, section 1) with flush pipes, lead pipes, gratings, traps and necessary C.P. fittings etc. all complete.	EACH	2.00	0.02%



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

2207	Supply, laying and jointing UPVC pipes of class 3 as per IS:4985 including bends, branches and all other necessary fittings, M.S holder bats/clamps, cutting and making good the walls and floors, jointing, testing etc. all complete for following.			
2207 a	75mm dia pipes	RM	40.00	0.02%
A2207	Supply, laying and jointing Supreme B class stoneware pipe including bends, branches and all other necessary fittings, socket and spigot joint, M.S holder bats/clamps, cutting and making good the walls and floors, lead jointing, testing etc. all complete for following.			
A2207 a	110mm dia pipes	RM	40.00	0.05%
2211	Providing and fixing C.I Manhole heavy duty cover of size 600mmx450mm including frame from reputed manufacture etc. all complete.	EACH	2.00	0.04%
2215	Providing and fixing C.I. floor traps with C.P jalli all complete.	EACH	10.00	0.03%
2508	Conducting routine load test on single job pile as specified in accordance with IS 2911 (Part-4) including preparation of pile head for testing, necessary excavation, providing all arrangements of loading, unloading, test equipments/accessories, jacks, recording of results, labour, submission of test report etc but excluding the cost of installation of job pile complete as per specification, drawing and as directed by the engineer-in-charge for the following.			
2508a	For vertical compression test by maintained load method			
III	600 mm diameter pile	Nos.	2.00	0.45%
2508b	For lateral load test			
III	600 mm diameter pile	Nos.	2.00	0.15%
2508c	For tension/uplift test			
III	600 mm diameter pile	Nos.	2.00	0.28%
A2509	Dismantling of concrete in chipping off pile head from existing level to cut-off level as per the drawing and specification and direction of engineer in-charge	CUM	84.00	0.51%



Notice Inviting Tender : BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu - 601203.

NIT Ref No: BHEL:PSSR: ENR-SEZ:2024-25: SCT:081

Date: 15/ 04/ 2024

VOLUME - II
PRICE BID - RATE SCHEDULE

SL. NO	DECRPTION OF WORK	Unit of Measurement (UOM)	Total Lump sum Amount (₹) (Exclusive of GST)
1	BTG Area balance Civil, Structural and Architectural works of Main plant at 2x660 MW Ennore SEZ STPP, Voyalur PO, Minjur, Ponneri Taluk, Tamil Nadu – 601203 <u>as per Scope of Work mentioned in TCC.</u>	Lump Sum	₹ _____/- Rupees _____ _____only

NOTES:

1. Quoted rate shall be exclusive of GST. The breakup of this total lump sum shall be done as per Bill of Quantity (BOQ) & payment to the contractor will be made accordingly.
2. All the above quoted rates shall be firm throughout the contract period.
3. The rate shall be entered in figure as well as in words.
4. Evaluation shall be done on overall lowest offer basis. Reverse Auction is applicable for this tender.

DATE:

SIGNATURE:

PLACE:

NAME OF SIGNATORY:

NAME OF BIDDER:

(SEAL OF THE BIDDER):



**TITLE: 2X660 MW ENNORE SEZ
SUPERCRITICAL TPP,
UNIT# 1 & 2**

SPECIFICATION NO. PE-TS-412-600-C002

VOLUME - II B

SECTION - C

REV.NO. 0

SHEET OF

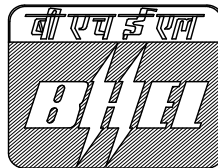
TAMILNADU GENERATION AND DISTRIBUTION CORPORATION

ENNORE SEZ SUPERCRITICAL TPP UNITS- 1 & 2 [2 x 660 MW]

VOLUME – II B CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-412-600-C002

SECTION – C *SPECIFIC TECHNICAL REQUIRMENTS*



**Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301**

CONTENT

Sr No	TITLE	PAGE NO:
–	INTRODUCTION	2
1	CODES AND STANDARDS	4
2	SCOPE OF CIVIL & STRUCTURAL WORKS	15
3	INSTRUCTION TO BIDDERS	22
4	SUBMISSION	27
5	GEO-TECHNICAL INVESTIGATION	30
6	GENERAL REQUIREMENT OF BUILDING / STRUCTURES	35
7	MATERIAL	41
8	LOADING	42
9	STEEL STRUCTURE	48
10	REINFORCED CONCRETE STRUCTURES AND FOUNDATIONS	55
11	DESCRIPTION OF BUILDINGS, STRUCTURES AND OTHER FACILITIES	65
12	REINFORCED CONCRETE CHIMNEY	84
13	NATURAL DRAUGHT COOLING TOWER	101
14	COAL HANDLING SYSTEM	115
15	ASH HANDLING SYSTEM	125
16	PLANT WATER PRE-TREATMENT ` AND DM PLANT SYSTEM	127
17	OUT DOOR CIVIL WORKS	130
18	ARCHITECTURE	138



1 GENERAL

1.1 Intent of Specification

Contractor shall read the parts of specification relevant to contract and shall ignore other parts of specification. In case of ambiguity between BOQ, Part C and Part D of specification, the following priority for acceptance of items may be followed:

- a) BOQ
- b) Specific technical specification (Part C)
- c) General technical specification (Part D)

1.00.00 CODES AND STANDARDS

Following is a general listing of Codes and Standards to be used in the design of the Plant. Specific applicable codes and standards will be identified in System Design Descriptions / Technical Specifications as appropriate. The latest editions / revision of following codes and standards along with addendums / amendments, if any, shall be followed:

1.01.00 General

- a) Internationally accepted design Codes and Standards where Indian Codes are not available and which are equivalent to Indian Standards.
- b) National Building Code of India.
- c) "Accepted Standards" and "good Practice" listed in the appendix to National Building Code of India.
- d) IS:1200 : Method of measurement of Building and Civil Engineering Works.
- e) IS:1256 : Code of Practice for Building Byelaws.

1.02.00 Earthwork

a)	IS-1498	:	Classification and identification of soils for General Engineering purpose
b)	IS-3764	:	Safety code for excavation work
c)	IS:7293	:	Safety code for working with construction machinery

1.03.00 Concrete

a)	IS-269	:	Ordinary and low heat Portland cement
b)	IS-383	:	Coarse and fine aggregate from natural sources for concrete
c)	IS-432	:	Mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
d)	IS-455	:	Portland slag cement
e)	IS-456	:	Code of practice for plain and reinforced concrete
f)	IS-460	:	Test Sieves (all parts)
g)	IS-516	:	Methods of test for strength of concrete
h)	IS-1199	:	Methods of sampling and analysis of concrete

DESEIN		Volume-VI(A): Civil, Structural & Architectural Works	
i)	IS-1566	:	Hard drawn steel wire fabric for concrete reinforcement
j)	IS-1786	:	High strength deformed steel bars and wires for concrete reinforcement
k)	IS-1834	:	Hot applied sealing compounds for joints in concrete
l)	IS-2386	:	Methods of test for aggregates for concrete (all parts)
m)	IS:2502	:	Code of practice for bending and fixing of bars for concrete reinforcement
n)	IS:3370	:	Code of practice for concrete structures for storage of liquids (all parts)
o)	IS-3414	:	Code of practice for design and installation of joints in buildings
p)	IS-4948	:	Welded steel wire fabrics for general use.
q)	IS-6452	:	High alumina cement for structural use
r)	IS-7320	:	Concrete slump test apparatus
s)	IS-7861	:	Code of practice for extreme weather concreting (all parts)
t)	IS-8041	:	Rapid hardening Portland cement
u)	IS-8112	:	High strength ordinary Portland cement
v)	IS-10262	:	Recommended guidelines for concrete mix design.
w)	IS:13290	:	Ductile detailing of RCC structure subjected to seismic loads
x)	SP:34	:	Handbook on concrete reinforcement and detailing
1.04.00	Foundations		
a)	IS-1904	:	Code of practice for structural safety of building - Shallow foundations
b)	IS-2950	:	Code of practice for design and construction of raft foundations
c)	IS-2974	:	Code of practice for design and construction of Machine foundations (all parts)



2 x 660 MW Ennore SEZ Supercritical Thermal
Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14
Vol. VI : 5



DESEIN	Volume-VI(A): Civil, Structural & Architectural Works
	d) IS-2911 : Code of practice for design and construction of pile foundation. e) IS-9716 : Lateral dynamic load test on pile f) IS-6313 (Part-1 & Part-2) : Code of Practice for anti-termite measures and treatment.
1.05.00 Loading	a) IS-875 : Code of practice for design loads for buildings and structures b) IRS : Bridge Rules of Government of India, Ministry of Railways (Railway Board)
1.06.00 Masonry	a) IS-712 : Building limes b) IS-1077 : Common burnt clay building bricks c) IS-1127 : Recommendations for dimensions and workmanship of natural building stones for masonry work. d) IS-1528 : Methods of sampling and physical tests for refractory materials e) IS-1597 : Code of practice for construction of stone masonry (all parts) f) IS-2212 : Code of practice for brickwork g) IS-2116 : Sand for masonry mortars h) IS-2185 : Concrete masonry units. (all parts – Hollow and Solid concrete blocks) i) IS-2250 : Code of practice for preparation and use of masonry mortars j) IS:2572 : Code of practice for construction of hollow concrete block masonry k) IS-2691 : Burnt clay facing bricks



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

- l) IS-3414 : Code of practice for design and installation of joints in buildings
- m) IS-3495 : Methods of tests of burnt clay building bricks
- n) IS-4441 : Code of practice for use of silicate type chemical resistant mortars
- o) IS-4860 : Acid resistant bricks

1.07.00

Doors, Windows & Ventilators

- a) IS-399 : Classification of commercial timbers and their zonal distribution
- b) IS-883 : Code of practice for design of structural timber in buildings
- c) IS-1003 : Timber paneled and glazed shutters (all parts)
- d) IS-1038 : Steel doors, windows and ventilators
- e) IS-1081 : Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators
- f) IS-1361 : Steel windows for industrial buildings
- g) IS-2835 : Transparent sheet glass for glazing and framing purposes
- h) IS-1948 : Aluminium doors, windows and ventilators
- i) IS-1949 : Aluminium windows for industrial building
- j) IS-2191 : Wooden flush door shutters (cellular and hollow core type)
- k) IS-2202 : Wooden flush door shutters (solid core type)
- l) IS-3103 : Code of practice for industrial ventilation
- m) IS-3548 : Code of practice for glazing in buildings
- n) IS-3614 : Fire check doors
- o) IS-4021 : Timber door, windows and ventilator frames
- p) IS-4351 : Steel door frames
- q) IS-6248 : Metal rolling shutters and rolling grills



2 x 660 MW Ennore SEZ Supercritical Thermal
Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14
Vol. VI : 7



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

1.08.00

Roof & Flooring

- a) IS-2204 : Code of practice for construction of reinforced concrete shell roof
- b) IS-3201 : Criteria for the design and construction of precast concrete trusses
- c) IS-2210 : Criteria for design of RC shell structures and folded plates
- d) IS-809 : Rubber flooring materials for general purposes
- e) IS-1195 : Bitumen mastic for flooring
- f) IS-1196 : Code of practice for laying bitumen mastic flooring
- g) IS-1198 : Code of practice for laying, fixing and maintenance of linoleum floors
- h) IS-1237 : Cement concrete flooring tiles
- i) IS-1443 : Code of practice for laying and finishing of cement concrete flooring tiles
- j) IS-2114 : Code of practice for laying in situ terrazzo floor finish
- k) IS-2571 : Code of practice for laying in situ cement concrete flooring
- l) IS-5491 : Code of practice for laying in situ granolithic concrete floor topping
- m) IS-5766 : Code of practice for laying burnt clay brick flooring
- n) IS-1197 : Code of practice for laying of rubber floors
- o) IS:2441 : Code of practice for fixing ceiling coverings.

1.09.00

Waterproofing

- a) IS-1322 : Bitumen felts for waterproofing and damp proofing
- b) IS-1346 : Code of practice for waterproofing of roofs with bitumen felts



2 x 660 MW Ennore SEZ Supercritical Thermal
Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14
Vol. VI : 8



DESEIN	Volume-VI(A): Civil, Structural & Architectural Works
	c) IS-1609 : Code of practice for laying damp proof treatment using bituminous felts. d) IS-3036 : Code of practice for laying lime concrete for a water proofed roof finish e) IS-3037 : Bitumen mastic for use in waterproofing of roofs. f) IS-3067 : Code of practice for general design, details and preparatory work for damp proofing and water proofing of buildings g) IS-3384 : Bitumen primer for use in water proofing and damp proofing h) IS-4365 : Code of practice for application of bitumen mastic for waterproofing of roofs.
1.10.00	Soil Engineering a) IS-1498 : Classification and identification of soils for general engineering purposes b) IS-1892 : Code of practice for sub-structure investigation for foundations c) IS-2131 : Method for standard penetration test for soils d) IS-2720 : Methods of test for soils (all parts)
1.11.00	Water Supply, Drainage & Sewerage a) IS-404 : Lead pipes b) IS-458 : Concrete pipes c) IS:651 : Salt glazed stoneware pipes and fittings d) IS-771 : Glazed fire-clay sanitary appliances (all parts) e) IS-774 : Flushing cisterns for water closets and urinals other than plastic cisterns f) IS-783 : Code of practice for laying of concrete pipes g) IS-1172 : Code of basic requirements for water supply, drainage and sanitation h) IS-1626 : Asbestos cement building pipes, gutters and fittings (all parts)



DESEIN	Volume-VI(A): Civil, Structural & Architectural Works		
i)	IS-1742	:	Code of practice for building drainage
j)	IS-2064	:	Code of practice for selection, installation and maintenance of sanitary appliances
k)	IS-2065	:	Code of practice for water supply in buildings
l)	IS-2470	:	Code of practice for installation of septic tanks (all parts)
m)	IS-3114	:	Code of practice for laying of cast iron pipes
n)	IS-4127	:	Code of practice for laying of glazed stoneware pipes
o)	IS-12251	:	Code of practice for drainage of building basement
p)	IS-1200	:	Method of measurement : Laying of water and (Part-XVI) sewer lines including appurtenant items
q)	IS-1536	:	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage
r)	IS-1537	:	Vertically cast iron pressure pipe for water, gas and sewage
s)	IS-3486	:	Cast iron spigot and socket drain pipes
t)	IS-5329	:	Code of practice for sanitary pipe work above ground for buildings
u)	IS-3076	:	Low density polyethylene pipes for potable water supplies
v)	IS-1538	:	Cast iron fittings for pressure pipes for potable water supplies
w)	IS-1230	:	Cast iron rainwater pipes and fittings
x)	IS-1729	:	Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories
y)	IS-784	:	Pre-stressed concrete pipes
z)	IS-1726	:	Cast iron manhole covers and frames
aa)	IS-5961	:	Cast iron grating for drainage purposes
bb)	IS-5219	:	“P” and “S” traps
	[Part-I]		
cc)	IS-772	:	General requirements for enameled cast iron sanitary



2 x 660 MW Ennore SEZ Supercritical Thermal
Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14
Vol. VI : 10



DESEIN	Volume-VI(A): Civil, Structural & Architectural Works
	appliances dd) IS-775 : Cast iron brackets and supports for wash basins and sinks ee) IS-777 : Glazed earthenware wall tiles ff) IS-2548 : Plastic water closet seats and covers (all parts) gg) IS-2527 : Code of practice for fixing rainwater gutters and down pipes for roof drainage.
1.12.00	Paving & Road Works a) IS-73 : Paving bitumen b) IS-702 : Industrial bitumen c) IS:1201 : Method of testing tar and bituminous materials thru' 1220 d) IRC-15 : Standard Specification and code of practice for construction of concrete roads. e) IRC-58 : Guidelines for the design of plain jointed rigid pavement for highways f) IRC-58 : Guidelines on cement fly ash concrete for rigid pavement.
1.13.00	Earthquake Resistant Design a) IS-1893 : Criteria for earthquake resistant design of structures b) IS-4326 : Code of practice for earthquake resistant design and construction of buildings
1.14.00	Chimney a) IS-4998 : Criteria for design of R.C. Chimneys (all parts)
1.15.00	Structural Steel Work a) IS-800 : Code of practice for general construction in steel b) IS-802 : Code of practice for use of structural steel in overhead transmission line Part-I: Load and permissible stresses



DESEIN		Volume-VI(A): Civil, Structural & Architectural Works	
		Part-II: Fabrication, galvanizing, inspection and packing.	
c)	IS-806	:	Code of practice for use of steel tubes in general building construction
d)	IS-808	:	Rolled steel beams, channels and angle sections
e)	IS-813	:	Scheme for symbols for welding
f)	IS-814	:	Covered electrodes for manual metal arc welding for carbon and carbon manganese steel
g)	IS-816	:	Code of practice for use of metal arc welding for general construction in mild steel
h)	IS-817	:	Code of practice for training and testing of metal arc welders
i)	IS-818	:	Code of practice for safety and health requirements in electric and gas welding and cutting operation
j)	IS-819	:	Code of practice for resistance spot welding for light assemblies in mild steel
k)	IS-919	:	Recommendations for limits and fits for engineering.
l)	IS-1024	:	Code of practice for use of welding in bridges and structures subjected to dynamic loading
m)	IS-1161	:	Steel tubes for structural purposes
n)	IS-1182	:	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
o)	IS-1200 [Part-VIII]	:	Method of measurement of steelwork and iron work
p)	IS-1239	:	Mild steel tubes, tubulars and other wrought steel fittings (all parts)
q)	IS-1363	:	Black hexagonal bolts, nuts and locknuts (dia. 6 to 39 mm) and black hexagon screws (dia. 6 to 24 mm) [all parts].
r)	IS-1364	:	Precision and semi-precision hexagon bolts, screws, nuts and locknuts (dia. range 6 to 39 mm) [all parts]
s)	IS-1365	:	Slotted counter sunk head screws (dia range 1.6 to 20 mm)
t)	IS-1367	:	Technical supply conditions for threaded steel



2 x 660 MW Ennore SEZ Supercritical Thermal
Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14
Vol. VI : 12



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

- fasteners
- u) IS-1443 : Code of practice for laying and finishing of cement concrete flooring tiles.
 - v) IS-1608 : Methods of tensile testing of steel products
 - w) IS-1730 : Dimensions for steel plate, sheet and strip for structural and general engineering purpose
 - x) IS-1731 : Dimensions for steel flats for structural and general engineering purposes
 - y) IS-1852 : Rolling and cutting tolerances for hot rolled steel products
 - z) IS-1977 : Structural steel (ordinary quality)
 - aa) IS-2016 : Plain washers
 - bb) IS-2062 : Steel for general structural purposes
 - cc) IS-2074 : Ready mixed paint, air drying, red oxide zinc-chrome, priming
 - dd) IS-2633 : Methods of testing uniformity of coating of zinc coated articles.
 - ee) IS-3613 : Acceptance test for wire-flux combinations for submerged arc welding of structural steel
 - ff) IS-3664 : Code of practice for ultrasonic pulse echo testing by contact and immersions methods
 - gg) IS-3757 : High strength structural bolts
 - hh) IS-4000 : High strength bolts in steel structures
 - ii) IS-4759 : Hot dip zinc coatings on structural steel and other allied products
 - jj) IS-5334 : Code of practice for magnetic particle flaw detection of welds
 - kk) IS-7215 : Tolerances for fabrication of steel structures
 - ll) IS-7280 : Base-wire electrodes for submerged arc welding of structural steel
 - mm) IS-7318 : Approval test for welders when welding procedure approval is not required.
[Part-I]



2 x 660 MW Ennore SEZ Supercritical Thermal
Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14
Vol. VI : 13



DESEIN	Volume-VI(A): Civil, Structural & Architectural Works
	nn) IS-8500 : Structural steel – micro-alloyed (medium and high strength qualities) oo) IS-9595 : Recommendation for metal arc welding of carbon and carbon manganese steel pp) AWS D.1.1 : Structural welding code.
1.16.00	Painting a) IS-348 : Specification for French polish b) IS-427 : Specification for distemper, dry colour as required c) IS-428 : Specification for distemper, oil emulsion, colour as required d) IS-1477 (I & II) : Code of practice for painting of ferrous metal in buildings e) IS-2338 (I & II) : Code of practice for finishing of wood and wood based materials f) IS-2339 : Specification for Aluminium Paints for general purposes in dual containers g) IS-2395 : Code of practice for painting concrete, masonry and plaster surface h) IS-2932 : Specification for enamel, synthetic, exterior - (a) undercoating , (b) finishing i) IS-2933 : Specification for enamel, exterior – (a) under-coating, (b) finishing. j) IS-5410 : Specification for cement paint.
1.17.00	a) Indian Road Congress (IRC) Bridge codes b) Indian Railways Standard Bridge Rules
1.18.00	Environmental Protection Charter on Corporate Responsibility for Environmental Protection (CREP) published in Gazette of India dated 27.08.2003.
1.19.00	Rules & Regulation of Local Authorities
1.20.00	Statutory Regulations of Tariff Regulation Commission (TAC)



2.00.00 SCOPE OF CIVIL & STRUCTURAL WORKS

2.01.00 This specification is to cover design, preparation of general arrangement, construction as well as fabrication drawings, supply of all labour as well as materials and construction of all civil, structural as well as architectural work on EPC basis.

2.02.00 The work to be performed under this specification consist of design, engineering as well as providing all labour, materials, consumables, equipment, temporary works, temporary labour, constructional plant, fuel supply, transportation and all incidental items not shown or specified but reasonably implied or necessary for the completion and proper functioning of the plant, all in strict accordance with the specifications and including revisions and amendments thereto as may be required during the execution of the work.

2.03.00 All materials including cement, reinforcement steel, structural steel etc. shall be arranged by the Contractor.

2.04.00 The scope shall also including setting up by the Contractor a complete testing laboratory in the field to carry out all relevant tests as per BIS or other international standards required for the civil works for the project.

2.05.00 The work shall be carried out according to the design/drawings to be developed by the Contractor and approved by the Purchaser. For all building and structures, foundations, etc. necessary layout and details are to be developed by the Contractor keeping in view the statutory & functional requirements of the plant & facilities and providing enough space & access for operation, use & maintenance. Certain minimum requirements are indicated in this specification for guidance purpose only. However, the Contractor's offer shall cover the complete requirements of the plant & facilities and providing enough space & access for operation, use & maintenance. Also the Contractor's offer shall cover the complete requirements as per the best prevailing practices and to the complete satisfaction of the Purchaser.

2.06.00 Description of various items of work under this specification and nature of work in detail are given hereinafter, but not limited to the items listed below. The complete work under this scope is referred to as CIVIL WORKS. List of various civil works covered under the scope is given below:

1. Turbine building foundation including Turbo-generator foundation and superstructure including service and maintenance bays.
2. Switch Gear and Control Room including Compressor house, D.G. set room and Co2 room.
3. Steam Generator Elevator supporting structure.
4. Foundation for steam generator / ESP / duct supporting structure & other equipments.
5. ESP control room.
6. Mill and bunker building including bunker structures & Mill Foundations.
7. Steel Mill reject silo and foundations to be provided for the same.



8. Foundations for various fans and fan handling system.
9. RCC chimney of 275m height with twin flues.
10. Ash pipe supporting structure both for bottom ash and fly ash (100% dry collection) from plant area upto RCC silo & wet fly ash slurry pipe & supports from silo to ash dyke.
11. Ash / mill reject handling system structures.
12. Fly ash silos.
13. Ash slurry pump house & ash compression house.
14. Buffer hopper tower.
15. Ash handling electrical/ Control room.
16. Intake pump house & channel near existing cooling water forebay of NCTPS-stage II with modification of existing forebay at intake point.
17. Pipe line to carry water from proposed pump house near existing forebay of NCTPS-stage II to proposed power plant area. Pipe line will be supported on RCC piers.
18. Cooling water (CW) pump house, sump including forebay, CW inlet and outlet conduits.
19. Cascade aerator, partial flume, clarifier, reject sump, RO Plant stage –I, RO stage-II, Permeate storage tank , Pump house.
20. RCC CW ducts from CW pump house to Turbine building, Turbine building to cooling tower and RCC channel from cooling tower to CW pump house forebay.
21. Natural draft cooling tower including basin and other apparatus.
22. Service water overhead tank, DM water storage tank, potable water tank, Condensate storage tank & Condensate polishing unit. Capacity to be provided for overhead water tank shall be 500m3 as per mechanical requirement whichever is higher.
23. Filtered Water Pumphouse/ fire water pumphouse & Filtered water reservoir/ fire water storage tank.
24. Clarified water storage tank and pump house.
25. Dual Media filters.
26. DM Plant – Eye washer & whole body shower shall be provided in DM plant area for emergency. Also a building for testing lab for coal, water, chemicals etc., in DM plant should be provided.
27. Electrochlorination Building.



28. Chemical house and bulk chemical area.
29. Neutralization pit, effluent treatment plant & sewage treatment plant.
30. Rain water harvesting pond **earthen construction.**
31. Guard pond and pump house.
32. Foundation of various water pumps.
33. Fuel oil tank (2x3000 KL) Foundation, Fuel oil pump house, fuel oil storage tank dyke area.
34. **External Coal Handling System from JTB-3** upto western side NCTPS Stage I compound wall and pipe conveyors from NCTPS Stage I to plant area with trestles and necessary transfer points.
From JTB-3 to TH1 -open belt conveyor with all sides completely covered as indicated in layout of ICHP drawing.
From TH1 to crusher house -pipe conveyor shall be proved by EPC contractor.
All civil works including foundation for above items is in the scope of EPC contractor.
- a) Rails complete with fixing accessories for stacker / reclaimer machines and travelling trippers.
- b) Crusher house and CHP control room.
35. **IN-Plant Coal Handling System:-** Junction towers (underground and above ground) in plant area, trestles and coal Conveyor galleries, cable galleries, stacker reclaimer, emergency reclaim hoppers with RCC water tight pit, underground tunnels, coal stockyard, coal run off pit, dust suppression / extraction and ventilation system, switchgear room, pump houses, cable trays, cable supports, underground cable trenches with cover, monorails, beams for hoists etc.
36. Switchyard control building and all works for GIS switchyard.
37. Transformer yard structures including rail track foundation for transformer.
38. Transformer Maintenance Building, Mill & Boiler Maintenance Building & FGD provisions.
39. **Auxiliaries buildings**
 - Service building.
 - Administrative building
 - Air washer building and Plant air compressor building.
 - Hydrogen generation plant (H₂ Plant)
 - Workshop



- Canteen building
- Dozer shed and repair shed
- Fire station
- DG House
- Bank extension counter with ATM and Post office **200sqm**
- Field maintenance building – 3 no.(20 x 10 m²) - **RCC Buildings**
- Main gate and Time office cum security complex with two no. of dormitory (100 m² each) with toilet and change rooms for security persons in the first floor. Steel building shall be provided for CW Pump House,

Workshop (Excluding Stores and Office area), D.M Plant, Parking sheds. The Structural Steel shall be confirm to IS 2062. The side wall shall be brick cladding for a height of 1.0m above that color coated galvalume sheets of minimum thickness not less than 0.6mm shall be provided. The roof shall be covered with same sheet of adequate thickness to suit the design requirement. Transparent / Translucent sheet may be used to permit natural lighting. Sufficient number of roof extractor shall be provided for effective ventilation. Aluminum glazed windows shall be provided for natural ventilation and lighting.

All other civil items not covered above but required for completion and proper functioning of plant shall form part of scope.

40. Trenches, tunnels, channels, duct banks etc.
41. Structural steel pipe rack and cable racks for pipes and cables for clarified water, D.M. Water, steam pipes, fuel oil pipes and other areas(if required). with walkways.
42. RCC paving from Transformer Yard to chimney including Boiler area.
43. Parking sheds for four wheelers and two wheelers
 - a) Car park – Partly covered parking – total parking area 3000 Sq.M.
 - b) Covered car parking with roof only and sides open shall be provided adjacent to the administrative building for minimum 20 Cars.
 - c) Parking area indicated are net areas only (i.e.) excluding ramp, etc.
 - d) Scooter and Cycle shed shall be provided with roof cover only.(Area 1250 Sq.M).
44. RCC storm water drainage system for the entire plant.
 - a) Site shall be graded upto **+9.5m** level with available material from existing bund and the balance depth i.e up to +10.00m (+ 10.00m corresponds to RL +



10.00m) shall be filled with approved good quality murram / gravel (Gravel Blanketing).

Site shall be graded upto **+9.2m** level by the OWNER. The EPC contractor has to carry out site grading work for the entire plant from **+9.2m** level to +9.50 m level with approved quality of murram/gravel. The finished floor level of Plant shall be +10.00m elevation.

45. Dispensary and first aid centre. **150sqm**
46. Service water system / make up water pipelines.
47. Rain Water Harvesting for all buildings. All roofs tops shall have RWH with filter arrangement. Filtered water shall be pumped to Raw Water Reservoir for its utilization.

Rain Water Harvesting should be implemented as per the scheme / design approved, Central ground water Authority / Board or State ground water authority or MoEF authorized agency shall be consulted for finalization of appropriate rain water harvesting technology. The necessary consultancy charges for the above agency for preparing rain water Harvesting method / scheme for the project to be borne by the Bidder.
48. Site illumination work.
49. All the civil works related to arrangement for lifting of stator.
50. Clearing and removing the buried items if any in the whole proposed plant area and the same is to be deposited to the NCTPS existing stores.
51. The contractor has to fill or excavate the areas to the required formation levels as indicated in the plot plan.
52. 30 metre high lighting towers shall be provided in Coal yard area and Switchyard area.
53. Road Weigh Bridge and Control Room
These shall be RCC framed structure with RCC roof and brick cladding. Adequate windows shall be provided for ventilation & lighting. Roof shall be given liquid membrane water proofing treatment. Flush welded steel doors shall be provided for personnel movement. Toilet facilities shall be provided.
54. All underground structures such as basement, sump etc. and water retaining structures shall be water proofed as per specification.
55. For under deck insulation, Fire Resistant Under deck insulation such as Lloyd foam or equivalent PUF may considered with suitable specification.
56. Modular furniture of approved make and model with electrical wiring and network cabling shall be provided in all office/operating personnel rooms/conference hall as per owner's requirements.
57. All the building shall have one dining room of owner's requirement.
58. Necessary lift/elevators for the buildings as per standard code shall also be provided by EPC contractor apart from the specifically mentioned lifts/ elevators.
59. Outfall structure- CT blowdown water, RO stage-II reject shall be let out into the seal well of stage-I. Necessary repair work required in seal well of stage-I shall be carried out by EPC contractor.



61. The Work also Includes:

- (a) Site surveying.
- (b) Soil investigation and preparation of soil investigation report and suggestion of type of foundations including design of piles.
- (c) Implementation of ground improvement techniques and post improvement evaluation of sub surface properties up to 15.0 m below the existing Ground level.
- (d) Preparation of Architectural drawings.
- (e) Design, preparation of drawings and construction of all structures.
- (f) Preparation of as built drawings of all structures and facilities to reflect as built status of construction.
- (g) Submission of as built drawings in Autocad in CDs.
- (h) Plumbing & sanitary works.
- (i) Painting.
- (j) Anti-termite and anti-weed treatment in all areas / buildings as per IS: 6313.
- (k) All temporary roads and approach roads necessary for construction purpose shall be of WBM for a minimum width of 4m. All permanent min roads inside the plant, cross road to auxiliary buildings and inspection road around compound wall will be provided by bidder.
- (l) Green belt development-30% of total plant area shall be developed as green belt by the EPC contractor
- (m) Internal compound wall required based on plot plan and layout. External compound wall is in the scope of bidder. Compound wall shall be provided all around the plant boundary. The wall will be 230 thick brick infill/Rcc slab of suitable thickness. Height of wall will be 4.50 m above FGL. Over the 4.5 m high wall 1 m high of 8 string barbed wire of 6 guage with 8 strands and with anti climbing arrangement of 50x50x8 Y shaped angles placed at 2.5 c/c shall be provided.

(Anti-weed treatment for Switchyard area)

It is not the intent to specify herein all the works in the scope of this contract. All other buildings, structures and works that are necessary which are not specifically mentioned here but required for construction, operation and maintenance of the power plant or mentioned elsewhere in the specification are deemed to be included in the scope of the Contractor.

In the event of conflict between requirement of any two clauses of this specification, or different codes / standards, the more stringent requirement as per the interpretation of Owner is to be followed by EPC contractor.

All works shall conform to the specification. The works shall conform to high standards of design, engineering and workmanship. Design and construction shall conform in every respect to all local and state regulations governing such works and to stipulations of Indian Standards unless stipulated otherwise in detail specification.



General

It is preferable to adopt Pre fabricated / Pre Engineering structures for CW Pump House, Fire Water Pump House, Workshop (Excluding Stores and Office area), D.M Plant, Parking sheds.

2.07.00

Protection of existing utilities and services

During construction, the contractor shall provide all protection for existing utilities and services as may be required by his construction operations. Permanent protection of certain items shall be as included under other sections or as instructed by the Owner.

In addition to the requirements as specified, herein the contractor shall comply with the following requirements:-

- a) Use all necessary precautionary and protective measures required to maintain existing utilities, services and appurtenances that must be kept in operation. In particular, the contractor shall take adequate measures to prevent undermining of utilities and services presently in services.
- b) Protect existing or new utilities and services where required by the contractor's operations and/or as directed by the Owner. The contractor shall be responsible for bracing and supporting utilities and services to prevent settlement, displacement or damage.
- c) If any existing structure such as Pipe line, Road drain, Culvert, Towers, Light Posts, Underground Structures, Buildings, Tanks, Rail line etc are damaged during execution of project, same shall be reconstructed by EPC Contractor at his own cost at locations wherever approved by owner.



3.00.00 INSTRUCTION TO BIDDERS

3.01.00 Data to be furnished by Bidder at the time of Bid

- 3.01.01** A write-up on survey to be undertaken indicating grid, intervals for taking spot levels, contour intervals, precision of surveying instruments proposed to be used, drawings that will be prepared, details to be covered by survey etc.
- 3.01.02** Detail general arrangements / architectural drawings of all buildings and structures showing dimensions, levels, plans, sections, elevations, loadings, materials proposed, types of framings, wall / cladding, floors, roofs, types of finishes etc.
- 3.01.03** Detail design criteria proposed to be adopted for each building, structures, foundations, facilities etc.
- 3.01.04** A write-up with schematic drawings of cooling water (CW) system indicating size and details of cooling tower, CW conduits, channels and forebay along with method of construction etc.
- 3.01.05** Organisation chart with no of Engineers to be furnished by EPC Contractor.
- 3.01.06** A write up on size and construction details of 275m high RCC chimney with steel twin flue and along with appurtenances shall be furnished.
- 3.01.07** Details of thermal insulation for ceiling and detail of false ceiling assumed with manufactures catalogue and areas where they propose.
- 3.01.08** All deviations from bid document shall be furnished by the Bidder.
- 3.01.09** List of equipment to be deployed and rates of labour assumed by the bidder and by other sub-contractors to be associated with him-in is to be furnished.
- 3.01.10** List of softwares proposed to be used against various areas for analysis, design, drafting and project monitoring along with their source and validation report for the softwares.
- 3.01.11** The list of documents indicated elsewhere of this section to be submitted by the contractor to the Owner for his approval and manner in which the same need to be submitted. No construction shall commence at site without obtaining approval from the Owner on these documents. Therefore, it is necessary that bar charts for buildings / structures / area wise shall be submitted for design / drawing activity indicating.
- A Level-1 pert chart showing the starting and completion date of all civil construction activities.
 - A Level-2 pert chart showing the time required for preparation of design criteria, for approval of design criteria by Owner, time required for detailed design and drawing preparation and time required for approval of design and drawing by Owner. This part shall taken into account the construction schedule (Level – 1 part).



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

c) A Level-3 pert chart for all civil works shall be submitted to Owner for monitoring of progress of works at site.

3.01.12 A detail note on quality plan both for design and construction activity proposed to be adopted for obtaining quality works.

3.01.13 List of all sub-contractors/Consultants/Architects that the bidder proposes to employ, in case the contract is awarded to him, indicating their addresses with telephone number, experience on similar jobs, name, qualification and experience of persons who shall be involved in the job on behalf of the contractor etc. shall be submitted to Owner. Only the sub-contractor approved by Owner shall be engaged by the contractor on the job.

3.01.14 Write-up on proposed storm water drainage system furnishing layout of the drains, types of drains and suggested disposal system.

3.01.15 A write-up on dewatering system proposed at the time of construction where deep construction such as for reclaim hoppers pit/track hopper pit, conveyor tunnels, CW forebay and pump house etc. are to be executed.

3.01.16 Tentative plot plan showing location of all buildings, structures, roads, site office, storage etc. with plan dimensions.

3.02.00 Inspection of Site by Bidder

3.02.01 Bidder shall inspect the site, examine and obtain all information required and satisfy himself regarding matters and things such as access to site, communications, transport, right of way, the type and number of equipment and facilities required for the work, availability of local labour, materials and their rates, local working conditions, weather, sub-soil conditions, natural drainage etc. Ignorance of the site conditions shall not be accepted by the Owner as basis for any claim for compensation or extension of time.

3.02.02 The submission of a bid by the Bidder will be considered as an evidence that such an examination was made and any later claims / disputes in regards to rates quoted shall not be entertained or considered by the Owner.

The contractor shall organize his own arrangement to transport his equipment, men and materials so as to match the construction schedule.

3.03.00 Construction Tools & Materials Supplied by Contractor

3.03.01 Contractor shall provide and maintain at the site necessary number and type of machinery and equipment including survey instruments in good working condition for proper setting out and timely completion of the various works cover under this specification. All arrangements for transporting the equipment to and from the site shall be done by the Contractor at his own expenses. No claim shall be entertained for mobilizing additional equipment and/or personnel to complete the work within the stipulated time.

3.03.02 Contractor shall provide all fuels and lubricants required for the operation and maintenance of construction machinery and equipment as well as his transport vehicles at his own cost.



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

- 3.03.03** The contractor shall ensure that the work shall proceed uninterrupted even in the event of power failure. As such, adequate number of diesel operated equipment shall be provided by the contractor at his own cost as an alternative arrangement, in case electrically operated equipment are proposed to be brought to site.
- 3.03.04** The contractor shall maintain sufficient stock of material so that there is no interruption of works at any point of time during the contract period & extended period if any.
- 3.03.05** All materials supplied by the contractor shall be original, new and of the best quality and shall conform to the given specifications. Approval in writing shall be obtained from the Owner before any alternative or equivalent material is used other than what is specifically mentioned in the drawings.
- 3.03.06** Contractor shall furnish manufacturer's test certificate for all the manufactured items supplied by him. Representative specimens of the material shall also be submitted to the Owner and shall be tested at a recognized testing laboratory at Contractor's cost in case Owner so desire.
- 3.03.07** The Owner reserves the right to test any construction material supplied by the Contractor in an established testing laboratory at Contractor's cost and to instruct the Contractor to remove all materials, which do not meet the specification requirements.
- 3.03.08** EPC Contractor to arrange third party quality inspection & audit of all construction material at site.
- 3.03.09** Contractor has to set-up a testing laboratory equipped with the following minimum apparatus, materials and competent trained staff required for carrying out field tests:
- Slump cone apparatus to measure slump.
 - Concrete cube testing machine with adequate number of moulds of (15cmx15cmx15cm) to measure compressive strength of concrete.
 - Vicat apparatus to find initial and final setting time of cement.
 - IS sieves with vibrating machine to determine fineness modulus of coarse and fine aggregate.
 - Abrasion & impact testing equipment for testing coarse aggregate and apparatus to determine flakiness index of aggregates.
 - Complete apparatus for the test of air content of concrete by pressure method as per IS:1199.
 - Density bottle to determine sand bulkage.
 - Hydrometer for testing pH value of water
 - Thermometer for checking temperature



- j) Apparatus for measuring proctor density, water content of compacted soil determining CBR values.
- k) All apparatus for determining dry density and water content of sand/soil and aggregates. Any other equipment felt appropriate by the Owner for measurement of paint thickness, testing of structural members, welding etc. The testing machines shall be recalibrated periodically and as directed by Owner to detect errors. The moulds for cubes shall be checked frequently and made to conform to specifications contained in IS-516.

3.04.00 Work Execution and Supervision

3.04.01 Contractor shall have at the site accredited and qualified engineers and foremen / supervisors with adequate number of years of experience in execution of similar works and also operators of machinery and equipment, for satisfactory progress and timely completion of the work.

3.04.02 Contractor's Engineer-in-charge of the work at site shall be capable of interpreting the specification and drawings and make adequate site decisions as and when required. He shall also take instructions from the Owner and be responsible for carrying out the instructions.

3.04.03 Contractor shall be fully responsible for the correctness and accuracy of the tests performed, results obtained / tabulated, interpretation of test results and recommendations made. The work shall be executed in a professional manner, with fully understanding of the importance of work for a project of this magnitude.

3.04.04 In the event of occurrence of any accidents at / near the site of the work or in connection with execution of the work, a report shall be made immediately to the Owner, giving full details of the accidents. He shall also report such accidents to all the competent authorities wherever such reports are required by them.

3.04.05 All temporary electrical installation shall be supervised by a qualified electrical supervisor of the Contractor.

3.04.06 Owner reserves the right to order in writing, from time to time, during the progress of the work, removal and re-execution of any work which in the opinion of the Owner, is not in accordance with the specification.

3.04.07 During inclement weather, rains etc. contractor shall suspend all works for such time as the Owner may direct and shall protect from damage all works already in progress or completed just then. All such temporary protective measures shall be at contractor's cost and any damage to works shall be made good by the contractor at his own expense.

3.04.08 Should the work be suspended by reasons of strikes / riots by Contractor's own employees or any other causes whatsoever save and except the force majeure condition, Contractor shall take all precautions necessary for the protection of works and make good, at his own expenses, any damage arising from any of these causes.

3.04.09 During the course of contractor's works, other works either by the Owner or by the Contractors or by both simultaneously will be in progress within the project area.



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

Contractor shall make his best effort to work in harmony with others in the best overall interest of the project and towards its speedy completion.

3.04.10 The Contractor shall be responsible for maintaining cleanliness of the site. The site shall be free of unwanted rubbish or filth, which is hazardous & detrimental to health, and affect safety of the work place. Proper watering to be done for dust suppression.

3.04.11 All material supplied shall conform to the specification. Entry of unwanted materials shall be prohibited.



4.00.00

SUBMISSION

The following documents are to be submitted for the approval of the OWNER, prior to commencement of fabrication & erection / construction. All drawings shall be of standard sizes (metric system) and shall be made on AUTOCAD. Software used for design shall be validated and established ones like STAAD Pro, NISA, and ANSYS. Hard and soft copies of all the drawings / document shall be submitted to the OWNER. The following list is not exhaustive but indicative only.

- 1) The analysis of TG building, Mill building, ESP control room, Chlorination building, Switchyard control building, CW pump house, Raw water pump house, Ash water pump houses and Service building are to be done by developing 3D mathematical model adopting response spectra method of analysis as per IS: 1893-2002 & 2005, in addition to wind load analysis as per IS: 875 Part-3.
- 2) Preparation of design drawings with maximum detailing possible and developing all possible connection / joint details for all the buildings within the scope of civil / structural works.
- 3) General plant layout drawing with coordinates of roads, boundary wall and facilities, piping / cable corridors, pipe and cable trestles, provision of landscaping and green belt development, diversion roads and drains, equipment lay down areas etc.
- 4) Drawing showing underground facilities with coordinates like buried pipes, buried cables, trenches, ducts, sewer, drains, sumps pits, culverts, foundations etc.
- 5) Soil investigation report based on additional geo-technical investigation carried out by CONTRACTOR along with foundation recommendation for various buildings / structures / facilities.
- 6) Site Grading and storm water drainage study furnishing levels of various terraces arrangement and details of drains, culverts etc for storm water drainage system.
- 7) Study note on disposal of sewage and other effluent from the plant to satisfy the statutory requirement.
- 8) Design basis memorandum for all buildings, facilities, services and structures.
- 9) Drawing showing loading data at various levels for all buildings and structures.
- 10) Architectural floor plans, elevations, cross sections and perspective view in colour scheme of all buildings. For main plant building CONTRACTOR shall submit two different schemes along with a report elaborating the underlying philosophy of the proposed architectural concepts.
- 11) Design calculations and drawings for foundations / substructure and superstructure of all buildings including pump houses and other structures.



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

- 12) Design calculations including dynamic analysis and drawings for all foundations subjected to dynamic loads like foundations for TG, BFP, Mill, Fans (PA, FD, ID), Crushers etc.
- 13) Design calculations and drawings for all facilities and services like roads, culverts, bridges, pavings, road / rail crossings, drainage pump house (if required), drains, sewers, sewage pump house, sewage treatment plant, water supply, water tank, sumps, tunnels, trenches, ducts etc.
The contractor shall resubmit the design document and drawings within a maximum period of 3week from the date of receipt of comments by the contractor. Timely submission of design/drawings to the owner for review/approval is the sole responsibility of the contractor and postal or other delays as reasons for late/non submission shall not be entertained by the owner.
- 14) Drawings of all architectural works including finishing schedule, colour schemes (both internal and external), doors & windows, flooring and false ceiling shall be submitted by EPC Contractor to owner along with or before releasing of construction drawings.
- 15) Design calculations and drawings for plumbing and building drainage.
- 16) Design calculations and drawings for switchyard structures, transformer yard, etc.
- 17) Design calculations and drawings for structures pertaining to condenser Cooling water system.
- 18) Design calculation and drawings / document for the sea water system structures is covered within the scope of the Contractor.
- 19) Design calculations and drawings for civil structures / works associated with fuel oil handling system, ash handling system, coal handling system, Ash disposal system, etc.
- 20) All other designs, details / drawings or any other submissions as indicated elsewhere in this specification and as required by the Owner.
- 21) Details of corrosion protection measures for all structures.
- 22) All design and drawings for the natural draught Cooling towers.
- 23) All design and drawings for RCC Twin flue chimney.
- 24) All design calculations and drawings for foundation of Boiler and ESP area structures.
- 25) Preparation & Review of structural steel fabrication drawings is entirely of the responsibility of contractor & will not be approved by the owner. However, all fabrication drawings shall be submitted by the contractor for owner's reference & records prior to the commencement of fabrication.



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

- 26) Construction and erection procedure for all major structure with specific reference to main plant building, bunker structures, transfer towers, conveyor galleries, TG foundation and other machine foundations.
- 27) Write up on various statutory requirements and their compliance for various buildings and facilities.
- 28) Quality assurance and Quality Control procedures. Third party quality audit is required.
- 29) Copies of all reports on investigation and studies carried out by the CONTRACTOR as per the scope.
- 30) Soft copies of all design calculation and drawings shall be submitted for records after approval of the OWNER.
- 31) EPC Contractor to ensure that photograph of progress of work at site with required album is being submitted to owner once in every month in soft & hard copy.
- 32) EPC Contractor to ensure that Bar Bending Schedule & Bill of quantities has been furnished in various construction drawings.
- 33) All drawings are approval category except fabrication drawings which are information category.



2 x 660 MW Ennore SEZ Supercritical Thermal
Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14
Vol. VI : 29



6.00.00 GENERAL REQUIREMENT OF BUILDING / STRUCTURES

The CONTRACTOR shall obtain and be conversant with all laws, by-laws and regulations of local and Statutory Bodies as applicable to the project. The architectural concept evolved should also take care of these requirements. The CONTRACTOR shall provide the drawings and documents for such statutory approvals.

EPC Contractor to ensure that all building layout has been finalized in such a way so that adequate space is available all-round the equipment for operation, repair & maintenance.

6.01.00 Roof Access

All roofs shall be provided with access thorough a staircase / cage ladder. Minimum 1000 mm wide access path shall be provided with tiles to approach equipment on roof.

6.02.00 Platform and Walkways

Platforms shall be provided to all major equipment, not directly accessible from - the floors, for maintenance. Platforms and connecting walkway shall have a minimum width of 750 mm. Platforms in front of the entry shall be atleast 900 mm wide. Platforms located close to each other shall be connected with walkways.

All steel platforms above grade level shall be constructed with kick plates at edge of the platform to prevent tools or materials from falling off. It shall consists of 8 mm thick Galvanised steel plate projecting 100 mm above the platform surface. Kick plate shall be painted with the same type of coating as the material to which it is attached.

Continuous walkway with GI Hand rail at least 750 mm (Wherever occurs) wide shall be provided along the crane girder level with handrails, on both side of the building. Approach to EOT crane shall be ensured by Cage ladder and staircase.

The plinth of powerhouse and its surrounding area is to be kept RL.10.0M. Top of finish of main approach road and internal road are to be kept be 250mm above surrounding Grade lvl. at RL.9.5M level.

Finished floor level boiler area / transformer yard area shall be kept 200mm lower than the finished floor level of power house building.

Finished ground floor level of all buildings and pump houses shall be minimum 500mm above the formation level / grade level.

6.03.00 Edge Protection

All-around floor openings an RCC kerb of 100 mm wide 150 mm high shall be provided. All concrete edges, where breakage of concrete corners expected shall be provided with angles of minimum size L 50x50x6 with lugs for edge protection e.g. all-round the cut-outs I openings in floor slab, edges of drains supporting grating covers, edges of. RCC cable I pipe trenches supporting covers, edges of manholes supporting covers and supporting edges of precast covers etc.

6.04.00 Anchor Bolts and Inserts Plates



Anchor bolts shall be designed for working stress, in tension and shear, for embedded length of the anchor bolts and pipe sleeves. Shear and crushing strength of concrete shall also be checked.

Insert plates shall be designed / checked for shear and bending moment. All lugs shall be checked for tension. Bond strength of concrete shall also be checked. Lugs using steel bars shall preferably be fillet welded to the plate to transfer full strength of the lug.

Insert plates required for the equipment supplied by BTG vendor will be supplied by BTG supplier and same shall be fixed in position under this contract and supply and fixing of all the balance inserts shall be under the scope of this contract.

6.05.00

Vertical Headroom

All accessible areas shall be provided with minimum clear headroom as follows, unless otherwise specified.

Finished floors to ceiling (buildings)	3000 mm
Doors, Walkways, Platforms, Stairs etc.	2100 mm
False ceiling of office areas	2400 mm
Above false ceiling	1000 mm
Safety cage for ladders	2500 mm
Access for fork lift trucks	2800 mm
Main roads / Railway crossings & crane access	7000 mm
Other plant roads and truck access	5000 mm
Cable & Pipe rack (except at road and rail crossings)	3000 mm

6.06.00

Anti Termite Treatment

Pre-constructional anti termite treatment shall be given to all vulnerable areas susceptible to termite attack and shall include column pits, wall trenches, foundations filling below the floors etc., as per IS: 6313 and other relevant Indian Standards.

6.07.00

STAIRS AND LADDERS

6.07.01

Steel Stairs



All steel staircases shall normally have minimum clear width (back to back of stringer) of 1000mm and maximum inclination with horizontal of 35.75°. However, in case of space restriction, minimum clear width upto 750mm and slope upto 45° may be provided. The vertical height between successive landings shall not exceed 5m. Channels (minimum MC200) shall be provided as stair stringers. Treads shall be minimum 250mm wide of grating, with suitable nosing, and spaced equally so as to restrict the rise to maximum 180mm.

6.07.02 Steel Ladders

Ladders shall be provided to platforms, walkways, instruments and equipments which do not require frequent access. Ladders shall preferably be vertical and its angle with vertical shall not exceed 5°. Ladders shall be of minimum 450mm clear width with 35x35x3 angle diameter MS rungs spaced at 300mm (maximum). Ladders shall be provided with a safety cage of minimum 750mm diameter clear when the top of ladder is more than 4.5m above the landing level. However safety cages shall start at 2.5m above the lower landing level.

6.07.03 RCC Stairs

All stairs shall have maximum riser of 180mm and a minimum tread of 250mm. However, for Administration & Control room building riser shall be limited to 150mm and tread width of 300mm. Minimum width of stairs shall be 1200mm generally. All stairs normally shall have not more than 15 risers in one flight. Aluminium angle nosing with minimum 50x25x3 angle shall be provided for edge protection of RCC stairs.

6.08.00 Handrails

Handrails shall be provided at appropriate places to ensure safety e.g. around all floors / roof openings, projections / balconies, walkways, platforms, steel stairs etc.

All handrails shall be of 32mm nominal bore MS pipes (medium class) as per IS:1161 galvanised using 750 gm/sq. m of zinc. Handrails for platforms, walkways and projections shall be a two-rail 450mm below the top rails. Handrail post spacing shall be limited to 1500mm as far as possible but can be proportioned to the length of the protected horizontal opening. In such a case spacing shall not exceed 1850mm center to center of posts. Handrails shall be shop fabricated for specific locations and field welded or bolted to the erected structural steel. For platforms at elevation more than 30m, three rail system with top rail at 1500mm shall be adopted.

For RCC stairs, handrails with 20mm square MS bar balustrade with suitable MS flat & Teakwood handrail shall be provided, unless specifically mentioned otherwise.

6.09.00 Expansion/Construction Joints

Expansion and construction joints shall be provided wherever required. All expansion and construction joints of water retaining structures in RCC shall be made watertight using PVC ribbed water stops with central bulb. However, kicker type (externally placed)



PVC water stops may be used for the base slabs and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 6mm and minimum width 225mm. At other joints these shall be 150mm wide.

Two part polysulphide sealant conforming to IS:12118 shall be used for sealing of joints in contact with water. For other cases, bitumen sealing compound conforming to IS:1834 shall be used. Dura board HD100 or its equivalent shall be used as joint filler.

6.10.00

Brick / Stone Masonry And Parapet Wall

All masonry works shall be designed in accordance with IS:1905, IS:2212, IS:4326, IS:2185 and other relevant IS codes as applicable. Structural design of load bearing and non load bearing walls constructed with fly ash bricks shall be in accordance with criteria specified by section-4 of National Building Code of India, Part-VI and codal provisions.

All walls shall be non-load bearing in filled panel walls. External walls of all buildings shall be atleast one brick thick. All internal walls shall be atleast one brick thick except for internal partition walls for office area, canteen, change room, first aid rooms and toilets, which may be half brick thick. RCC bands (transoms and mullions) shall be provided wherever necessary to curtail the unsupported length / width of the wall.

50mm thick DPC (1:1.5:3) with water proofing admixture shall be provided at plinth level before starting masonry works.

Bricks having minimum 75 kg/sq.cm compressive strength shall be used for non-load bearing superstructure brick work. Cement and sand mortar 1:5 for one brick thick wall and 1:4 for half brick thick wall shall be used. For half brick walls, RCC transoms and mullions shall be provided. Transoms shall be provided at lintel / door height. The spacing of mullions shall not exceed 2000 mm centre to centre. The size of transoms / mullions shall be minimum 115mm square with four numbers, 8 mm dia bars and 6mm stirrups 150 mm centers.

Type, thickness and height of external wall, facing the transformer yard to take care of fire accidents in transformer yard shall be according to the requirements of Tariff Advisory Committee.

Even where metal cladding is specified, for initial 3m height from the ground level, minimum one brick thick masonry wall shall be provided.

All upstands and parapet walls on roof shall be of RCC construction, minimum height of parapet walls shall be 750mm and thickness 125 mm.

6.11.00

Waterproofing Of Underground Structures

All underground structures like water retaining structures, track hoppers, transfer house, conveyor tunnel & other deep underground structures etc., shall have plasticizer cum water proofing cement additives conforming to IS:9103. In addition, limits on permeability as given in IS:2545 shall also be met with.



All water retaining structures shall be hydro tested as per IS 3370 for leakage & in case leakage is noticed pressure grouting or any other approved method shall be used to rectify the same.

The concrete surface of these structures in contact with soil shall be provided with water proofing treatment as stated below.

- i) For base slab, a layer of PCC 1:4:8 shall be laid. Over PCC layer, 25mm thk CM 1:3 mixed with approved water proofing compound at the rate specified by the manufacturer shall be applied. Over this two coats of acrylic polymer modified cement based flexible water proofing membrane of approved make laid as per manufacture's and instruction. Over water proofing membrane, 25mm thk CM 1:3 mixed with approved water proofing compound at the rate specified by the manufacturer shall be provided over which protective layer of 15mm thk kota / cuddapa or equivalent stone with joints sealed with C1:3 shall be laid. Over this stone layer, 25mm thk CM 1:3 mixed with approved water proofing compound at the rate specified by the manufacturer shall be applied before RCC base slab shall be casted.
- ii) For side walls, two coats of acrylic polymer modified cement based flexible water proofing membrane of approved make laid as per manufacture's specification and instruction shall be applied to the sides of RCC walls. 25mm thk CM 1:3 mixed with approved water proofing compound at the rate specified by the manufacturer shall be applied over it. Protective layer of 15mm thk kota / ciddapa or equivalent stone with joints sealed with CM 1:3 shall be laid. Finally 25mm thk CM 1:3 mixed with approved water proofing compound at the rate specified by the manufacturer shall be applied.

For all other foundation & pedestal work below ground coming in contact with soil, bituminous painting of grade 85/25 conforming IS 702@ 1.7 kg/ sqm.(min)

6.12.00

Miscellaneous Requirements

Doors and windows on external walls of buildings shall be provided with RCC sunshade over the openings With 300 mm, projection on either side of the opening. Projection on sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings.

Doors and windows on the external walls of buildings with metal cladding shall be fixed by creating recesses in the cladding system.

No cable trenches shall be provided in TG hall, Boiler/ESP area, fuel oil pump house, Ash pump houses etc.

Duct banks consisting of MS/PVC conduits for cables shall be provided with proper sealing arrangement consisting of fire retardant sealing compound.

All floor openings for cables below electrical panel shall be sealed with fire sealing compound after cables are laid.



All openings in external walls provided for pipes, cables, duct etc. shall be effectively sealed to prevent water seepage, after the routing of the services are completed.

Natural lighting & Ventilation.

The area of windows shall be a minimum 15 % of the floor area to ensure adequate natural lighting. Fans shall be provided in general office areas as per standard norms. Sewerage system shall be provided with adequate ventilation for the pipe work as well as manhole.

6.13.00

Statutory Requirements

All the applicable statutory rules pertaining to Indian Factories act, Factory rules of State Government, Fire safety rules of Tariff Advisory committee, Water act of Pollution Control boards, Explosives act, Environmental requirements etc., and stipulations of other relevant statutory authorities shall be taken into consideration at the time of design and construction.

Provisions of safety, health and welfare according to Factories act shall be complied with at design stage. These shall include provision of continuous walkway (minimum 750 mm wide) along crane-girder at crane girder level on both sides of the building, comfortable approach to **EOT** crane. cabin, railings, fire escape locker room for workmen, pantry, toilets, rest rooms etc.

Adequate no. of fire escapes shall be provided in a building. Fire proof doors, no. of staircase, fire separation walls, lath plastering on structural steel member (in fire prone areas) shall. be made according to the recommendation of TAC.

Obtaining statutory approval clearance/ license from relevant agency will be within the scope of EPC Contractor.

For fire safety requirements of buildings IS: 1641 and IS: 1642 shall be followed in addition to TAC requirements. All masonry firewalls shall be minimum 345 thick and RCC firewall shall be minimum 200 mm thick.



7.00.00 MATERIAL

7.01.00 Structural Steel

Steel will conform to Grade-A of IS:2062 (latest) for rolled steel members or plates upto 20 mm thickness. For plates above 20 mm thickness and welded construction steel conforming to Grade-B (killed and normalized) of IS: 2062(latest) shall be used except for crane girders where Grade-C (IS: 2062) steel shall be used. Steel shall be procured from SAIL or any other approved main producers.

Chequered plate shall conform to IS: 3502 (latest) and minimum thickness of chequered plate for floorings, covers etc shall be 8 mm O/P.

Bottom 1.0 M of cylindrical portion and entire conical portion of bunker in mill building shall be provided with lining of atleast 6mm thik SS plate grade SS 316L.

The electrodes classification as per AWS shall be as follows:-

- a) For welding of stainless steel to stainless steel : E308L
- b) For welding of stainless steel to mild steel : E309

7.02.00 Cement

Ordinary Portland Cement (OPC) shall be used for all structures except for foundations, under ground structures & structures coming in contact with sea water where in sulphate resistant cement with C3A content limited to 5% to 8% shall be used. Grade of cement shall be 43 conforming to IS: 8113.

7.03.00 Reinforcement

The reinforcement used shall be cold worked steel high strength deformed bars of grade Fe 415 / Fe 500 conforming to IS:1786 – latest.

Fusion bonded epoxy coated reinforcement steel with coating conforming to IS:13620 shall be used for the complete project.

Intermixing of different grades of rebars or rebars of different material composition in same structure shall not be allowed.

Welding of reinforcement shall not be carried out without the permission of the Owner.

Projecting reinforcement or dowel bars for future connection of the structural works shall be protected by cement paint, if they are to be left exposed for a long time.



9.00.00 STEEL STRUCTURE

9.01.00 Framing

All steel framed structures shall be either “rigid frame” or “simple space frame” or a combination of two.

Lateral forces shall be resisted by stiff jointed moment connections in rigid frame design. The column bases shall generally be fixed to concrete foundation pedestal by providing moment resistant base detail.

The power house building design shall be a combination of rigid frame in transverse direction and simple frame in longitudinal direction.

If RCC floor / roof is assumed to act as diaphragm transmitting lateral loads to braced bays, it shall be provided with shear connectors. However, whenever large / more number of cut-outs are provided in the floor slab, horizontal floor bracings shall be provided below slab to transfer horizontal force to columns without considering diaphragm action from slab.

Floors for vibrating machines of all kind together with supporting framework shall be adequately braced in both horizontal and vertical planes. Floors or structure supporting mechanical equipment shall be designed to minimise vibration, avoid resonance and maintain alignment and level.

9.02.00 Design Concepts

Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc. Criticality of erection / maintenance loads shall also be checked separately in combination with other simultaneously occurring loads for possible design loadings.

The different load combinations shall be taken as per IS:875 (Part-5) and other relevant IS Codes.

- a. Wind and seismic forces shall not be considered to act simultaneously.
- b. For the design of main plant structures during seismic condition, the deaerator feed water tank shall be considered full upto operating level. However, for other load combinations, deaerator feed water tank in flooded condition shall also be considered.
- c. In the analysis of main plant building & bunker building, the stresses arising due to temperature shall be considered.
- d. ‘Lifted load’ of crane shall not be considered during seismic condition.
- e. In case two cranes are provided and tandem operation is not envisaged, the load shall be taken as one crane fully loaded and second crane without lifted load but standing idle adjacent to first crane.



- f. In case two cranes are provided and tandem operation is envisaged for some bays, then the load shall be taken as both the cranes fully loaded and standing side for these bays. For other bays, load shall be taken as one crane fully loaded and second crane without lifted load but standing idle adjacent to first crane.
- g. Permissible stresses for different load combinations shall be taken as per relevant IS codes.
- h. For the design of pipe / cable supporting structure, the soil weight shall be considered as backfilled upto grade level for the condition of pipe running full / cables in position.
- i. Frictional force between the pipes and supporting structure in longitudinal direction need not be considered along with seismic or wind forces.

The design of steel structures shall be done by working stress method. Design shall be as per provision of IS:800 (latest) and other relevant IS standards. For design of coal bins and loading hopper IS:9178 (Part I to III) shall be followed.

Roof decking sheets shall be designed as per IS:801 to carry the self load, dead load due to RCC slab and finishes and imposed load. The deflection of metal deck shall be limited as per BS:5950. In case composite action is considered in the design, suitable shear studs shall be provided as per BS: 5950.

Permissible stresses for different members shall be allowed to exceed upto 33.33% only under normal loads along with wind and seismic conditions. The members which are designed primarily to resist wind load such as bracing members, no increase in permissible stress will be permitted. However, permissible stresses in bolts and welds shall be allowed to exceed up to 25 % only under wind and seismic conditions.

For design which requires the use of the minimum column load (such as, uplift on anchor bolts, column axial tension, etc.) the following criteria shall be used in determining minimum load: Use 90% of the column dead load, No live load is used, Uplift forces from vertical bracing are included where applicable and Wind uplift on the roof is included where applicable.

Base plates shall be placed on foundation pedestal with grouting. For large base plates necessary grout holes shall be provided. All anchor bolts for fastening steel columns on foundation shall be embedded in foundation during concreting itself. No anchor pockets in foundation shall be allowed. Design of base plates shall be based on design pressure on foundation which shall not exceed the following:

Pedestal in concrete grade M20	5.0 N / sq.mm
Pedestal in concrete grade M25	6.25 N / sq.mm
Pedestal in concrete grade M30	7.5 N / sq.mm

The total horizontal shear force at the base of column is transferred to the column pedestals through friction between the base plate and the grout. A coefficient of



friction of 0.30 shall be used in conjunction with the minimum column load as defined above. If the horizontal shear force exceeds the frictional resistance force or if the column is subjected to a net uplift load, the total force shall then be transmitted through shear bars / shear keys welded to the base plate. Anchor bolts are not assumed to resist any horizontal shear force. Necessary recesses shall be kept in the foundation concrete for shear lugs.

Welding shall be used for fabrication and erection. Site connections shall generally be with welding. However, high Strength Structural (HSS) bolts shall be used for all important connections to be decided during detail engineering stage. In few cases, for shear connections or removable beam connections, bolted joints with MS bolts may be adopted. For HSS bolt connection, IS:4000, IS:3757, IS:6623 and IS:6649 shall be followed. IS:814, IS:816, IS:1024, IS:4353 and IS:9595 shall be followed for welding of structures.

Trestles supporting coal conveyor galleries shall be so proportioned that the transverse deflection of trestles due to wind / seismic load shall not exceed trestle height / 1000 as stipulated in IS:11592.

In the case of galleries, temperature expansion joint shall be introduced at intervals less than 90 m to divide the galleries into temperature block. In each block at least one number four legged rigid support guaranteeing stability of structure in the longitudinal direction shall be provided. This shall also take care of all longitudinal forces in the given block. Effect of wind load acting on 2-legged trestle shall also be considered while designing the 4-legged trestle.

Base plates for trestles shall be designed as gusseted bases with shear lugs to transfer horizontal forces. Anchor bolts shall be designed only for uplift forces.

Anchor fasteners shall not be used for supporting equipment imparting dynamic forces.

Pedestals supporting gravity take-up shall be designed to resist 100% impact.

For calculation of coal load on moving conveyor, a multiplication factor of 1.6 shall be used to take care of inertia force.

- a) Conveyor gallery structure & trestles shall be designed considering both conveyors operating simultaneously.
 1. Dynamic analysis of conveyor galleries and conveyor supporting system shall be carried out for spans greater than 25m.
 2. All structures close to railway line shall have clearances conforming to Railway norms.

Transverse coal pressure on Bunker/ Silo / Hopper walls shall be calculated using Walker's theory and IS:9178. The Coal Bunker / Silo / Hopper shall be designed for the following conditions.



- i) The Bunker / Silo / Hopper is full up to its full capacity with top surface nearly horizontal.
- ii) The Bunker / Silo / Hopper is partially empty with the top surface of coal at an angle of repose of 37 degrees.

Design pressure on coal bunker / hopper walls shall take into account all possible flow regimes (core flow, mass flow, etc.), and different aeration regimes (radial, diametrical, radial and core, impulsive etc.)

9.03.00 Permissible Deflections

The permissible deflections of various steel members under normal loading conditions shall be as specified below. For calculation of deflections in structures and individual members dynamic effects shall not be considered, unless specified otherwise. Also, no increase in deflection limits shall be allowed when wind or seismic load are acting concurrent with normal loading conditions.

9.04.00 Vertical Deflection

- 9.04.01**
- a) For beams supporting dynamic equipment : Span / 500
 - b) For beams supporting floors / masonry : Span / 325
 - c) For beams supporting pipes : Span / 400
 - d) For roofing and cladding components : Span / 325
 - e) For gratings and chequered plates : Span / 200 subject to a maximum of 6 mm
 - f) Coal/ Ash conveyor gallery bridges : Span / 450

9.04.02 For crane gantries or any member subjected to working loads, the maximum deflection under dead load and live load excluding impact shall not exceed the following values:

- a) For manually operated cranes & monorails : Span / 500
- b) For electric overhead cranes
 - i) Up to 50 t capacity : Span / 750
 - ii) Over 50 t capacity : Span / 1000

9.05.00 Horizontal deflections

The permissible horizontal deflections shall be as per following unless specified otherwise:

- a) Single storey building (without crane load) : Height / 325
- b) Multistoried building (without crane load) : Height / 500



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

c)	Pipe rack columns	:	Height / 200
d)	Crane gantry girder due to surge	:	Height/200
e)	Building main columns at crane rail level due to action of crane surge load only	:	Height / 2500 limited to maximum of 10 mm
f)	Open gantry columns at crane rail level due to action of crane surge load only	:	Height/4000 limited to maximum of 10 mm
g)	Open structures	:	Span / 2000 Limited to Maximum of 15mm
h)	Coal handling trestles	:	Height / 1000

9.06.00 Provisions of IS: 800 and relevant IS Code shall be followed for limiting deflections of structural elements not listed above.

9.07.00 MINIMUM THICKNESS OF STRUCTURAL STEEL ELEMENTS

The minimum thickness of various components of a structure and hot rolled sections shall be as follows. The minimum thickness of rolled shapes shall mean flange thickness regardless of web thickness. Structural steel members exposed to significantly corrosive environment shall be increased suitably in thickness or suitably protected otherwise as per good practice and sound engineering judgement in each instance.

a)	Trusses, purlins, girts and bracing	6mm
b)	Columns and beams	8mm
c)	Guessets	8mm
d)	Stiffeners	8mm
e)	Base plates	10mm & above
e)	Chequered plates	8 mm o/p & above
f)	Grating flats	5 mm

Minimum thickness of structural members other than gratings directly exposed to weather and inaccessible for painting and maintenance shall be 8 mm.

9.08.00 Minimum Sizes

The flange width of purlins supporting light weight concrete slab shall not be less than 65 mm and for those supporting roof sheeting and wall cladding it shall not be less than 50 mm. Width of steel rolled section connected to other member shall be at least 50 mm. The depth of beams for platform of all structures shall not be less than 125 mm.



9.09.00

Slenderness and Depth Ratio

The slenderness ratio of main members in tension, compression or bending shall be in accordance with IS:800.

The following limiting ratios of depth to span shall be considered as a general guide.

a) Truss	1 / 10
b) Rolled beams and girders for ordinary floors and rafters	1 / 24
c) Supporting floor beams for vibrating machinery /equipment	1 / 15
d) Roof purlins and girts	1 / 45
e) Gable columns	1 / 30

9.10.00

Joints / Connections in Steel Structures:

9.10.01

Steel structures shall be detailed and connection and joints provided as per the provisions of IS:800, IS:9595, IS:1367, IS:9178 and IS:816 and as per following requirements:

- a. Connection of vertical bracings with connection members and diagonals of truss members shall be designed for full tensile capacity of the bracings unless actual loads are indicated on the drawings.
- b. Size of fillet weld for flange to web connection for built up section shall be as follows:
 - i) For box section weld size shall be designed for 60% of full shear capacity or actual shear whichever is more. Where fillet weld is not possible, full penetration but weld shall be provided.
 - ii) For built-up I section, weld size shall be designed for 80% of full shear capacity or actual shear, (if indicated in drawings) whichever is more. However, weld size shall not be less 0.5 times the web thickness. Weld shall be double fillet.
 - iii) All welds shall be continuous unless otherwise specifically approved. The minimum size of the fillet weld shall be 6 mm.
- c. Shear connections shall be designed for 70% of section strength for rolled sections and 80% of section strength of built-up section or rolled section with cover plates. However, if actual shear load is more than above, the connection shall be designed for actual load.
- d. Moment connection between beam and column shall be designed for 100% of moment capacity of the beam section. This can be achieved either by direct butt welding of the top flange of beam with column flange or by providing top moment plate with suitable notch for additional weld length.
- e. All bolts and nuts shall have property class compatible to each other. For bolts carrying dynamic or fluctuating loads and those in direct tension



shall be provided with an additional double coil helical spring washer conforming to IS:6755. The threaded portion of the bolt shall project through the nut at least by one thread.

- f) Where a steel beam or member is to be connected on RCC structure, it shall be connected using an insert plate and preferably through shear connection.
- g) All butt welds shall be full penetration butt welds.
- h) The connection between top flange and web of crane girder shall be full penetration butt weld. Bottom flange, connection with web can be fillet weld or butt weld as directed by Purchaser. Bearing edges of crane girders shall be machine finished.
- i) Connection of base plate and associated stiffeners with the columns shall be designed considering the total load transferred through welds. However, minimum weld size (double fillet) shall not be less than 0.6 times the thickness of stiffeners.
- j) Splicing: All work shall be full strength. Field splicing shall be done with web and flange cover plates for full strength. In exceptional cases, the field splicing shall be designed for 50% of load carried by the cover plates and remaining 50% load through full penetration butt weld. Shop splicing for all sections other than rolled shall be carried out by full penetration butt welds with no cover plates. Splicing for all rolled sections shall be carried out using web and flange cover plates.

9.10.02 All bolted connections shall have bolts of minimum 16 mm dia. The connections of stairs and hand railing shall be made with 20 mm diameter threaded fasteners conforming to IS:1363. Erection bolts shall be black bolts of minimum 12 mm dia.

9.10.03 Efficiency of site welds to be considered shall be as follows:

- a) Butt weld above 25 m from ground --- 50%
- b) Others --- 80%

9.11.00 Specification for Painting of Steel Structures / Material

Refer Volume-VI, Part-B



10.00.00 REINFORCED CONCRETE STRUCTURES AND FOUNDATIONS

10.01.00 General

All structures, building foundation, machines / equipment foundation, water retaining structure, trenches, pits, etc., shall be designed as per relevant IS codes in general. Construction in general shall follow provisions of IS :456 and IS:3370 for normal and water retaining structures respectively

10.02.00 Design Methodology

- a) The design and construction of RCC structures shall be carried out as per IS: 456-2000. Working stress method shall be adopted for the design wherever specifically mentioned in this specification.
- b) For all concrete structures, ductile detailing has to be done as per IS: 13920 and IS: 4326.
- c) For reinforcement detailing, IS: 5525 and SP34 shall be followed.
- d) Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150mm or more.

10.03.00 Foundation and Underground structures

- a) Foundation system to be adopted for structures shall be based on loading arrangement , load intensity and soil strata.
- b) All RCC liquid retaining / conveying structure / slurry pump house / underground structures, such as conveyor tunnel, reclaimer hooper pit, etc., shall be designed in accordance with IS:3370 (Part 1 to 4) . For under ground structures not in contact with liquid on inside face may be designed as cracked sections with crack width limited to 0.1mm for both faces.
- c) All liquid retaining / carrying structures shall be tested for water tightness as per the provisions of IS:3370 and IS:6494 and in case of leakage, the same shall be rectified by chemical injection grouting through nozzles.
- d) Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest. Co-efficient of passive earth pressure shall be used only in design of shear keys for stability against sliding.
- e) In all liquid retaining structures , pvc water bar shall be provided at each construction / expansion joint. No pressure relieving devices shall be permitted in underground structures except forebay.
- f) For design of all underground structures, including CW ducts, pump house and forebay etc. ground water table shall be assumed at the finished ground level unless specified otherwise. In addition to ground water pressure, minimum



surcharge load of 2 T/M² shall also be considered for design of all underground structures.

- g) All building sub-structures including pump houses shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factor of safety for these cases shall be as per IS:456 and other relevant IS codes. However, following minimum factor of safety shall be followed,
 - a) Factor of safety against overturning due to wind, seismic or other lateral load shall be 1.5 minimum.
 - b) Factor of safety against sliding shall be 1.5 minimum.
 - c) Factor of safety against uplift due to hydrostatic forces shall be 1.2 and due to any other loads shall be 1.5.
- h) In cases where dead load provides the restoring forces, only 0.9 times characteristic dead load shall be considered. Imposed loads shall not be considered as restoring force.

10.04.00 Grouting

- i) Non-shrink flowable grout shall be used for under pinning work below base plate of columns. Non-shrink cum plasticiser admixture shall be added in the grout. For grouting of base of machine foundation high strength flowable ready mixed non-shrink grout shall be used.
- ii) Type and grade of grouting for structural columns and equipment bases shall be indicated. Crushing strength of the grout shall generally be one grade higher than the base concrete. Minimum grade of grout shall be M30.
- iii) Nominal thickness of grouting shall be at least 50 mm for building columns and pedestals of major equipment. For secondary posts, stair and ladder base, etc. grouting shall not be less than 25 mm thick.

10.05.00 Edge Distance For Bolts

Minimum distance from the center line of foundation / anchor bolt to edge of pedestal shall be the maximum of the following:

- i) Clear distance from the edge of base plate / base frames to the outer edge of the pedestal shall be minimum 50 mm.
- ii) Clear distance from the face of pocket to the outer edge of pedestal shall be 75 mm.
- iii) Clear distance from the face of pocket to the outer edge of pedestal shall be 75 mm.



10.06.00 Loading conditions for underground structures

Following loading conditions shall be considered in addition to the loading from super structure for the design of substructure of pump house, channels, sumps, tanks, trenches and other underground structures containing liquid.

- a. Water pressure from inside and no outside pressure, like earth pressure, ground water & surcharge pressure (applicable only to structures which are liable to be filled up with water or any other liquid.)
- b. Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.
- c. Design shall also be checked against buoyancy due to the ground water during construction as well as after construction stages. Minimum factor of safety against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loadings. Provision of pressure relief valves / flap valves, etc. may be considered only in forebay of CW Pump House to counter the buoyancy. When pressure relief valves are used, 60% of the hydrostatic pressure shall be considered for design of the base slab.
- d. Base slab of the pump houses shall also be designed for the condition of different combination of pump sump being empty during maintenance stages with maximum ground water level.
- e. Intermediate dividing pier of pump sumps and partition wall (if applicable) in channel shall be designed considering water on one side only and other side being empty for maintenance.
- f. All pump houses and other substructures (wherever applicable) shall be checked for stability against sliding and overturning during construction as well as operating conditions for various combinations of loads.

10.07.00 Machine Foundations

The design of equipment foundation shall be as per IS: 456 and IS: 2974. The provisions of DIN 4024 shall also be followed for machine foundations.

10.07.01 All machine / equipment foundations and structures subject to vibrations shall suitably proportioned so that amplitude and frequency of the foundation / structures are within permissible limits.

10.07.02 All block foundations resting on soil shall be designed using the elastic half space theory or Barkens theory. Block foundation resting on piles shall be designed using Novak's theory or Barken's theory. The mass of the RCC block shall not be less than three times mass of the machine and the CG of the combined mass of foundation and equipment should pass through the CG of the base area with tolerance not more than 5%. Dynamic analysis shall be carried out to calculate natural frequencies in all modes including coupled modes and to calculate vibration amplitudes. Frequency and amplitude criteria as laid down by the relevant codes or



machine manufacturers shall be satisfied. Minimum reinforcement shall be governed by IS: 2974 and IS: 456.

10.07.03

For the foundations supporting minor equipment weighing less than one ton or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structures, floors, etc. suitable vibration isolation shall be provided by means of springs, neoprene pads, etc. and such vibration isolation system (VIS) shall be designed suitably.

10.07.04

a) For the foundation of Turbo-generator, Boiler feed pumps, Fan (ID, FD and PA), Mills etc., detailed static and dynamic analysis shall be done. The static analysis shall include all operating conditions, load cases and abnormal loads like short circuit, loss of blade, unbalance and seismic forces. Unbalance loads for normal operating condition as given by machine manufacturer and / or VDI 2060 whichever is more conservative shall be used for calculating dynamic response. The dynamic analysis. Transient analysis shall be carried out for the short circuit condition with an appropriate force function. Frequency separation criteria and amplitude criteria as laid down in IS: 2974 and / or DIN 4024 and / or VDI 2056 and / or as required by the machine manufacturer, whichever is more stringent shall be satisfied. RCC design shall be done by working stress method for all machine foundations. A fatigue factor of 2.0 shall be considered for dynamic forces. Minimum reinforcement shall be governed by IS:2974 as well as IS:456. However minimum reinforcement in bottom face of the foundation raft resting on soil or pile shall not be less than 0.2% of effective cross sectional area of the raft.

The special requirements for concreting including grade, type of aggregate, use of admixture, temperature control, ultrasonic testing, etc. shall be as mentioned elsewhere in this specification.

b) All block foundations supporting rotating equipment resting on soil or piles shall be designed using the elastic half space theory. The mass of the RCC block shall not be less than three times the mass of the machine. Dynamic analysis shall be carried out to calculate natural frequencies in all the modes including coupled modes and to calculate vibration amplitudes. Frequency and amplitude criteria as laid down in the relevant codes and / or by machine manufacturer whichever is more stringent shall be satisfied. Minimum reinforcement shall be governed by IS: 2974 and IS: 456. Minimum Reinforcement in base raft in either direction shall be as follows:-

i)	At bottom face	0.2% of gross cross-sectional area.
ii)	At top face	0.12% of gross cross-sectional area.

c) For the foundations supporting minor rotating equipment weighing less than one tonne or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structure, floors, etc. suitable vibration



isolation shall be provided by means of springs, neoprene pads, etc. and such vibration isolation system shall be designed suitably.

- d) BFP, Mill, PA, FD & ID fan foundations shall be supported on vibration isolation system. The vibration isolation system shall consist of steel helical spring units and viscous dampers supporting the RCC deck which would support the machine. The spring units shall conform to DIN 2089 and DIN 2096.
- e) GERB or equivalent manufacturer's vibration isolation system shall be supplied for supporting machines like TG, BFP, Mill, PA, FD & ID fan.
- f) Isolation efficiency of at least 90% shall be provided for the Turbo generator, ID fan foundations.
- g) All approved drawings of equipment foundations shall be vetted by execution agency of civil works in order to match between the equipment sizing and foundation.

10.08.00 Increase in Stresses

10.08.01 Where stresses due to wind (or seismic) and temperature are combined with those due to other loads, the allowable stresses in concrete and reinforcement steel shall be increased by 33.33% in case of working stress design.

10.08.02 Bearing capacity of the soil / pile capacity shall be allowed to increase by 25% under seismic / wind load condition except for chimney where increase in bearing capacity/pile capacity is not considered.

10.09.00 Minimum thickness of structural elements:

The following minimum thickness shall be followed:

Flat roof slab	:	125 mm
Suspended floor / slab / walkways / canopy slabs etc.	:	150 mm
Ground floor slab (non-suspended)	:	200 mm
Water retaining slabs / walls	:	200 mm
Cable / pipe trenches / underground pits / Launder walls and base slab	:	125 mm
All footings (including raft foundations)	:	200 mm
Parapets	:	125 mm
Sunshades at edge	:	75 mm
Pre-cast louvers / fins	:	50 mm



Pre-cast trench cover slabs / floor slabs / louvers	:	75 mm
Paving	:	200 mm
Basement walls and base slab	:	200 mm
Silo / bin walls	:	150 mm
Underground reservoir:		
Below ground	:	200 mm
Above ground	:	150 mm

10.10.00 From fire resistance point of view minimum thickness of reinforced concrete members shall be as per fig. 1 or table 16a of IS:456.

10.11.00 MINIMUM HEIGHT FOR PEDESTALS / ENCASEMENT OF STEEL COLUMNS

10.11.01 Pedestals to steel columns for building structures

In case the top of pedestal is kept at a lower level so that the column base plate together with gussets and stiffeners remain below finished floor level (FFL) the column bases as well as the column sections shall be encased in concrete above FFL as per following:

- a. Open area : 500 mm above paved level
- b. Covered area
 - Internal Column : 1000 mm above FFL
 - Peripheral Column : 500 mm above FFL

Stair and ladder pedestal shall be kept 500 mm above the finished floor level.

Boiler structure supporting steel columns will be encased upto scarper feeder top level.

10.11.02 Pedestals to steel columns for equipment structure:

- a. Equipment in open area : As required (300 mm min.)
- b. Equipment in covered area : As required (150 mm min.)
- c. Structures and equipment : As per vendor's data subject to supplied by vendor minimum as specified above.

Dense and durable concrete with controlled water cement ratio preferably 0.45 shall be used for all underground concrete structures such as foundations, basements, pump



houses, water retaining structures, cable and pipe trenches etc. for achieving water tightness and durability.

All foundation, embedments, inserts, block-outs etc. required for equipment shall be provided by the Bidder.

Fly ash bricks shall be used for masonry work. Bidder shall ascertain himself at site regarding the availability of fly ash bricks of minimum 75kg/cm² compressive strength before submitting his offer.

Aluminium nosing shall be provided for edge protection in RCC stairs.

Wherever possible around floor openings an RCC kerb of 100 mm wide 150 mm high shall be provided. All concrete edges, where breakage of concrete corners expected shall be provided with angles of minimum size L 50x50x6 with lugs for edge protection e.g. all round the cut-outs I openings in floor slab, edges of drains supporting grating covers, edges of RCC cable I pipe trenches supporting covers, edges of manholes supporting covers and supporting edges of precast covers etc.

All cables & pipes in outlying area shall run above ground over steel trestles or other supporting structures for easy inspection & maintenance except in transformer yard area and some other localized area where the same can run in RCC trenches. However, for facilities for which buried pipe & cables are permitted by Purchaser, the same can be provided. In case of trestles, minimum 7.0 m head clearance shall be provided for road crossings. In other areas, the clear height shall be 3.0m minimum.

All cable and pipe trenches shall be of RCC of minimum M25 grade. Trenches located outside buildings shall project at least 200mm above the finished formation level so that no storm water shall enter into trench. The bottom of the trench shall be sloped suitably for draining out the collected water into sump pit. The pre-cast covers shall be of minimum M25 grade and shall not weigh more than 65kg. Lifting hooks shall be provided in the pre-cast covers. Pre-cast covers shall have edge protection angles at top and bottom on all the four sides along with lugs.

All construction drawing furnished by Bidder shall consist of total quantity of concrete (grade-wise), reinforcement steel (diameter wise) and structural steel (Section – wise).

Duct banks consisting of PVC / GI conduits for cables shall be sealed using approved fire retardant sealing compound.

All water retaining structures designed as un-cracked section shall also be tested for water tightness at full water level in accordance with IS:3370 (Part – I) and IS:6494.

10.12.00 Formwork Requirements

Refer Volume-VI, Part-B.

10.13.00 The number of construction joints in the columns of steam turbine foundation shall be restricted.

Construction joints at the following three locations shall be provided:

- a) At the meeting points of the columns and the raft.



b) At the meeting points of the column and the top deck.

Additional reinforcement and shear keys shall be provided at the construction joints.

The base raft for steam turbine and GT foundation and table top for steam turbine shall be cast in single pour.

Mild steel bars required for earthing / grounding mat shall also be supplied and installed.

All cable vaults shall be located above ground level i.e. cable vaults shall not be provided as basements in the buildings. Minimum clear height below beam bottom shall be 2200mm in all cable vaults.

Connection work at terminal points is included in the scope of the Bidder.

All transformer / shunt reactor foundations shall be designed as per relevant IS Codes. This will include collection of oil, drainage of oil along with rainwater collected in such foundation.

Ground floor slab of all the building and RCC paving shall be of minimum 200mm thick of M-20 grade laid over minimum 75mm thick PCC and 230mm soling (minimum) course unless specifically mentioned otherwise. The reinforcement shall consist of minimum 8mm diameter bars at 200 mm c/c of grade Fe 415 at top and bottom in both directions.

10.14.00

Concrete Mix

The following minimum grades of concrete as per IS:456 shall generally be used for the type of structures noted against each grade.

a.	Grade M15	:	Fill concrete
b.	Mix (1:4:8)	:	Foundation below brick wall, blinding layer below foundations, trenches and underground structures, minimum thickness of the layer shall be 75 mm.
c.	Grade M20	:	Base plate encasement, pavement around building including plinth protection work, encasement of structural steel work, grade slab & grade beams etc.
d.	Grade M25 & M30	:	Chimney raft and all RCC members, e.g. foundation and superstructure, pedestals, roof slabs, cable and pipe trenches, water retaining structures, cooling water channel, CWPB forebay, raft & sump etc.



- e. Grade M35 : TG foundation, TG top deck, chimney shell etc. and for structures coming in contact with sea water.

For superstructure of RCC chimney and natural draft cooling towers richer mix may be used as per design requirement. However, requirement of Table-4 & 5 of IS:456 shall be satisfied as per the exposure condition. As per IS:456, exposure condition will be “severe” for all structures under the civil scope of work except for sea water intake well and pump house, cooling tower, CWPB forebay & sump etc. coming in contact with sea water, where in exposure condition shall be “very severe”.

Washing and screening of coarse and fine aggregates to remove fines, dirt or other deleterious materials shall be carried out by approved means, if desired by the Engineer-in-charge.

The water cement ratio by weight shall be 0.45 maximum including free moisture in the aggregate and slump should be suitably decided to provide good quality concrete work.

10.15.00 Special Painting For Sea Water Structures

All concrete surface coming in contact with sea water will be painted with 1.5 mm thick polyurea coating meeting ASTM D-16, Type V (two component, chemical cure). This will be applicable for pump house, Natural draught cooling tower and CW pump house forebay and sump, Clarified Water reservoir, Guard pond, Fire water sump, RO stage I Permeate Tank etc.

For NDCT inside surface special painting shall be provided upto 2.0m above drift eliminator level.

10.16.00 Allowable Settlement

The total permissible settlement and differential settlement of the foundations will be governed by IS:1904, IS:13063 and from functional requirements whichever is more stringent.

Maximum allowable total settlement should be restricted to 25 mm for foundations of all plant structures like cooling towers, CW pump house, DM plant, crusher house, transfer house etc.,

Maximum allowable total settlement should be restricted to 40 mm for all other foundations.

All foundations shall be so designed that the settlements are within permissible limits as per relevant Indian Standard or from consideration of safe equipment / machine operation whichever is critical. In case of open foundations without piles, Ground improvement methods opted by contractor, like sand drains / stone columns etc. to reduce settlement and increase the rate of settlement, detail methodology of such installation supported by calculation based on relevant field data shall be furnished for approval of Owner / Consultants before execution. In the event, the contractor adopts any patented method of ground improvement or retain any specialized agency for such purpose, the same can be done subject to prior approval of owner.



Boiler and ESP support structures shall be checked for differential settlement of foundations which shall be restricted to 1 in 1000 of span or 8 mm whichever is less.



2 x 660 MW Ennore SEZ Supercritical Thermal
Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14
Vol. VI : 64



11.00.00 DESCRIPTION OF BUILDINGS, STRUCTURES AND OTHER FACILITIES.

11.01.00 TEMPORARY STRUCTURES FOR EXECUTION

11.01.01 Construction water:

The OWNER shall provide water at one point within the plant boundary or a limited purpose such as for construction. The Contractor may avail this facility. Necessary charges for drawing the water shall be borne by the CONTRACTOR.

11.01.02 Construction Power

Construction power will be made available at a single point, metered and supplied on chargeable base by the owner. Further extension of power line to the various locations required shall be executed by Contractor at his cost. Contractor has to make provision of D.G sets as standby power source. This is especially in the case of structure involving deep dewatering as well as where uninterrupted concreting has to be resorted to. The bidder along with his bid shall indicate his average and peak power demand.

11.01.03 Temporary site buildings

The Contractor shall provide for at his cost the following building facilities for proper execution and quality control of the job, while meeting the provision stipulated by Factory Rules regarding staff welfare facilities. All these buildings shall have brick cladding, Steel / AC sheet roofing over steel roof truss with cement concrete flooring and false ceiling with A/C as required.

a) **Site office for Owner**

The site office shall make a provision of about 700 sqm of office area with A/C and false ceiling for the use of Owner / Owner's representative in addition to the Contractor's requirement. Additionally an A/C Conference room to accommodate about 70 people shall also be provided in the site office complex for the Owner's use. In addition to these, basic facilities like toilet for gents and ladies, potable water tanks, soak pit and septic tank for sewage disposal shall also be provided. Covered parking area for parking 10 cars shall also be provided for Owner's use. EPC Contractor to ensure that finished site office is handed over to owner within 3 months from the date of taken over the site by Contractor

b) **Stores**

A covered store shall be provided with brick cladding and G.I./colour coated sheeting to store at least one month requirement of cement. Cement in bags shall be stored on a raised floor well away from outer walls and insulated from the floor to avoid moisture. Not more than 15 bags shall be stacked in any tier. Each consignment of cement shall be stored separately and consumed in its order of receipt.

Covered storage area may also be provided to store other construction material which will be affected on exposure to wind, sun and rain.



Reinforcement shall be stacked on top of timber sleepers to avoid contact with ground / water.

Storage yard paved or unpaved shall be provided with in the stores complex for storage of other material.

Proper fencing and security arrangement shall be provided for the stores complex.

Contractor may consider using the existing building in the site with necessary repairs and restoration for use of this facility, provided the same does not interfere with construction of Permanent works.

11.01.04 Fabrication yard

Depending on the extent of fabrication envisaged at site, the CONTRACTOR shall establish a full fledged structural fabrication yard with adequate handling facility during and after the fabrication. A fully equipped testing laboratory providing radiography, ultrasonic, dye penetration, magnetic particle test facilities shall be ensured adjacent to the fabrication yard to enforce strict quality control. Portion of the yard shall have covered shed with H.O.T / E.O.T cranes so that fabrication work can proceed even during inclement weather.

11.01.05 Quality control laboratory

A fully equipped quality control laboratory shall be established at site with qualified personnel to conduct acceptance test on all construction material, weldments, concrete cubes etc. This laboratory shall be housed in a covered building with A/C facility as required by the testing facility. All testing equipment shall be periodically calibrated to the satisfaction of the OWNER. All testing shall be carried out in presence of OWNER. Finally the laboratory shall be handed over to OWNER in good condition after completion of project.

11.01.06 Fuel storage area

CONTRACTOR shall obtain necessary permission from competent authorities and establish and operate a POL outlet with proper storage, dispensing and adequate fire fighting facility.

11.01.07 Staff Welfare facility

CONTRACTOR shall provide adequate facility for his staff inside the plant boundary such as Toilets for both gents and ladies, Canteens, drinking water facility, rest places, creches etc.

Necessary approach roads to the construction facility complex and internal roads within the complex as well as proper drainage of the area shall be the CONTRACTOR's responsibility.

CONTRACTOR shall also provide for proper disposal of sewage and other wastewater to



meet with the requirement of Pollution Board.

CONTRACTOR shall identify sufficient area outside the plant boundary to locate his staff and labour colony. Construction and maintenance of the staff and labour colony to satisfy all statutory requirement is the sole responsibility of CONTRACTOR.

11.02.00

TURBINE GENERATOR BUILDING

Turbine building (TG bay and heater bay) framing shall be of structural steel with moment connected framing in the transverse direction and bracing in the longitudinal direction.

Service and maintenance bays shall not have any intermediate floors, however a 1500 mm wide observation gallery with handrails shall be given along the wall at the operating floor level to observe the TG erection operation. Intermediate floors shall preferably be provided at 8.50 m and operating floor at 17.0m. Floor at 8.50m and operating level shall be RCC floors over steel framing, where as the floor at any other level if required may have chequered plate supported on structural steel frame work.

Crane capacity and crane rail level shall be fixed based on the equipment to be lifted and the method of lifting generator stator. At crane girder top flange level a crane walkway shall be provided in line with factory rules. Access shall be provided to crane walkway through staircase from operating floor in addition to cage ladder at two ends. Bottom level of roof framing shall be decided by the crane clearance requirement duly taking into account clearance required for mounting light fixtures. Roofing shall consist of in-situ RCC slab of minimum 150 mm thickness laid to a slope of 1 in 100, constructed over permanently colour coated galvanized MS troughed metal sheet of approved profile supported on steel purlins and trusses. TG bay roof shall be provided with exhaust system.

Permanent colour coated sandwiched insulated metal cladding system from 3m (approx) above ground floor up to roof shall be provided on gable end and A row. Brickwork shall generally be provided from ground floor to 3m (approx) height. On other rows brickwork shall be provided upto roof level. Wall in front of transformers shall be of adequate thickness to satisfy "fire rating" as per TAC regulations. On the heater bay side the brick wall shall be provided upto 1m above deaerator floor level. Cladding beyond the above level shall of permanent colour coated sandwiched insulated metal cladding system.

Windows shall be side-hung steel glazed using 6mm thick wired glass generally. However in areas where cladding is of sheeting fixed glazing in anodized aluminium framework and in accessible areas sliding windows in anodized aluminium framework using 6mm thick wired glass shall be provided. All the doors on external walls shall be of double plate flush steel doors. For equipment entry into the service bay specially designed steel sliding cum / folding / rolling shutters shall be provided with appropriate operating mechanism. Rolling shutter shall also be provided in front of condenser to facilitate tube removal.

Staircase protected on all sides with fireproof enclosure shall be provided to satisfy LPA regulations. All the doors leading to the inside of the power house from staircase shall be automatically closing fire proof door satisfying LPA regulations. Access staircase shall be provided to TG building roof.



A roof shall be provided with roof water proofing treatment using high solid content liquid applied elastomeric water proofing membrane with separate wearing course as per ASTM-C-836 & 898. Thickness of the membrane shall be 1.5mm (min.). This treatment shall include application of polymerized mastic over the roof to achieve smooth surface and primer coat. Wearing course on the top of membrane shall consist of 25 mm thick PCC (1:2:4) cast in panels of maximum 1.2x1.2m size and reinforced with 0.56mm dia galvanized chicken wire mesh and sealing of joints using sealing compound/ elastomeric water proofing membrane. However, chequered concrete tile flooring 22mm (min.) thick of approved colour and shade conforming to IS:13801 shall be provided for path way of 1m width for access of personnel and handling of equipment and for the entire area of the roof where equipment like A/C ventilation plant, cooling towers, etc. are provided in place of PCC wearing course. Equipment shall be installed on raised pedestal of minimum 30 cm height from the finished roof to facilitate maintenance of roof treatment in future. HDPE rain water pipe of min. 150 dia OD conforming to IS:4984 shall be provided to drain off the rainwater from roof. They shall be suitably concealed from the façade.

Adequate no of roof extractors shall be provided As/mech layout details.

Thickness of structural RCC floor shall be minimum 150 mm above the steel floor beams for the intermediate floors with an additional 50 mm floor finish, which shall be provided later.

All the intermediate floors shall be provided with proper drainage. Catch pit with CI grills shall be provided near the internal column in a regular pattern and the floor shall be sloped towards the catch pit by varying the thickness of the bedding concrete for the floor finish. Catch pits shall be at the same co-ordinate for all floor levels. 80 NB galvanized MS pipes conforming to IS:1239 shall be provided to carry the drainage down. The pipes shall be clamped on to the intermediate column. Sumps shall be provided in ground floor to receive the water. Proper drainage arrangement shall be provided in the ground floor by means of RCC gravity channels with MS grills on top. The drainage shall be led to sumps from where the water shall be pumped to plant drainage, concrete kerb shall be provided to isolate the area and water shall be led through sump and channels to the floor drainage system. Oil water separator should be provided as required to isolate oil from the drainage water where the water is mixed with oil.

In operating floor the design live load shall be painted on the floors prominently showing the extent of the area where such loading is permitted.

Wherever openings are provided in the floor for handling of equipment using EOT cranes such openings shall be covered with gratings provided over removable steel beams.

Expansion joint shall be provided in the building to satisfy the requirements of IS:800 and IS:3414.

Suitable provision for future expansion shall be made by BIDDER while designing / executing the foundation system for last grid of main plant building.

In any case auxiliary columns shall not be supported on TG foundation. Preferably auxiliary columns shall be fabricated box section.



Separate Maintenance room for Turbine and Generator are to be provided.

11.03.00

CONTROL ROOM/ ELECTRICAL BAY STRUCTURE

The building framing shall be structural steel with moment connection in the transverse direction and bracing in longitudinal direction located by the side of turbine building. It shall be ensured that in front of control room no cross bracing is provided.

A minimum headroom of 3000 mm below beam bottom shall be given in the cable vaults. In control room false ceiling level shall be kept 4000 mm above furnished floor level

All floors shall be of deck RCC slab provided over structural steel beams with colour coated permanently laid deck sheet shuttering. Minimum uniform thickness of structural concrete above deck corrugation shall be 150 mm with an additional 50 mm provided for finish. Roof shall also be of in-situ concrete with colour coated permanently laid deck sheet shuttering. The concrete shall be given a slope of minimum 1 in 100 to effect proper drainage. No openings will be permitted on the roof of control room except possible opening for A/C duct to exercise proper control on air conditioning.

Cladding shall be of brick walls. Windows from switchgear room and control room / electronic cubicle room will not normally be allowed on the Boiler side to avoid coal dust nuisance. Walls shall normally be supported on wall/floor beams.

All the wall beams shall be provided with 50mm gunniting using Lugs and steel mesh.

Portion of the structural steel column projecting into the room shall be encased with brick masonry to shield it from fire hazards.

Cable vault in ground and second floor shall be provided with minimum 2 doors per unit. The doors shall be flush steel doors. No windows shall be provided on the turbine bay side

Switchgear room shall be provided with minimum two steel doors to satisfy statutory requirement. In addition a two leaf sliding doors of slush welded steel construction shall be provided to move the switchgears into the room making use of equipment lifting hatch provided in turbine building.

Main entrance to control room shall be provided with air locked lobby with automatic closing sliding glass doors. Lobby shall be formed of anodized aluminium framing with toughened sheet glass 6 mm thick. Partition between control room and adjoining rooms shall be of glazed aluminium partition with 300 mm high brick wall at bottom for toe protection. All the doors shall be single leaf glazed aluminium doors for all cabins. For movements of panels suitably sized double leaf aluminium glazed doors shall be provided. Control room wall upto the false ceiling level shall be of aluminium glazed partition on either side of air lock. In other area cladding shall be of brick wall. UPS room shall be provided with brick cladding all-round to reduce sound nuisance.

Battery room shall be provided with metal door. For Air washer room steel doors shall be used which shall be airtight. No window shall be provided in air washer room.



Necessary separation walls for the UPS charger, panels and the batteries in the battery room shall be provided.

Staircase properly enclosed to satisfy LPA regulations shall be provided at either ends of each unit. All doors leading to staircase shall be automatic closing fireproof door. Staircase shall not be provided around the passenger lift. Staircase shall extend upto roof. Toilets shall be provided at the switchgear room level and control room level. Toilet floors shall be sunk by 50mm and shaft shall be provided to route the soil pipe. Sunken floor shall be provided with damp proofing treatment.

Control room and electronic cubicle room is to be provided with false ceiling. False ceiling shall be designed aesthetically properly arranging, supply air diffuser, return air grill, fire protection sprinklers and light fittings. Aluminium ceiling system shall be provided. Under deck insulation shall be provided on the ceiling, on the walls and beams above false ceiling. Under deck insulation shall be provided for air washer room also.

Floor above control room where APRDS and other pipes are located as well as floor below the deaerator area shall be provided with proper drains to prevent any accumulation of water. This is very important to prevent seepage of water into the control room.

All openings in floor for switchgear and other panels shall be sealed with fireproof material after cables are connected. Adequately designed RCC storm water drains shall be provided to lead the roof drainage on to the plant drainage system. These drains shall have pre-cast RCC slotted cover. Plinth protection shall be given on the side of the drain up to the brick wall.

Provision of central control room shall be satisfied the requirement of vol. V also.

11.04.00

MILL AND BUNKER BAY BUILDING

The framing shall be of structural steel. This shall be designed as a moment connected framing in the transverse direction and braced in the longitudinal direction. These structures primarily support coalbunkers, coal feeders and tripper arrangement to feed the coal into coal bunker.

The bunker shall be circular in plan and shall have the capacity as per the requirement of steam generator.

A mill maintenance platform shall be provided at appropriate elevation to attend to routine maintenance. This platform shall be of chequered plate over steel framing with handrail all around. Above this floor a framing shall be provided to support under slung crane used for handling mill maintenance work. The crane runway girders shall extend to the full length of mill bay to enable approach to the service bay also.

Framework for supporting the circular bunker are provided above the feeder floor based on geometry of the hopper. Preferably bunker shall be supported on equally spaced (min.) 8 supports.

Bunker shall be provided with a top steel cover with slit openings for entry of coal. On sides of the bunker necessary openings shall have to be provided for bunker ventilation / dust extraction.



Tripper floor is immediately above the bunker. This floor is of RCC supported on structural steel framework.

Tripper roof shall be of RCC supported on structural steel framework. A fall of about 300 mm is given for the roof framing to effect proper drainage. Tripper roof supports bunker ventilation / dust supporting structure. An RCC parapet shall be provided for the tripper roof. Access stair/ladder shall be provided from tripper floor to roof in each unit.

In addition to the above, framing arrangement for structural steel platform at various levels around the bunker shall be provided with proper access ladder, for poking, striking and attending to air canons

Tripper floor and roof shall be given access through boiler staircase / elevators.

Bunker supporting structure is normally left uncladded up to the bottom of tripper floor. For tripper floor upto 3000 mm above finished tripper floor level, brick wall shall be provided. Above this level permanent colour coated galvanized trough sheet cladding shall be provided. Fixed steel windows with 6mm thick wired glass shall be provided in the tripper house as per requirements for conveyor gallery

Roof slab will be sloped to one side to permit easy drainage. Liquid membrane water proofing treatment is to be provided. As the roof is accessible and maintenance crew is likely to work on this floor, the entire roof shall be provided with min. 50 thick screed over the water proofing treatment.

Rainwater down take pipes shall be UPVC pipe of class-3 conforming to IS:4985.

One number goods cum passenger elevator, and two nos. of staircase shall provide access to all floor/platforms extending upto the roof level. These structures primarily support coal bunkers, coal feeders and tripper arrangement to feed the coal into coal bunker. Requisite nos. of corridor as per operational requirements shall be provided to access steam generator building from Mill building. The Mill building and steam generator building shall have expansion gap and corridor shall be connected with sliding supports.

Stainless steel liners shall be provided in bunkers for the conical / hyperbolic as well as vertical portion of Bunker. The grade SS liner shall be SS316L.

Colour coated metal deck sheet will be used below RCC floors, it shall be treated as shuttering material only. Uniform thickness of slab, excluding corrugations shall be min. 150mm. In this case, top of steel of beam shall be decided carefully.

11.05.00

STEAM GENERATOR AREA PAVING

Entire steam generator area upto the end of chimney shall be provided with RCC paving over rubble stone soling (for the details of RCC paving refer clause 10.13 of Volume-VI, Part-A).

Paving shall be carefully planned such that maintenance access roads of minimum 4m wide to all major equipment are available. This area shall be designed for heavy loads similar to design of roads. Such approach road shall be provided to the SG elevator also



to enable handling of equipment at higher level during maintenance. Such roadways shall be clearly identified with kerbs / painting. All drain / trench covers in these areas shall be designed to withstand truck loading.

The drainage of the entire SG area shall be properly planned. Network of RCC drains with RCC cover with slotted holes or MS grills shall be provided covering the entire area which lead the storm as well as process leakage water to the peripheral drains, which in turn will lead to plant drainage system. Where open drains are not permitted under ground pipes may be provided in which case at all junctions and ends proper manholes shall be provided to permit periodic cleaning of the pipes. All structural steel columns in the area shall be provided with encasing to a height of minimum 1000 mm above paving level and in addition the bases also need encasing if base plates are below paving level. For periodical cleaning of manholes suitable screens or baskets shall be provided for easy cleaning from time to time.

11.06.00 TRANSFORMER YARD

Generator transformer, station transformer, unit auxiliary transformer and service transformer are located in front of the turbine building. Transformers shall be installed on RCC foundations with rails on the top and oil soak pits filled with hard stone aggregate. Burnt oil pits are provided to collect leaked oil from the soak pit through salt glazed, pipes laid to slope. RCC blast wall / RCC frame with brick wall of adequate thickness and height to satisfy TAC regulations shall be provided in between transformers as fire barrier wall. Common oil sump & emergency oil sump with RCC roof shall also be provided with man hole arrangements.

RCC foundations shall be provided with rail to transport transformers out of transformer yard during maintenance. Entire area shall be surrounded with 3m high chain link fencing with gates. Where rails cross the fencing, fencing shall be made of removable type to facilitate transport of transformer. Floors shall be paved with plain cement concrete and shall be sloped towards peripheral drains, which shall lead to a sump from which the drainage is led through an oil water separator. The clear water shall be led to plant drainage. All oil sumps shall be covered with RCC cover slab with manhole arrangement.

11.07.00 ESP Control Room

ESP panel control room buildings shall be RCC framed building with brick walls plastered on both faces, complete with drains, space conditioning, and building lighting. The building shall have a separate air-conditioned area; and a separate non air-conditioned area except as required for the contained equipment. The contractor shall ascertain the building size according to the design requirements. ESP Transformer yard, firewalls & fencing shall also be provided as per requirement. One RCC maintenance room of size 20X10 m² shall be provided.

11.08.00 SWITCHYARD STRUCTURES & CONTROL BUILDING

Extent of GIS switchyard and number of towers and gantries and the size of switchyard control room will be as per the layout of the switchyard which has been outlined in Vol. IV of the specification.



Switchyard control building will be of concrete frame structure having brick wall cladding. A crane of suitable capacity will be housed in switchyard building.

The building shall be complete with toilets, drains, plumbing, sanitary drainage and treatment piping, space conditioning for a non-air-conditioned area, building lighting, station combinations and fire protection etc. An adequately sized dedicated air conditioning plant shall be provided for the control room. For switchyard Civil Work refer Section-28 of Part-B, Volume-VI. Epoxy flooring shall be provided in all switchyard control room buildings and GIS buildings.

Maintenance room, Mini conference hall, Pantry room, battery room and EPBAX room shall be provided in these area.

Necessary covered pathways shall be made for GIS and other adjacent buildings.

11.09.00

INTAKE WATER PUMP HOUSE (AT EXISTING COOLING WATER FOREBAY OF NCTPS STAGE-II)

Near existing cooling water forebay of NCTPS-stage II, a pump house is proposed for makeup water with necessary modification of existing forebay at intake point. Raw water would be conveyed through steel conduits / pipe to the plant area.

The pump house structures shall be designed in accordance with IS-3370 (Part -1 to 4) . Cladding shall be of brick work. Crane girder shall be of steel. Cage ladder shall be provided for access to crane platform. Side of the pump house up to motor floor level on the pump discharge side shall be of RCC. Maintenance bay of the pump house shall have RCC grade slab with granolithic finish and non-metallic floor hardener. Motor floor shall also have similar finish.

Pump sump shall be designed as water retaining structure. Each sump shall be provided with stainless steel (SS 316L) groove for inserting coarse screen, fine screen and stop logs. Grooves for stop log shall be provided before and after the screens. Number of pump sumps shall be minimum of 3. Stop logs, coarse screen and fine screen shall be of material as mentioned in mechanical part of the specification. Top of the sump floor shall be kept same as of the top of forebay. This floor shall have openings for lowering the lifting of stop logs and screens. These openings shall be covered with galvanized mild steel gratings when the screens are placed in position. Provision for handling of the screens and stoplogs shall be made. Sufficient paved space shall be provided to keep the stop log when not in use and also for maintenance of screens. Galvanized MS handrails shall be provided on 3 sides of the pump floor (sump roof). Each individual pump sump shall also be provided with a drain sump to empty the sump for attending maintenance of pump.

Vertical wet pit type of pumps are envisaged in the pump house.

Dimension of the pump sump shall be decided as per mechanical requirements.

EOT crane of adequate capacity shall be provided for maintenance of the pumps and other auxiliary equipments.

An annex to sea water pump house shall be provided in RCC framed structure to accommodate switchgear and control room with cable vault below, chlorinator room and toilet block. Side cladding shall be of brickwork. All floors and roofs shall be RCC. Roof shall have proper slope and Elastomeric Membrane water proofing treatment shall



Top level of parking area shall be flushed with crown connecting roads with cross slope. Parking area shall be provided rigid pavements & shall be provided with anti skid tiles.

On either side of type I and type II roads and on one side of type III roads, open drains shall be provided. Minimum clear width of drains shall be 600mm. The drains shall be designed and built using RCC. Drainage lines and other underground services shall be located at least 1m clear from the edge of the roads. All service and utility lines crossing the roads shall be taken through NP3 class RCC pipe designed for impact loading. All culverts carrying storm water shall be cast in place RCC box culverts.

No underground service piping except for drainage and sewage system shall run directly below the road (including upto 1 m. from edge of road) along its longitudinal direction.

Surface drainage of roads shall be provided by giving proper longitudinal slopes and cross falls.

The Minimum thickness of RCC road pavement, Sub-base and minimum reinforcements shall be as follows.

Type I & II roads –

250mm thick with 8mm TOR at 250mm c/c both ways at top and bottom (double layer)
Sub – base : 2 layers of granular sub base plus 100mm thick PCC.

Type III roads –

150mm thick with 8mm TOR at 250mm c/c both ways (Single layer) Sub – base : 250mm thick granular sub base plus 100mm thick PCC The sub-grade shall be compacted to atleast 98% Proctor Dry Density. The actual thickness road pavement, sub-base thickness, reinforcement etc., shall be provided as per design and functional requirements.

Roads shall be designed for IRC and MOST standards (MORTH). Minimum thickness of basement slab and walls and drains to be 200mm thick with 2 layers of reinforcement.

A Separation membrane shall be used between Concrete and sub-base. Membrane shall be impermeable. Plastic sheeting shall be 125microns thick laid flat without creases.

The drainage system shall be designed for precipitation intensity of minimum 80mm per hour.

The joints, dowel bars, tie bars, joint pillars, ceiling compounds tolerances curing shall be as per latest IRC MOST standards.

17.02.00

Surface Drainage

- a) All the paved and unpaved areas shall be adequately drained. The surface drainage system shall be designed for surface washings and / or rain / fire water as the case may be. Unpaved open areas shall be drained through RCC drains and connected to main storm drains.
- b) The paved area shall be sloped towards the drains with a minimum slope of 1 in 100. The maximum drainage travel extent shall be limited to 10 metres.



- c) The surface drainage from uncontaminated area shall be connected to nearest open storm water drains through rectangular drains. Contaminated area surface drainage shall be collected through separate network.
- d) The interconnecting pipes and rectangular drains shall be sized for carrying the design discharge when running full.
- e) The rectangular drains shall be minimum 450 mm wide of RCC construction. The pipes for water drainage system shall be of RCC class NP2 conforming to IS:458 with minimum size of 150 mm NB. However, for road crossings etc., pipe of class NP3 SHALL BE PROVIDED. For rail crossings, pipes conforming to railway loading standards shall be provided. If sufficient clearance cannot be provided between the top of the pipe and road top, the pipes shall be encased in RCC. Minimum clear width of drain shall be 300 mm.
- f) The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8m/sec respectively. However, minimum velocity for self cleansing of 0.6m/sec shall be ensured. Slope of drain shall not be milder than 1 in 1000.
- g) Minimum earth cover of 450 mm shall be provided over drainage pipes in paved areas.
- h) RCC Garland drains minimum 300mm wide shall be provided allround the building to lead away roof drainage to plant drainage system. Plinth protection in PCC grade 1:2:4 shall be provided between brick wall and drain with appropriate slope.

17.03.00

Storm Water Drainage System

- a) The plant storm water drainage system shall take into account the topography of the plant area, area drainage patterns and intensity of rainfall etc. The drainage system shall be designed for a precipitation intensity equal to hourly rainfall for a return period of 1 in 50 years. However, storm frequency of 100 years return period shall be applied for Coal Storage area. These values shall be based on the recommendations of Indian metrological department (IMD).
- b) All storm water drainage shall preferably be through open storm water drains. These shall be provided on both sides of the roads and shall be designed to drain the appropriate catchment area including road surface, open and covered area etc. The drains shall be minimum 300 mm wide at the base.
- c) All open drains shall be rectangular in cross section & in RCC. In the main plant block, rectangular section RCC drains in minimum M25 grade concrete shall be provided. The thickness of side and bottom shall be minimum 125 mm or as per design considerations whichever is higher.
- d) The pipes for water drainage system shall be concrete pipes of class NP2 conforming to IS:458. However, for road crossings etc. higher strength pipe of class NP3 shall be provided. Diameter of pipes used for drainage / culverts shall be between 300 mm to 600mm. Beyond 600mm, box drains / culverts shall be provided. Water way RCC culvert shall not be less than 1m.



- e) Surface drains shall normally have a bed slope not milder than 1 in 1000 along longitudinal direction and RCC pipes shall have such slopes so as to have effective discharge. The maximum velocity for pipe drains and open drains shall be limited to 2.4 m/sec and 1.8 m/sec respectively. However, minimum velocity for self cleansing of 0.6m/sec shall be ensured at peak flow condition (i.e. 3 times average flow) for pipes flowing at half full.
- f) Suitable manholes shall be provided to piped drainage lines at every 30m intervals, at junctions and at change of gradient, alignment and diameter of pipe and shall be of masonry or RCC construction. Minimum size of manholes shall be 1.0m x 1.0m. All manholes shall be designed considering maintenance, inspection and cleaning of pipes. Easy accessibility and safety shall also be given due consideration.
- g) The cushion over the pipes for storm culverts shall be minimum 600mm. Where less cushion is available, pipe shall be cased in RCC m-15. Suitable RCC or masonry structures shall be provided at drops / falls to prevent scouring or damage to surface.
- h) Invert of drainage pipe / drain shall be decided in such a way that the water can easily be discharged above the high water level in water course outside the plant boundary to which the storm water is to be led.
- i) The storm water drainage for the contaminated area such as coal stack pile, fuel oil area, oil skids etc. shall be designed separately and the discharge shall be led separately for treatment and disposal.

17.04.00

Paving

Sufficient pavement areas adjacent to administrative building, canteen building, service building, fire station and first aid centre shall be provided for parking facilities.

Concrete paving of grade M-20 with suitable underbed shall be provided in the entire area from Transformer yard to full length up to 5m beyond chimney.

The inside area of fuel oil dyke shall be provided with concrete paving.

The transformer yard, covering area between A row of the turbine building upto the fencing of transformer yard shall be provided with minimum 100 mm thick PCC paving of nominal mix 1 : 2 : 4 of grade M-20. Paving shall be laid over 150mm thick compacted rubble soling and laid to slope towards drains.

Entire switch yard shall be provided with 75mm paving of 20 to 40mm size stone aggregate on top and 75mm paving of 20 mm stone aggregate below. Before laying the paving, the ground surface shall be treated with antiweed chemicals as per manufacturer recommendations.

For auxiliary transformer yard, paving of stone aggregate of 75 mm thick using 20 mm size aggregate shall be provided after compacting the under bed and treating with anti-weed chemicals.



The RCC paving in specified areas shall comprise of following layers :

1. 255 mm thick approved quality boulders shall be placed on well compacted soil underneath. The interstices of the boulders shall be filled with sand. This layer shall be compacted to the satisfaction of engineer.
2. 100 mm thick M15 grade plain cement concrete on layer mentioned (1) above.
3. M20 grade reinforced concrete with nominal reinforcement 8 tor @ 250 c/c both ways top and bottom having thickness 200mm shall be laid over the layer mentioned (2) above.

17.05.00

Security cum Time Office Complex :

Approximate area of this complex shall be a minimum of 400 sqm. The dormitory shall be constructed in the first floor for security persons.

One dormitory of 100 sqm for security personnel to be provided in the time office.

The complete security gate complex consisting of Gates, Guard House, Wicket gate, time and security office, speed breakers, traffic barriers and parking/waiting space shall be carefully planned such that they function smoothly, specifically at the time of Change of shift.

The whole complex shall be aesthetically pleasing merging with the architecture of the compound wall.

Time and Security Office shall have adequate area to house the security staff and time office staff in addition to the record room, waiting rooms, toilet facilities etc.

In Time office, separate dress change rooms shall be provided for ladies and gents.

In addition to inside toilet, another toilet with entry from outside shall be provided for the use of visitors.

Speed brakers shall be provided both out side and inside the compound with manually operated traffic barriers.

Emergency Gate shall be provided in addition to the main gate. Main Gate shall have two separate entry one for project site and other for fly ash silo trucks movement. Gate latches shall be arranged for padlocking with the padlock accessible from both sides of the gate. Padlocks shall be provided and the key shall be in accordance with the Purchaser's requirements.

Cantilever type motorized sliding gate shall be furnished at the main plant entrance. The gate shall be operable by push button at both the guard house and the security office in the Administration / Plant Service area, and by card reader or key switches.

The road near the main entrance to be widened additionally by 7.5 m on either sides of the road for parking of vehicles for security check.

Suitable median arrangements to be made.

Security cabin to be provided on either sides of the road near the main gate.



Elevated platform either in steel structure / Brick work or RCC to carry out checking on Lorries/Tippers by security personnel while the vehicles getting in or going out from the premises.

17.06.00 Fencing

- a. Minimum 3m height fencing above toe wall shall be provided around transformer yard and other areas where fencing is necessary due to statutory requirements.
- b. Fencing shall comprise 3.0m height PVC coated galvanized chain link fencing of minimum 8 gauge including PVC coating of mesh size 75 mm and galvanized concertina.
- c. Galvanized barbed of a height of 0.6m shall be provided above the chain link fence. The diameter of steel wire for chain link fencing excluding PVC coating shall not be less than 12 gauges.
- d. MS entry gate shall be provided for all fenced areas. Top of toe wall shall be min. 200 mm above formation level.
- e. Removable type of fencing shall be provided at suitable location to permit entry and exit of equipment.

17.07.00 Watch Tower

Watch Tower shall be constructed with RCC frame work. Floor of tower shall be at least 6m above graded level.

Covered area for each tower shall be approx. 25 sqm. Number of towers shall be such that the complete periphery of the plant can be watched from the towers but in no case the number of towers shall be less than twelve.

Walking platform of 1.5m wide with hand rails shall be provided all round of watch cabin.

17.08.00 Plinth Protection

All buildings shall be provided with 1000 mm wide and 100 mm thick PCC of grade M-20 for plinth protection all round with surface drain of required size and slope, to suite storm water quantity. Plinth protection shall be laid over prepared subgrade and base formed with broken brickbats or rubble laid to a thickness of 150 mm.

17.09.00 Waste Water Treatment and Drainage System

Waste water treatment plant will receive plant waste water except RO plant reject and CT blow down. The treated water and the solid waste will be used within the plant.

Guard pond will hold the RO Stage-I reject, clarifier sludge treated water from oil water separator and this will be pumped to the sea. For this return water to the sea temperature shall not exceed 5°C over the inlet temperature of cold water.



The cooling tower blow down shall be pumped to sea with the help of blow down pumps installed in the CW pump house.

All necessary civil / structural works for waste water treatment plant shall be under scope of contractor. The major source of plant waste water are Boiler blow down, coal mill area drainage, PH and boiler area oily effluent drain, F.O. pump house oil drainage, boiler and ESP area floor washing drains, water pre-treatment plant effluent, fly ash silo area effluent, transformer yard waste water etc. Design and construction of channels / settling pits / sumps / pipe lines / separators shall be done by the Bidder.

The description of some of the major structures / components covered under the waste water system package is given below:

Coal pile area run-off will be led to settling pond. Earthen settling pond with two (2) compartments will be provided. Top of earthen dyke shall be 500 mm above surrounding finished grade level to restrict ingress of storm water from adjacent areas. Capacity of pond shall be determined on the basis of inlet drain invert. The side slopes and bottom will be protected with PCC blocks of minimum 75 mm thickness with suitable under-bed having interstices filled with cement-sand mortar. At the downstream of pond RCC overflow weir and sump shall be provided. Design and detailing of pond shall be as per good engineering practice so as to satisfy functional requirement as specified in the specification. Necessary sluice gates with hoisting arrangement shall be provided in inlet drain carrying coal pile area run-off so that one settling pond can be operative while the other one under maintenance.

The Power House and boiler area service water waste shall be collected in a RCC underground oily waste retention pit. Necessary pumps and supporting floor / maintenance area shall be provided. This effluent will finally be treated in TPI (tilted plate interceptor). Foundation from TPI shall be designed as per IS:456. RO Stage-II reject shall be led to fire water sump and green belt development. In case the fire sump is full then arrangement shall also be made to lead this to the guard pond.

Oil storage and handling area run-off will be collected to a conventional baffled oil water separator. This oil water separator will be an underground RCC structure having RCC baffle wall and overflow sump for collecting water at outlet end. An oil collection pit shall be provided on sidewall of oil water separator. This structure shall be designed as un-cracked section as per IS:3370. The structure shall project at least 300 mm above finished grade level. Handrail shall also be provided around the pit. The overflow sump shall be covered at top over which pumps will be installed.

RCC sump for collecting boiler blow down and ESP area floor washing is included in scope of bidder. Civil work for outlet of this effluent shall also be under scope of this package.

Guard Pond (effluent monitoring pond and equalization basin) sized for holding waste water from RO Stage-I reject, clarifier sludge, treated water from oil water separator and boiler blow down as per capacity indicated in Vol. III & Composite Water Scheme. The guard pond (earthen) shall have adequate capacity as per design requirement with 750 mm free board. Top of earthen dyke shall be 500 mm above finished grade level. The pond shall be of such construction as to prevent pollution of ground water by seepage of



any wastewater having side slopes and bottom lined with minimum 250 micron LDPE for minimizing seepage loss. Over the LDPE lining, PCC blocks of minimum 75 mm thickness having interstices filled with cement-sand mortar shall be provided. Filter media shall be suitably designed and provided below liner.

17.10.00 Sanitary Sewerage System

Sanitary Sewerage System shall be carried out as specified in VOL – III (Mechanical Spec.).

The treated water to be provided with necessary pumps and distribution lines for reutilization for Horticulture / Green belt development.

The sewerage system of foul water from toilet shall include layout and laying of sewers up to a sewage treatment plant together with all fittings and fixture and inclusive of ancillary works such as connections, installation of man-hole and inspection chambers. The construction of a sewage treatment plant of adequate capacity including settling tank, lifting stations, pump house and all other necessary provisions shall be made for treating the sewage water by using the latest CAACO technology developed by M/s. Central Leather Research Institute, Taramani, Chennai.

The domestic effluent from the plant shall be collected and treated in proper STP to meet the prescribed BIS standard before being discharged or reutilized for green belt development.

17.10.01 Sanitary Sewer Drains

- a) Sanitary sewers shall be designed for a minimum self cleansing velocity of 0.75 m/sec. and the maximum velocity shall not exceed 2.5m/sec.
- b) Very hot (over 60⁰C) water shall be first cooled down to less than 60⁰C in collecting basin by mixing with cold water before connecting to storm drainage system.
- c) The maximum temperature, quality, quantity and location of drain water of individual equipment shall be tabulated and furnished to the Owner's representative.
- d) All underground piping below concrete slab shall be cast iron of minimum 100mm dia and for outdoors it shall be reinforced concrete pipe of minimum 200mm diameter. In buried piping system manholes shall be placed at every change in direction and at every SOM (max.) interval in straight run. Suitable clean outs shall be provided for buried piping under floor slab.
- e) Following minimum drainage slope shall be provided:
 - Pipes of diameter less than 200mm : 1 (vertical) : 100 (horizontal)
 - Pipes of diameter 200mm & more: 1 (vertical): 200 (horizontal).



18.00.00 ARCHITECTURE

18.01.00 Architectural Concepts

- a) Layout of the plant area shall have definite hierarchy of road network depending upon its usage, aesthetic, visual sensibilities for creating road vistas, focal points, building back drops, building frames. General layout shall be evolved taking over the basis of landform & local climate & due consideration shall be given to orientation & wind direction. The resulting built mass shall present a definite image width in distinct vocabulary in the form of landmarks, nodes & skyline.
- b) Main Plant Building shall be architecturally treated in such a way that it retains a monumental scale, yet presents a pleasing composition of mass and void with suitable and functionally designed projections and recesses. The overall impact of the building shall be one of aesthetically unified architectural composition having a comprehensible scale, blending tonal values with the surroundings and taking full consideration of the climatic conditions, the building orientation and the existing structures nearby.
- c) All other buildings and structures shall be architecturally treated in such a way so as to be in complete harmony with the main plant, surrounding structures and environment. Local architectural characters and materials may be judiciously imbibed. The building shall be designed initiating an architectural control common to all buildings. The architectural control shall be clearly spelt out in terms of scale, man & form.
- d) Overall colour scheme and finish schedule of the plant and other buildings shall be designed judiciously and in a comprehensive manner taking into account the mass and void of buildings, its façade, equipments, exposed structural elements, piping, trestles, bus ducts and other service elements.
- e) Overall emphasis shall be on developing an eco-friendly architecture, merging with the nature with its own sustainable energy management systems.

The scheme shall be conceptually finalized in totality including that of equipments so that the proper coordination with other agencies can be taken up at appropriate time.

18.02.00 Architectural Design

- i) Natural light shall be used to the maximum extent specially in the form of north light / sky light. For adequate light & ventilation, National Building code recommendations shall be followed.
- ii) Entrance canopies, chajjas (projections, recesses) over openable windows and door openings on exterior facades shall be provided.
- iii) All the buildings shall be architecturally designed to meet the National Building Code (SP:7) norms and local building bye laws, wherever applicable.



- iv) Architectural design and detailing aspects of all the buildings shall be rendered through professional services of an Architect. Statutory requirements and any clearances from local authority may be required to be met with, wherever essential. The Architect Consultant shall be of National / International repute having experience in similar kind of works. The consultant shall evolve the design philosophy based on Employer's guidelines and shall present it in the form of presentation drawings, Prospective views, 3-D Models & detail drawings.
- v) Minimum 1000mm high (from floor / roof level) hand railing shall be provided around all floor / roof openings, projections / balconies, walkways, platforms, steel stairs, etc., All handrails and ladder pipes (except at operating floors) shall be 50mm nominal bore MS pipes (medium class) conforming to IS:1161 and shall be galvanized as per IS:4736 treated with etch primer and finished with suitable paint. All rungs and ladders shall also be galvanized. Minimum weight of galvanizing shall be 610 g/sqm.

All stairs and around all floor openings at operating floors, 1000mm high hand railing with 32 NB (polished) stainless steel pipe shall be provided.
- vi) All stairs shall have a maximum riser height of 180mm and a minimum tread width of 250mm. Minimum clear width of stair shall be 1200mm unless specified otherwise.
- vii) All buildings having metal cladding shall be provided with a 150mm high RCC toe curb at the edge of the floor along the metal cladding. 900mm high hand railing shall be provided on this RCC curb, wherever required from the safety point of view.
- viii) In all buildings, structures, suitable arrangement for draining out water collected from equipment blow downs, leakages, floor washings, fire fighting, etc., shall be provided for each floor. All the drains shall be suitably covered with grating or pre-cast RCC panels.
- ix) RCC staircase shall be provided for all RCC construction buildings and structural steel staircase for all structural steel buildings.
- x) Parapet, Chajjas over window and door heads, architectural facias, projections, etc., shall be provided with drip course in cement sand mortar 1:3. Cut lintels over windows/doors shall be avoided as far as possible.
- xi) All fire exits shall be painted with P.O red/signal red colour shade which shall not be used anywhere except to indicate emergency or safety measure. Fire safety norms shall be followed as per National Building Codes and fire safety requirements for providing fire exits, escape stairs and firefighting equipment. In detailing of all buildings, fire safety requirements conforming to IS:1641 and IS:1642 shall be followed.
- xii) All windows shall be provided with granite slab at sill level.
- xiii) All grills of window shall be of 12 mm square MS bars both ways.



18.03.00 Interior Design

A comprehensive interior design scheme shall be conceived with the intention of projecting a definite theme and aesthetic appearance to inside working environment. It shall take into account the multidisciplinary engineering activities involving power plant technology, and architectural and civil engineering for a smooth control hierarchy and man machine interface. All the design aspects such as flooring, false ceiling, furniture, colour scheme, equipment design, layout, illumination, fire fighting, acoustics and ergonomics requirements shall be detailed out so as to present an overall unified aesthetic spatial appearance. The areas to be undertaken for this interior design process shall be control room complex including common control room, computer room, conference rooms and office areas in the main plant building and the following aspects shall be reviewed and evaluated for design. Furniture to be supplied by Bidder for the control room complex shall be as specified under C&I specification.

- a) Layout, keeping in view the main-machine interface and suitable ergonomic practices.
- b) Integration of civil engineering with architecture and interior design.
- c) Illumination levels, noise levels, electromagnetic interference levels, taking into account the equipment and furniture.
- d) Comfort and safety requirements such as air conditioning, fire fighting, fire escapes etc.
- e) Microprocessors based control system to control the functional requirements.

The above design philosophy put into practice shall be detailed out through presentation drawings, perspective views, scale models, detail drawing etc.

18.04.00 Sealant

Silicone sealant or polyurethane shall be used in all expansion joints exposed to weather. All joints around exterior doors, windows and expansion joints shall be sealed for proper water tightness.

18.05.00 Damp Proof Course

50mm thick 1:1.5:3 concrete with water proofing admixture shall be used. Water proofing compound shall be of Zydex, Sikka or similar make.

18.06.00 Finishing Schedule

The minimum quality of finishes used for various building areas are furnished in Table-1 in this section. The Bidder is at liberty to use superior finishes provided all specific requirements for the finish specified in Part-B of Vol-VI.

18.07.00 Roof Drainage and Water Proofing

- a) Roof drainage system shall be provided for quick and efficient draining of rainwater from roof to avoid seepage and damage to roof. The runoff gradient for the roof shall



not be less than 1 in 100. Roof drainage system shall consist of roof drain heads, rain water down comer and fixtures. System shall be designed to handle design rainfall for the specific site and shall be in accordance to stipulations of IS: 1742 and IS: 2527. The down comer pipes shall be suitably concealed with masonry work, cement concrete or sheeting to match with the exterior finish.

- b) Multiple drains (minimum 2) shall be provided for all roof areas. Any roof more than 8 m above grade shall have access from within the building for cleaning of roof drains.
- c) Rain water down comers shall be of HDPE pipe conforming to IS: 4984.
- d) All roofs shall be provided extra with heavy duty water proofing treatment comprising of
 - i. Seven courses as per IS:1346 using layer of Type 2 Grade 1 glass fire based felt as per IS:7193.
 - ii. 50mm thick foam concrete as per IS:6598 for thermal insulation
 - iii. 15mm thick cement sand plaster 1:4.
 - iv. Chequered cement tiles as per IS:13801 shall be provided over water proofing treatment in areas where movement of personnel is expected. Minimum width of pathway if provided only locally shall be 1000mm.
 - v. In areas such as roof of control room bay of Main Turbine building, Bunker bay roof etc where handling of equipment is anticipated, the foam concrete may be replaced by 40mm screed concrete.

Roof water proofing may also be provided using high solid content liquid applied elastomeric water proofing membrane with separate wearing course as per ASTM C-898. Thickness of the membrane shall be a minimum of 1.5mm. The treatment includes application of polymerized mortar over sloped roof to achieve a smooth surface and a primer coat. Wearing course shall be 40mm screed of 1:2:4 concrete as above cast in panels of 1.2m x 1.2m and reinforced with 0.56mm dia galvanised chicken wire mesh and joints sealed using sealing compound. Accessible roof shall be provided with chequered tiles as above.

18.08.00 Sumps

In case of underground structures, sumps with pumping arrangement shall be provided at suitable location to collect and pump out any incidental water collection to nearest storm water drain.

18.09.00 Master Key System

An appropriate serviceable and functional master key system for the whole plant shall be installed. The elaboration of the system itself shall be made in close co-ordination with the Purchaser / Consultant and only after obtaining the Purchaser's / Consultant's approval in writing shall the order of production be placed.

The following requirements shall be met:



- The general master key shall operate all locks
- The main key shall open all locks of one building
- The single key shall open the lock of a single room.

Necessary attention shall be paid to later extensions of the master key system, which shall be suitable for the entire plant including all final stages.

The profile cylinders shall be sea water resistant and shall suit all plant requirements. The material of the cylinders shall be of massive brass, nickel-plated with six security pawl studs.

The keys shall be made of material approved by the Purchaser / Consultant and shall have an engraved indication of the applicable key system and the building or door number.

Keys shall be supplied in the following numbers:

General Master Key	10	nos
Main keys	10	nos. per each building
Single keys	3	nos. per each door

18.10.00 Land Scaping

18.10.01 General

This specification covers broadly the requirements for Landscaping within the Plant Area. Landscaping shall be carried out after all the underground utilities and drainage systems are in place. The entire work of Landscaping shall be carried out to the satisfaction of the Engineer and in a manner to have a beautiful appearance after completion of the work.

The Landscaping plan should be prepared by the Contractor with the help of an expert Horticulturist with due considerations for Fauna & Flora grown in the adjacent area and which can sustain in the saline climate. Minimum 30% of total plant area shall be covered with grass belt. In addition approximately 1000sqm of area shall be landscaped with Korean grass & latest flowers.

The area to be landscaped shall be clearly demarcated at site and got approved by the Engineer and the work shall be divided into following sub-items.

18.10.02 Preparing Lawn

For this purpose, within the area where lawn is to be grown, about 0.3 metres of earth shall be removed. This shall be replaced by fresh garden soil and manure in 2: 1 proportions spread evenly. Fresh garden soil & manure shall be mixed thoroughly, well watered and left overnight. The next morning, the variety of lawn, as per approved plan and as directed by the Engineer, shall be planted. This grass shall be maintained till well established by watering, weeding, clipping, rolling etc.

18.10.03 Preparing Clipped Hedges



Hedges made of Casuarinas or other shrubs as directed by the Engineer shall form borders between footpath and the Lawns. The shrubs shall be planted at spacing not more than 25 cms.

18.10.04 Planting Shrubs

Shrubs with coloured leaves like Crotons, Acalyphia, Oleander and Bougainvillea, Hibiscus etc. which are perennial shall be planted in clusters or over a large area at locations and in the manner as per approved layout. These shrubs shall be planted at spacing of not more than 25 cms.

18.10.05 Installation of Watering System

Shall prepare and submit watering System for the Plants. Drip Irrigation and Spray System consisting of complete PVC pipe with all necessary bends, Tees, Elbows etc., valves, stop cocks, Spray nozzles, sufficient lengths of Flexible PVC pipes to reach all area of Landscaping shall be included in the watering system. Only after approval of the Engineer, the Contractor shall commence the work.

TABLE – 1

FINISHING SCHEDULE

Building / Area	Wall (Internal)	Floor Finish	Ceiling	Roof Treatment	Wall (External)
STG Building					
Ground Floor: Maintenance Bay & Unloading Areas	Acrylic washable distemper	Granolithic with non-metallic hardner	Acrylic washable distemper	--	Water proof cement based paint
Ground floor general area	Acrylic washable distemper	Granolithic Flooring	Acrylic washable distemper	--	Water proof cement based paint
Mezzanine Floor	Acrylic washable distemper	Granolithic flooring	Acrylic washable Distemper	--	Water proof cement based paint
Operating Floor					
1. Operating Area, laydown area	Acrylic washer distemper	Corborandum tiles	Acrylic washable Distemper	--	Water proof cement based paint
2. General circulation and movement	Acrylic washable	Glazed vitrified ceramic tiles	Acrylic washable	--	Water proof cement based



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

Building / Area	Wall (Internal)	Floor Finish	Ceiling	Roof Treatment	Wall (External)
areas	distemper		Distemper		paint
3. Heater area	Acrylic washable distemper	Heavy duty cement concrete tiles (Carborandum)	Acrylic washable Distemper	--	Water proof cement based paint
Toilet	Dadoing for 2100 mm high + Acrylic distemper	Heavy duty ceramic tiles (Anti skid only.)	Acrylic washable Distemper	--	Water proof cement based paint
Roof	--	--	--	Elastomeric water proofing treatment	--
Clarified Water Pump House	Acrylic washable distemper	Granolithic floor with non metallic floor hardener	Acrylic washable Distemper	Heavy duty water proofing as per IS:1346	Water proof cement based paint
Cooling Water Pump House	Acrylic washable distemper	Granolithic floor with non metallic floor hardener	Acrylic washable Distemper	Heavy duty water proofing as per IS:1346	Water proof cement based paint
Raw Water Pump House	Acrylic washable distemper	Granolithic floor with non metallic floor hardener	Acrylic washable Distemper	Heavy duty water proofing as per IS:1346	Water proof cement based paint
Control Rooms	Acrylic emulsion paint	Glaze vitrified ceramic tiles	Aluminum Fall Ceiling	--	Water proof cement based paint
MCC Switchgear Room	Acrylic washable distemper	Granolithic floor with non metallic floor hardener & top finished with epoxy coating.	Acrylic washable Distemper	--	Water proof cement based paint
Office Areas	Acrylic emulsion paint	Heavy duty Ceramic Tiles	Acrylic washable Distemper	--	Water proof cement based paint



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

Building / Area	Wall (Internal)	Floor Finish	Ceiling	Roof Treatment	Wall (External)
Cable Vaults	Acrylic Distemper	Granolithic floor with non metallic floor hardener	Acrylic washable Distemper	--	Water proof cement based paint
Control & Switchgear Building					
Central Control Room	Acrylic emulsion paint	Anti skid Marbonite tiles	Aluminum False Ceiling	Elastomeric water proofing treatment	Water proof cement based paint
Electronic cubicle room & Computer room	Acrylic emulsion paint	Heavy duty ceramic tiles	Aluminum False Ceiling	--	Water proof cement based paint
Conference room, senior executive room	Acrylic emulsion paint	Glazed vitrified ceramic tiles	Aluminum False Ceiling	--	Water proof cement based paint
Switchgear room	Acrylic washable distemper	Granolithic with non-metallic floor hardner & top finished with epoxy coating.	Acrylic washable Distemper	--	Water proof cement based paint
Battery Room	Acid & alkali tile dadoing for 2100 mm high + Chlorinated rubber based paint	Acid / alkali resistant tiles	Chlorinated rubber based paint	--	Water proof cement based paint
SWAS room	Acrylic washable distemper	Glazed vitrified ceramic tiles for dry areas. For wet areas Heat resistant, anti skid of approved brand & colour.	Acrylic washable Distemper	--	--
Office, Common areas & corridor	Acrylic emulsion paint	Heavy duty ceramic tiles	Acrylic washable Distemper	--	Water proof cement based paint



2 x 660 MW Ennore SEZ Supercritical Thermal
Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14
Vol. VI : 145



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

Building / Area	Wall (Internal)	Floor Finish	Ceiling	Roof Treatment	Wall (External)
Cable Room	Acrylic distemper	Granolithic with non-metallic floor hardener	Acrylic washable Distemper	--	Water proof cement based paint
Toilet	Dadoing for 2100 mm high + Acrylic distemper	Heavy duty matt finish ceramic tiles	Acrylic washable Distemper	--	Water proof cement based paint
Lockers room	Acrylic washable distemper	Kota stone.	Acrylic washable Distemper	--	--
Pantry	Dadoing for 2100 mm high + Acrylic distemper	Heavy duty matt finish ceramic tiles	Acrylic washable Distemper	--	--
Laboratory room	Acrylic washable distemper	Heavy duty ceramic tiles	Acrylic washable Distemper	--	Water proof cement based paint
Records Room	Acrylic washable distemper	Kota stone.	Acrylic washable Distemper	--	--
Other Buildings					
Bunker Building	Acrylic washable distemper	Granolithic floor with non metallic floor hardener	Acrylic washable Distemper	Heavy duty water proofing as per IS:1346	Water proof cement based paint
Chlorination Building	Chlorinated rubber based paint	Acid / Alkali resistant tiles	Acrylic washable Distemper	Heavy duty water proofing as per IS:1346	Water proof cement based paint
Chemical House	Acid/Alkali resistant tiles on wall up to 1500mm height & chemical resistant paint above.	Acid/Alkali resistant Tiles	Chemical resistant paint	Heavy duty water proofing as per IS:1346	Water proof cement based paint



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

Building / Area	Wall (Internal)	Floor Finish	Ceiling	Roof Treatment	Wall (External)
DM Plant	Chlorinated rubber based paint	Granolithic	Chlorinated rubber based paint	Heavy duty water proofing as per IS:1346	Water proof cement based paint
Switchyard control room building and GIS building	Acrylic emulsion paint in control room and Acrylic washable distemper in other areas.	Epoxy finish on Granolithic flooring.	Aluminum false ceiling in control room and acrylic distemper in other areas.	Heavy duty water proofing as per IS:1346	Water proof cement based paint
Workshop	Acrylic washable distemper in Workshop area and Acrylic emulsion paint in office area.	Granolithic flooring with non metallic floor hardener in workshop area and Heavy duty ceramic tiles in office area.	Acrylic washable Distemper	Heavy duty water proofing as per IS:1346	Water proof cement based paint
Canteen : General Area Kitchen	Dadoing for 2100mm high & Acrylic Distemper above. Dadoing for 2100mm high & Acrylic Distemper above.	Heavy Duty Ceramic Tiles Terrazo Tiles	Acrylic washable Distemper Acrylic washable Distemper	Elastomeric water proofing treatment	Granular finish Granular finish
Fire Station Building	Acrylic washable distemper	Vitrified ceramic tiles in office, dormitory area & granolithic flooring with non metallic floor hardener in parking & equipment store area.	Acrylic washable Distemper	Heavy duty water proofing as per IS:1346	Water proof cement based Paint
Service building: Ent.	Acrylic	20mm thick polished granite	Acrylic washable	Roof of service	Granular finish (Vineratex) or



2 x 660 MW Ennore SEZ Supercritical Thermal
Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT No.3 /2013-14
Vol. VI : 147



DESEIN

Volume-VI(A): Civil, Structural & Architectural Works

Building / Area	Wall (Internal)	Floor Finish	Ceiling	Roof Treatment	Wall (External)
Lobby, Reception, Portico, staircase & Lift Area	emulsion paint	stone	Distemper	building shall be provided with Elastomeric water proofing treatment	equivalent.
Office area	Acrylic emulsion paint	Glaze vitrified Ceramic tiles	Acrylic washable Distemper		
Administrative Building : Ent. Lobby, Reception, Portico, staircase & Lift Area	Acrylic emulsion paint	20mm thick polished granite stone	Acrylic washable Distemper	Roof of service building shall be provided with Elastomeric water proofing treatment	Granular finish (Vineratex) or equivalent.
Office area	Acrylic emulsion paint	Glaze vitrified Ceramic tiles	Acrylic washable Distemper		





**TITLE: 2X660 MW ENNORE SEZ
SUPERCRITICAL TPP,
UNIT# 1 & 2**

SPECIFICATION NO. PE-TS-412-600-C002

VOLUME - II B

SECTION - D

REV.NO. 0

SHEET OF

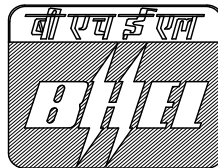
TAMILNADU GENERATION AND DISTRIBUTION CORPORATION

ENNORE SEZ SUPERCRITICAL TPP UNITS- 1 & 2 [2 x 660 MW]

VOLUME – II B CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-412-600-C002

SECTION – D *GENERAL TECHNICAL SPECIFICATION*



**Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301**

DESEIN

Volume-VI (B) : Civil, Structural & Architectural Works

CONTENT

SR NO	TITLE	PAGE NO
19	SURVEYING WORKS	2
20	EXCAVATION AND FILLING	4
21	CEMENT, CONCRETE & ALLIED WORKS	9
22	CONSTRUCTION OF SHELL BY SLIP-FORM METHOD	46
23	FABRICATION OF STRUCTURAL STEEL WORK	53
24	ERECTION OF STRUCTURAL STEELWORK	71
25	MASONRY AND ALLIED WORKS	80
26	ARCHITECTURAL FINISHES	82
27	WATER SUPPLY, DRAINAGE AND SANITATION	97
28	SWITCHYARD CIVIL WORKS	106
29	GALVANIZING	110
30	PILING	112
31	ROAD & DRAINAGE	124
32	CARPENTER	160
33	SHUTTER	166
34	MISC. METAL	171
35	WATERPROOF	177
36	ANTI-TERMITE	184
37	LEVELLING & GRADING	189



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1



19.00.00 SURVEYING WORKS

19.01.00 Site survey shall be carried out to establish the ground levels and to determine any existing structures, roads etc. The site survey shall be carried out before the commencement of the work and if required during the progress of the work. The site survey shall be carried out at a grid spacing of 5-10 meters and at every change of level of the existing ground to produce contour drawings at 0.25 meter intervals. Scale of the contour drawings shall be as directed by the Consultant. A specialized firm approved by the Consultant shall carry out the site survey.

A single grid pillar will be given by the client with coordinates in plant area. Necessary grids shall be made by EPC contractor including demarcating the structures, buildings and jungle clearance including Cutting, uprooting and removing of trees and dispose the same away from the site etc.

19.02.00 Survey points (reference points and bench marks) : The contractor shall construct adequate number of reference points and bench marks for marking the setting out lines and levels. The reference points shall consist of suitable metal plates set in 400 mm x 400 mm x 500 mm precast concrete plinth (grid pillars) and inscribed with the exact level. All levels of the benchmarks shall be related to the agreed datum. The exposed numbers, locations, co-ordinates and level of the reference points and bench marks shall be plotted on drawings and approved by the consultant prior to the commencement of the work. Survey points in solid walls shall be stainless steel plates or cast iron, fixed firmly and sufficiently deep in the walls.

19.03.00 Safeguard of survey points: The survey points shall not be removed from their position without the permission of the Consultant. If any of the survey points are damaged or lost due to any work carried out near their location, the contractor shall be responsible for replacing such survey points.

19.04.00 Surveying during the progress of work : The contractor shall assist the consultant at any time when checking survey points, setting out, checking construction items and erection parts. The contractor shall provide and arrange the following:

- i) Provision and maintenance of survey instruments and accessories.
- ii) Provision of skilled personnel, supply of all material required for the survey exposing covered survey points.
- iii) Shifting of any machinery used for construction out of the sight lines.
- iv) Stopping all drilling, blasting, driving and any other works.
- v) Causing soil vibrations and stopping during instrument observations.
- vi) Removing all obstructive accumulation of water.
- vii) Taking all necessary safety precautions.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 2



- viii) Furnishing any marking material requested by the Consultant in connection with control surveys.
- ix) Providing additional survey points in accordance with the consultant's instruction.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 3



20.00.00 EXCAVATION AND FILLING

20.01.00 The works to be provided by the bidder in respect of excavation in all types of soils including shoring, dewatering, filling around foundations and to grade, compaction of fills and approaches, protective fencing, lighting, etc. relevant to structures and locations shall be as detailed below:

- a. Furnish all labour, supervision, services including facilities as required under statutory labour regulations, materials, equipment, tools and plants, transportation etc. required for the work.
- b. Prepare and submit working drawings showing the approaches, slopes, beams, shoring, sumps for dewatering including drains and outfall for drainage, space for temporary stacking of spoils, disposal area, fencing etc. and all other details as may be required by the Engineer.
- c. To carryout sampling and testing and submit to the Engineer, results of soil compaction tests if required by the Engineer to assess the degree of compaction.

20.02.00 All works should conform to the requirements of the latest revision of relevant ISS.

IS: 3764 : Indian Standard for Safety Code for excavation work.

IS:1200 (PartI) : Indian Standard Methods of Measurement of Building and Civil Engineering work, Part-I: Earthwork.

20.03.00 The bidder should carryout the work as per the approved drawings. All materials required for the work shall be of best commercial variety. Borrow materials for back- filling shall be excavated from approved locations and shall consist of material, free from roots, vegetation, decayed organic matter, harmful salts and chemicals free from lumps and clods. If specified, clean graded sand free from harmful and deleterious material from approved quarries, shall be used as fill material.

20.04.00 Quality Control: The bidder shall establish and maintain quality control for the various aspects of the work, method, material and equipment used. The quality control operation shall include but not be limited to the following items of work:

- a. Lines, Levels and Grades :
 - i. Periodic surveys.
 - ii. Establishment of markers, boards etc.
- b. Back-filling :
 - i. Checking the quality of fill material
 - ii. Checking moisture content



of

the backfill.

- iii. Checking the degree of compaction.

20.05.00 Excavation

- a. Setting out : The contractor should submit to the Engineer, detailed drawings of the excavation work to be executed by him showing the dimensions as per drawings and specification adding his proposals of slopes, shoring, approaches, dewatering sumps, beams etc. Upon Engineer's approval the contractor should set out the work from the control points furnished by the Engineer and fix permanent points and markers for ease of future checking. These permanent points and markers shall be fixed at intervals prescribed by the Engineer. The contractor should proceed with the work after Engineer's approval. It should be noted that this checking by the Engineer prior to start of the work shall in no way absolve the contractor of his responsibility of carrying out the work to true lines , levels and grades as per drawing and subsequent corrections, if necessary, should be carried out by the contractor free of cost to the Purchaser.
- b. Clearing and Grubbing etc.: The area to be excavated shall be cleared out of fences, trees, logs, stumps, bush, vegetation, rubbish, slush etc. and leveled up. Trees upto 300mm girth shall be uprooted. Trees above 300mm girth to be cut, shall be approved by the Engineer and then marked. Felling of trees shall include taking out roots upto 600mm below ground level or 150mm below formation level whichever is lower. After the tree is cut and roots taken out, the pit-holes formed shall be filled with good earth in 250 mm layers and consolidated. The trees shall be cut in suitable pieces as instructed by the Engineer.
Before earthwork is started, all the spoils/ unserviceable materials and rubbish shall be burned or removed from the site to approved disposal areas as specified. Useful materials, saleable timber, firewood etc. shall be the property of the Purchaser and shall be stacked properly at the work site in a manner as directed by the Engineer.
- c. Excavation in all kinds of soil: The excavation in all kinds of soil including old (from demolished structures) underground RCC / CC / brick masonry shall be carried out as per the approved proposal, modified and corrected where necessary by the Engineer. The work shall be carried out in a workman like manner without endangering the safety of nearby structures/ services or works and without causing hindrances to other activities in the area. As the excavation reaches the required dimensions, lines, levels and grades, the work shall be checked by the Engineer thoroughly and the balance work shall be carried out carefully to avoid any over-excavation. On completion, the work shall be finally checked and approved by the Engineer. In certain cases, where deterioration of the ground, upheaval, slips etc. are expected, the Engineer may order to suspend the work at any stage and instruct the contractor to carryout the balance work just before the foundation work of the structure can be started.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 5



- d. Disposal: The excavated soils shall be disposed of within 5 km crow fly distance from site as directed by the Engineer-in-charge in any or all the following manners:
 - i) By using it for backfilling straightway.
 - ii) By stacking it temporarily for use in backfilling at a later date during execution.
 - iii) By either spreading or spreading and compacting at designated disposal areas.
 - iv) By selecting the useful material and stacking it nearly in areas designated by the Engineer for use in backfilling by some other agency.
- e. Disposal of Surplus: The surplus material from excavation shall be carried away from the excavation site to designated disposal area selected by the Engineer. All goods excavated from the pits and all assorted materials of dismantled structures shall be the property of the Purchaser.

20.06.00 Back-filling

- a. The backfilling material shall consist of materials, approved by the Engineer obtained directly from nearby areas where excavation work by the same agency is in progress, from temporary stacks of excavated spoils or from borrow pits from selected areas designated by the Engineer. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials, etc. In certain locations, the Engineer may direct sand fillings. The sand should be clean, well graded and be of quality normally acceptable for use in concrete.
- b. Filling and compaction in pits and trenches around structures: As soon as the work in foundations has been accepted and measured, the space around the foundation structures in pits and trenches shall be cleared of all debris, brick bats, mortar droppings etc. and filled with earth in layers not exceeding 250 mm in loose thickness; each layer being watered, rammed and properly compacted to the satisfaction of the Engineer. Earth shall be rammed with approved mechanized compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the Engineer. The final surface shall be trimmed and leveled to proper profile as desired by the Engineer. Since the degree of compaction depends on the moisture content of the soil, a close watch should be kept on it and corrections done to optimize the moisture content.

The backfilling shall be carried out at optimum moisture content to achieve 95% of Proctor's Maximum Dry Density.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 6



- c. Plinth filling: The plinth shall be filled with earth in layers not exceeding 250 mm in loose thickness, watered and compacted with approved compaction machine or manually, if specifically permitted by the Engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted, in order to avoid any settlement at a later stage. The finished level of the filling shall be trimmed to the slopes intended to be given to the floor.
- d. Filling in trenches for water pipes and drains: Earth used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not bigger than 150 mm size in any direction, mixed with fine material consisting of disintegrated rock, moorum or earth as available, so as to fill up the voids as far as possible and then the mixture used for filling. Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150 mm, watered, rammed and compacted taking care that no damage is caused to the pipe below.
- e. Filling in disposal area: Surplus material from excavation which is not required for backfilling shall be disposed of in designated disposal areas within the lead for disposal as 5 km crow fly distance from the site. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250 mm thick when loose and compacted with the help of compacting equipment. In wide areas, rollers shall be employed and compaction done to the satisfaction of the Engineer at the optimum moisture content which shall be checked and controlled by the contractor.
In certain cases, the Engineer may direct disposal without compaction which can be done by tipping the spoils from a high bench neatly maintaining always a proper level and grade of the bench.

20.07.00 Approaches and Fencing : The contractor should provide and maintain proper approaches for workmen and for inspection. The roads and approaches around the excavated pits should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the plant. Sturdy and elegant fencing shall be provided around the top edge of the excavation as well as the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.

20.08.00 Lighting: Full scale area lighting should be provided if night work is permitted or directed by the Engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the filling.

20.09.00 Testing and Acceptance Criteria

- a. Excavation: On „completion of excavation, the dimensions of the pits shall be checked as per the drawings. After the pits are completely dewatered, the



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 7



work shall be accepted after all undercuts have been set right and all over excavations filled back to required lines, levels and grades by placing ordinary concrete of M10 proportion and/ or richer and/ or by compacted earth, as directed by the Engineer. Over excavation of the sides shall be made good while carrying out the back-filling. The excavation work shall be accepted after the above requirements are fulfilled and all temporary approaches encroaching inside the required dimension of the excavation have been removed.

- b. Back-filling: The degree of compaction required shall be as per IS standards and the actual method of measuring the compaction achieved shall be as decided by the Engineer. The work of back-filling shall be accepted after the Engineer is satisfied with the degree of compaction achieved.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 8



21.00.00 CEMENT, CONCRETE & ALLIED WORKS

- 21.01.00**
- a. This part covers the requirements for general use of Plain and Reinforced Cement Concrete work in structures at all locations, cast-in-situ or precast, including all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work. The special requirements of structures covered in latest IS:456 should also be complied with.
 - b. The works to be provided by Contractor:
 - i) Furnish all labour, supervision services including facilities as required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plant, transportation etc. required for the work.
 - ii) Prepare progressively detailed drawings and bar bending schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.
 - iii) Submit shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedment, hangers, openings, frames etc.
 - iv) Submit detailed drawings of supports, templates, hangers etc. required for installation of various embedment like inserts, anchor bolts, pipe sleeves, joint seals, hangers, openings, frames etc.
 - v) Submit detailed schemes of all operations required for executing the work e.g. material handling, concrete mixing, placement of concrete, compaction, curing, services, approaches etc.
 - vi) Design and submit concrete mix designs required to be adopted on the job.
 - vii) Provide all incidental items necessary for successful completion of the work in accordance with the drawings, specifications and schedule of Items.
 - ix) Supply of specialized materials as directed by the Engineer with a guarantee in approved performa for satisfactory performance.
 - x) Furnish samples and submit for approval the results of various properties of the following materials :
 - a. The various ingredients of concrete including concrete
 - b. Embedments.
 - c. Joint seals

21.02.00 AFTER AWARD OF WORK ACTIVITIES

The following information and data including samples where necessary shall be submitted by the bidder progressively during the execution of contract:



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 9



a) **Programme of execution and Requirement of Materials.**

Within 15 days of the award of contract ,the Contractor will submit a Master Programme for completion of the work giving month wise requirements of materials , particularly mentioning in details the materials which are to be supplied by the Owner and for the procurement of which the help of the Owner is required as per the terms and conditions of the contract.

The master Programme may have to be reviewed and updated by the Contractor quarterly or at more frequent intervals as may be directed by the engineer depending on the emergency of the work.

b) **Samples**

Materials supplied by the Contractor have to be tested for physical, chemical and other properties in the reputed labs at their cost. If found unsuitable, the same shall be removed from the site. Samples of the following materials & any other materials proposed to be used, shall be submitted as directed by the Engineer in Charge, in sufficient quantities free of cost for approval. Approved samples will be preserved by the Engineer in Charge for future reference. The approval of the Engineer in Charge shall not, in any way, relieve the Contractor of his responsibility of supplying materials of specified qualities :-

- i) Coarse and fine aggregates.
- ii) Cement.
- iii) Reinforcement.
- iv) Admixtures.
- v) Plywood for formwork.
- vi) Embedded & anchorage materials as may be desired by the Engineer in Charge.
- vii) Joint sealing strips and other waterproofing materials.
- viii) Joint filling compounds.
- ix) Foundation quality Rubber Pads.

c) **Design mix**

Design mix as per the specification giving proportions of the ingredients, sources of aggregates & cement, along with test results of trial mixes as per relevant I.S. is to be submitted to the Engineer in Charge for his approval before it can be used on the works.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 0



- a. Detailed drawings & designs of formworks to be used.
- b. Detailed drawings for templates & temporary supports for embedments.
- c. Test reports for cement, reinforcement steel and formwork including inspection reports.
- d. Any other data as per specification.

d) Conformity with Design

The contractor should prepare check lists in approved performa which will be known as “Pour Cards” listing out all items of work involved. The contractor should inform the Engineer, sufficiently in advance, whenever any particular pour is ready for concreting. He shall accord all necessary help & assistance to the Engineer for checking required in the pour. On satisfying himself that all details are in accordance to the drawings & specifications, the Engineer will give written permission allowing the contractor to commence placement of concrete. Details of all instructions issued by the Engineer and the records of compliance by the contractor; deviations allowed by the Engineer and any other relevant information should be written on accompanying sheets attached to the Pour Cards. These sheets, termed as “Progress Cards” shall be prepared by the contractor on approved performa. The Pour Cards alongwith accompaniments shall be handed over to the Engineer before starting placement of concrete. One of mix designs developed by the contractor as per the I.S. specifications and established to the satisfaction of the Engineer by trial mixes shall be permitted to be used by the Engineer, the choice being dictated by the requirements of designs and workability. The methods of mixing, conveyance, placement, vibration, finishing, curing, protection and testing of concrete shall be to Engineer’s approval.

21.03.00 Materials to be Used / Supplied by Contractor

All materials whether to be incorporated in the work or used temporarily for the construction shall conform to the relevant IS Specifications unless stated otherwise and be of best approved quality.

a) Cement

Ordinary Portland Cement (OPC) Grade 43 shall be used for all structures.

For mix design, water cement ratio would not exceed 0.45. Chloride free sulphonated melamine based super plasticizer conforming to IS:9103 shall be added as per mix design and manufacturer’s instructions to improve workability.

b) Coarse Aggregate

Aggregate of sizes ranging between 4.75 mm & 150 mm shall be termed as Coarse Aggregate. Only Coarse Aggregate from approved quarries & conforming to IS: 383 shall be allowed to be used on the works. Aggregates shall be washed to make it free



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 1



from deleterious materials, if necessary.

c) **Fine Aggregate**

Aggregate smaller than 4.75 mm and within the grading limits and other requirements set in IS: 383 is termed as Fine Aggregate or Sand. Only Fine Aggregate from approved sources and conforming to the above IS Specification shall be allowed to be used on works.

In certain cases crushed stone sand may be added to natural sand in order to achieve the required grading with prior approval of the Owner.

Crushed stone sand alone may be used only with the prior approval of the Engineer for filling and PCC works only.

d) **Water**

Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts and other impurities. Normally potable water is found to be suitable. Generally, IS: 3550 shall be followed for routine tests. In case of doubt, the acceptance test for water shall be as per IS: 3025 and Table-I of IS: 456.

f) **Admixture**

Only admixtures of approved quality shall be used when directed or permitted by the Engineer in Charge. The admixture shall conform to IS: 9103.

g) **Reinforcement**

The reinforcement used shall be cold worked steel high strength deformed bars of grade Fe 415/Fe 500 conforming to IS:1786- latest.

21.04.00 Storage of Materials

a) All materials shall be so stored as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Engineer, shall not be used for concrete and shall be removed from site immediately. The contractor shall maintain up-to-date accounts of receipt, issue and balance (stack wise) of all materials. Storage of materials shall conform to IS: 4082.

b) Cement shall be stored off the ground in dry, leak proof, well-ventilated ware-house at the works in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter. Sufficient space of storage with open passages should be arranged between stacks. Cement shall be stored in easily countable stacks with consignment identification marks arranged in the order



of their receipts at site. Sub standards or partly set cement shall not be used; and shall be removed from the site, as soon as it is detected.

- c) Aggregates shall be stored on planks or on steel plates or on concrete or masonry surface. Each size shall be kept separated with wooden or steel or concrete or masonry bulk-heads or in stockpiles stacks and sufficient care shall be taken to prevent the material at the edges of the stockpiles from getting intermixed. Stacks of fine & coarse aggregate shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of suitable depths
- d) Reinforcing shall be stored consignment –wise and size wise off the ground & under cover. It shall be protected from rusting, oil, grease and distortions.

The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

21.05.00 Quality Control

Contractor shall establish and maintain quality control for different items of work and material to assure compliance with spec requirements and submit to the Engineer. The quality control operation shall include but not be limited to the following items of work :-

- a) Admixture : Type, quantity, physical and chemical properties that affect strength, workability and durability of concrete. For air entraining admixtures, doses to be adjusted to maintain air contents within desirable limits.
- b) Aggregates : Physical, chemical, mineralogical qualities, grading moisture contents and impurities.
- c) Water : Impurities test.
- d) Cement : Test to satisfy relevant IS: Specification
- e) Form work : Material shape, dimension, lines, elevation, surface finish, adequacy of form, ties, bracing and shoring & coating.
- f) Reinforcement : Shape, Dimension, Length of splices, clearances ties and supports. Quality & requirement of welded splices. Material test and certificates to satisfy relevant IS: Specification.
- g) Grade of concrete : Usage & Mixdesign. Testing of all



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 13



- properties.
- h) Batching & Mixing : Types & capacities of Plant, concrete mixtures and transportation equipment.
- i) Joints : Location of joints, water stops and filler quality and materials. Dimension of joints, shape of joints material and splices.
- j) Embedments & anchorage items : Material, shape, location and setting.
- k) Placing : Preparation, rate of pouring, weather limitations, time intervals between mixing and placing and between two successive lifts, covering over dry or wet surfaces, cleaning and preparation of surfaces on which concrete is to be placed, application mortar, slurry for proper bond, prevention of cold joints and type of chutes or conveyors.
- l) Compaction : Number of vibrators, their prime movers, frequency and amplitude of vibration, diameters and weight of vibrators, duration of vibrator, hands spreading and rodding and tamping.
- m) Setting of base : Lines, elevation and bedding mortar.
- n) Concrete finishes : Repair of surface defects, screening, floating, steel trowelling and brooming special finishes.
- o) Curing : Methods and length of time.

21.06.00 Concrete Mix Requirements

Concrete mix requirements shall be in accordance with IS:456 and as supplemented and modified herein or by other best possible standards.

- a) Washing & Screening of coarse and fine aggregates shall be carried out to remove fines, dirt and other deleterious material.
- b) Admixture: All concrete shall be designed for normal rate of setting and hardening at normal temperature and humidity under different climatic conditions. Admixtures shall be used in accordance with IS:456 to modify the rate of hardening, to improve workability or an and aid to control quality. The Engineer reserves the right to order for laboratory test or use test data or



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 4



other satisfactory reference before granting approval. The admixture shall be used strictly in accordance with the manufacturer's directions and/or as desired by the Engineer.

- c) Concrete grades to be used in different parts of work shall be as shown on the drawings or as per the Engineer's instructions. In case of liquid retaining structures, IS:3370 shall be followed.

- d) Proportioning of ingredients of concrete shall be made either with preliminary test by designing the concrete mix ["Design Mix Concrete "] or without preliminary test adopting nominal concrete mix. Design mix concrete shall be used on all concrete works while nominal mix concrete, as per IS:456, may be used as shown on drawings and approved by the Engineer. In all cases, the proportioning of ingredients and works control shall be in accordance with IS:456 and its adequacy after obtaining Engineer's approval.

- e) **Mix Design Concrete**

Concrete mixes shall be designed by the contractor to achieve the strength, durability and workability economically with various ingredients. In general the design will keep in view the following considerations :

- i) Consistent with the various other requirements of the mix, the quantity of water should be kept at the lowest possible level.
- ii) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.
- iii) The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix.
- iv) Chemical admixtures may be used to modify the rate of hardening and improve workability.
- v) The finished concrete should have adequate durability in all conditions, to withstand satisfactorily the weather and other destructive agencies which it is expected to be subjected to in actual service.
- vi) Concrete Mix Design and Strength requirements

Concrete mix design shall be as per IS: 10262 and SP: 23. The strength requirements of both design mix and nominal mix concrete where ordinary Portland cement or Portland slag cement is used shall be as per Table-2 of IS: 456. All other relevant clauses of IS: 456 shall also apply.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 5



f) Minimum cement content

The minimum cement content for each grade of concrete shall be as shown below:

TABLE – I
MINIMUM CEMENT CONTENT & MAX. W / C RATIO SPECIFIED
FOR
DIFFERENT GRADES OF CONCRETE

Sl no	Class	Conc Grade	Min cement content (kg/cum)	Water, Cement ratio	Slump (mm)
1	Plain concrete used for lean concrete.	M 10	-	-	-
2	Backfill	M 15	250	0.5	-
3	Pavement around buildings, Base plate encasement, etc.	M 20	320	0.55	80+/20
4	Precast concrete	M 25	365	0.50	Do
5	a) Reinforced concrete for structural work in foundation & superstructure	M 30	365 - 400	0.45	Do
	b) Reinforced concrete for Water retaining structure (not in contact with sea water)	M 30	365 - 400	0.45	Do
6	TG top deck, Chimney shell & structures coming in contact of sea water.	M 35	365-400	0.45	Do
7	Natural draft Cooling Tower	M 40	365-400	0.40	Do

The Engineer will always have the unquestionable right to revise the minimum cement content as decided above, if, in his opinion, there is any chance of deterioration of quality on account of use of lower cement content or any other reason.

g) Water-Cement Ratio

The choice of water-cement ratio in designing a concrete mix will depend on

- i) The requirement of strength.
- ii) The requirement of durability.

i) Strength Requirements of Concrete Mix

In case of 'Design Mix Concrete', the water-cement ratio of such value as to give



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 6



acceptable test results as per IS: 456 will be selected by trial and error. The values of water- cement ratios for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Engineer.

Frequent checks on test will have to be carried out and the water-cement ratios will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the Contractor's responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered.

In case of nominal mix concrete, the maximum water-cement ratio for different grades of concrete is specified in Table-9 of IS: 456 and no tests are necessary. The acceptance test criteria for nominal mix concrete shall be as per IS: 456.

ii) Durability

Tables 4 of IS:456 give the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks and contact with harmful chemicals. Impermeability may also be an important consideration.

Whenever the water-cement ratio dictated by durability consideration is lower than that required from strength criterion, the former shall be adopted.

In general the water cement ratio between 0.4 and 0.45 will be desirable to satisfy the durability requirement and from the consideration of Impermeability of concrete. The contractor may propose lower water cement ratio as mentioned above by addition of a suitable plasticizer / super- plasticizer.

h) Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedment's and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. The limits of consistency for various types of structures as per Table – I With the permission of the Engineer. For any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. No extra payment will be made for this additional cement.

The workability of concrete shall be checked at frequent intervals by slump tests. Alternatively where facilities exist or if required by the Engineer, the compacting factor test in accordance with IS: 1199 and Clause 7 of IS: 456 shall be carried out.

i) Size of Coarse Aggregates

The maximum size of coarse aggregates for different locations shall be as follows



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 17



unless otherwise directed by the Engineer:

Reinforced concrete except foundation
mm - 20

Ordinary Plain concrete and Reinforced concrete foundations
mm - 40

Grading of coarse aggregates for a particular size shall conform to relevant I.S. Codes and shall also be such as to produce a dense concrete of the specified proportions, strength and consistency that will work readily into position without segregation.

Coarse aggregate will normally be separated into the following sizes and stacked separately in properly designed stockpiles 40 mm to 20 mm and 20 mm to 5 mm.

In certain cases it may be necessary to further split the 20 mm to 5 mm fraction into 20 mm to 10 mm and 10 mm to 5 mm fractions.

This separation of aggregates in different size fractions is necessary so that they may be remixed in the desired proportion to arrive at a correct internal

j) **Mixing of Concrete**

Concrete shall always be mixed in mechanical mixer for unimportant works & in small quantities. Water shall not normally be charged into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for atleast one minute. Mixing of each batch shall be continued for uniform distribution of the materials with uniform mass in colour and consistency, but in no case shall mixing be done for less than 2 minutes and at least 40 revolutions after all the materials and water are in the drum. When absorbent aggregates are used or when the mix is very dry, the

mixing time shall be extended as needed. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

Controlled concrete only in batching plant shall be used for power house column foundation, TG, boiler foundation, ID, FD, PA, BFP foundations, chimney cooling tower & other important structure.

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time, the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Purchaser to allow for loss in the drum.

Regular checks on mixer efficiency shall be carried out as per IS: 4634 on all mixers employed at site. Only those mixers whose efficiencies are within the tolerances



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 8



specified in IS: 1791 should be allowed to be employed. Batching Plant where used shall conform to IS: 4925.

Hand mixing if permitted shall be carried out on a water-tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand-mixing, 10% extra cement shall be added to each batch at no extra cost to the Purchaser.

Crushed ice shall be used in concrete mixing water so as to maintain temperature in the concrete in the top decks of the machine foundations. Arrangements for standby weight batching plant and equipment shall also be made available by the contractor for continuous pour of concrete.

k) **Conveying Concrete**

Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means, concrete shall be placed and compacted in the final position before the initial setting of the cement starts. Concrete should be conveyed in such a way preventing segregation or loss of any of the ingredients. For long distance haulage, agitator cars of approved design should be used. If, inspite of all precautions, segregation does occur during transport, the concrete shall be properly remixed before placement. During very hot weather, concrete shall be transported in deep container to reduce the rate of loss of water by evaporation or loss of heat. If necessary, the container should be covered. Conveying equipment for concrete shall be well maintained and thoroughly cleaned before commencement of concrete mixing. Such equipment shall be kept free from set concrete.

l) **Placing and Compacting of Concrete**

i) Relevant I.S. Code should be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. Concrete shall be placed against the surfaces of formwork or construction joint in concrete or masonry. The surface against which concrete is placed shall be cleaned thoroughly. Old construction joint has to be roughened by wire brushing, chipping sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. shall be removed by air water jetting or water at high pressure.

Concrete shall be placed in the formwork by approved means, and shall not be dropped from a height or handled in a manner which may cause segregation.

ii) Construction joint shall be kept moist for atleast 72 hours prior to placement. Concrete shall be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution shall be adopted. Formwork shall be cleaned thoroughly and smeared lightly with form oil or grease of approved quality



just prior to placement.

- iii) 12 mm thick mortar with less w/c ratio as that of the concrete being placed and cement slurry shall be spread thoroughly on the construction joint just prior to placement of concrete. The concrete shall be spread, and thoroughly compacted without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant IS. In thin members with heavy congestion of reinforcement of other embedments, where effective use of internal vibrator is, doubtful, in addition to immersion vibrators, the contractor should employ form vibrators conforming to IS: 4656. For slabs and other similar structures, the contractor should employ screed vibrator as per IS: 2506. Care must be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or distorted during placing and consolidation of concrete.
- iv) The rate of placement of concrete shall be such that no cold joint is formed; and fresh concrete is placed always against green, plastic and workable concrete. No concrete shall be placed in open during rains. During rainy season, no placement in the open should be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete.
- v) Slabs, beams and similar members shall be poured in one operation. Moulding, throating, drip course, etc., shall be poured as per the drawings. Holes shall be provided and bolts, sleeves, anchors, fastenings or other fixtures shall be embedded in concrete as per drawings. In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same.

The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement. Once the concrete is deposited, consolidated and finished in its final position, it shall not be disturbed.

21.07.00 a) Construction Joints

Concrete structure shall be completed by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete at certain predetermined stages. These joints shall be formed as per drawings. Vertical construction joints shall be made with rigid



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 2 0



stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. For water retaining structures and leak proof buildings suitable and approved water stops shall be installed at the construction joints as per clause 12.4 of IS:456. Where the location of the joints are not specified, it shall be in accordance with the following :-

- i) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.
- ii) Concrete in a beam shall preferably be placed without a joint, but if provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span.
- iii) A joint in a suspended floor slab shall be vertical and at the middle of the span and at right angles to the principal reinforcement.
- iv) Feather-edges in concrete shall be avoided while forming a joint.
- v) A construction joint should preferably be placed in a low stress zone and at right angles to the direction of the principal stress.

b) Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The contractor should always remain vigilant to avoid cold joints. If however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it :-

- i) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete should be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible, and the joint thoroughly and systematically vibrated.
- ii) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface shall be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness, shall be placed on the cold joint, fresh concrete shall be placed on the mortar layer and the joint shall be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.
- iii) In case the concrete at the joint has become so stiff that it cannot be remolded and mortar or slurry does not rise inspite of extensive vibration, the



joint shall be left to harden for atleast 12 to 24 hrs. It shall then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as indicated above.

c) Expansion And Isolation Joints

i) Expansion and isolation joints in concrete structures shall be provided at specific places as shown on the drawings with materials and types of joints as specified. In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids as specified on the drawings. All materials should be procured from reliable manufacturers to the approval of the Engineer. Test certificates for the materials should be furnished. Joints shall be formed true to line, level, shape, dimension and quality as per drawings and specifications. Prior approval from concerned engineer of the method of forming the joints should be obtained.

ii) Duraboard HD or its equivalent of approved manufacturer shall be used as filler for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as recommended by the manufacturer.

Commercial quality of expanded polystyrene products commonly used for thermal insulation can also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material should be procured from reliable manufacturers as approved by the Engineer. The method of installation shall be similar to that recommended by the manufacturer for fixing on walls. A coat of bitumen paint shall be applied on the board against which concrete is placed.

iii) Joint sealing strips shall be provided at the construction, expansion and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure. General strips shall be of PVC or otherwise as specified. Sealing strips shall not have any longitudinal joint; and shall be procured and installed in largest practicable lengths having a minimum number of transverse joints. The material shall be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations. The contractor should supply all labour and materials for installation including the material and tools required for jointing, testing, protection, etc. The joints in rubber seals shall be vulcanised as needed.



- iv) The minimum thickness of P.V.C. sealing strips shall be 3 mm and the minimum width 100mm. The actual size and shape shall be as shown in drawings. The material should be of good quality Polyvinyl Chloride highly resistant to tarring, abrasion and corrosion as well as to chemicals likely to come in contact with during use. The physical properties shall generally be as follows:
- i) Specific Gravity : 1.3 to 1.35
 - ii) Shore Hardness : 60A to 80A
 - iii) Tensile Strength : 10 to 15 N/Sq.mm
 - iv) Maximum Safe Continuous Temperature : 70 Deg.C
 - v) Ultimate Elongation : Not less than 275%
 - vi) Bitumen Compound: When directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per Manufacturer's recommendation. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS: 1834.
 - vi) Isolation Joints: Strong and tough alkathene sheet or equivalent, about 1 mm in thickness shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete, to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.
 - vii) Rubber Pad: Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings. The rubber shall have a unit weight of 1500 kg/cum, shore hardness – 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.
 - viii) All foundation structures in contact with soil shall be coated with two coats of Bituminous coating.

21.08.00 Repairs, Finishes and Treatment of Concrete Surfaces

- a) Adequate and sound concrete surfaces, whether formed or unformed, should



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 2 3



be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing and consolidation by experienced workmen.

- b) Unsound concrete resulting from improper mix design, incompetent methods, equipment and form work, poor workmanship and protection shall not be accepted and shall be dismantled, removed and replaced by sound concrete at the contractor's cost. All concrete work shall be inspected by the contractor immediately after the forms are removed and he should promptly report of occurrence of any defects to the Engineer. All repair works should be carried out as per the instructions and in the presence of the Engineer. Generally, repair work shall consist of any or all of the following operations :
- i) Sack rubbing with mortar and stoning with carborundum stone.
 - ii) Cutting away the defective concrete to the required depth and shape.
 - iii) Cleaning of reinforcement and embedments.
 - iv) Roughening by sand blasting or chipping.
 - v) Installing additional reinforcement/ welded mesh fabric.
 - vi) Dry packing with stiff mortar.
 - vii) Plastering, guniting, shotcreting etc.
 - viii) Placing and compacting concrete in the void left by cutting out defective concrete.
 - ix) Grouting with cement sand slurry of 1:1 mix.

c) Finishing Unformed Surface

The requirement of finishes of formed surfaces are specified hereunder separately. The contractor should include for concrete, the provision of normal finishes in unformed surfaces which can be achieved by screeding, floating, trowelling etc. A few typical and common cases of treatment of concrete surface are cited below :

- i) Floor: For non-integral floor finish, the surface of reinforcement concrete slab shall be struck off at the specified levels and slopes and finished with a wooden float fairly smooth removing all laitance. No over trowelling, to obtain a very smooth surface, shall be done as it will prevent adequate bond with the subsequent finish. The surface shall be scored and marked to provide better bond.



For monolithic finish, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type; and then floated with a wooden float. Steel trowelling should then started after the moisture film & shine disappeared from the surface; and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done should flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes, ripples and trowel marks. A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water should be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface. To provide a better grip, the floor should be marked in a regular geometric pattern after initial trowelling.

ii) Beams, Columns & Walls: If on any other concrete structure, it is intended to apply plaster or such concrete surfaces against which brick- work or other allied works are to be built, the contractor shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop.

d) Protection and Curing of concrete: Newly placed concrete shall be protected from rain, sun and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days. Steps shall be taken to protect immature concrete from damage by debris, excessive loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, hessian, canvas or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water shall be allowed if the Engineer is satisfied with the adequacy of the arrangements made by the contractor.

The contractor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. In case any lapse on the part of the contractor is noticed, the Engineer will inform the contractor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the contractor within 3 hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and recover the cost thereof from the contractor.

21.09.00

a) **Reinforcement**

The reinforcement used shall be cold worked steel high strength deformed



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 2 5



bars of grade Fe 415/ Fe 500 conforming to IS:1786 – latest.

All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete.

b) Bar Bending Schedules

The contractor shall submit to the Engineer bar bending schedules with working drawings showing clearly the arrangements proposed by the contractor. Upon receipt of the Engineer's final approval of the bar bending schedule and drawings, the contractor shall submit the final drawings with one reproducible print after incorporating necessary modifications or corrections, for final record and distribution. Approval of such detailed drawings shall not relieve the contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the contractor.

c) Bending

Reinforcing steel shall be bent in accordance with the procedure specified in IS:2502. Bends and shapes shall comply strictly with the dimensions corresponding to the approved bar bending schedules which shall be rechecked by the contractor before any bending is done.

No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Re-bending can be done only if approved by the Engineer. Reinforcing bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent.

d) Placing in position

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings. Bars at crossing points, shall be securely tied together by # 20G annealed soft iron PVC coated wire or by tack welding in case of bar larger than 25 mm dia. binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained with FBEC spacer bars. They should be spaced such that the main bars do not sag perceptibly between adjacent spacers. Before actual placing, the contractor shall study the drawings thoroughly and inform the Engineer in case he feels that placement of certain bars is not possible due to congestion. In such cases, he should not start placing any bar before obtaining clearance from the Engineer.

e) Welding

Normal bond laps in reinforcement should be placed by lap or butt welding reinforcement bars. The work should be done with suitable safe guards as per



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 2 6



IS for welding of mild steel bars used in reinforced concrete construction as per IS: 2751 and IS: 456. Welded mesh fabrics to IS:566 shall also be as per drawings.

f) **Control**

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars shall be as per IS: 456. If the bars in a lap are not of the same diameter, the smaller will guide the lap length. The laps shall be staggered as far as practicable. Arrangements for placing concrete shall be such that reinforcement in position do not have to bear extra load and get disturbed.

The cover for concrete over the reinforcements shall be as shown on the approved drawings. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar not leaner than 1part cement to 2 parts sand by volume and cured in a pond for at least 14 days. The type, shape, size and location of the concrete blocks shall be as approved by the Engineer.

g) **Cold Weather Concreting**

When conditions are such that the ambient temperature may be expected to be 4.5 Deg.C or below during the placing and curing period, the work shall conform to the requirements of clause 13 of IS: 456 and IS: 7861.

h) **Hot Weather Concreting**

When depositing concrete in very hot weather, the contractor shall take all precautions as per IS: 7861 and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 38oC while placing.

21.10.00 Form Work

- a) The contractor shall prepare, before commencement of actual work, designs and working drawings for formwork and centering. The formwork shall conform to the shape, grade, lines, levels and dimensions as shown on the drawings. Materials used for the formwork inclusive of the supports and centering shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel.
- b) The centering shall be true to vertical, rigid and thoroughly braced both



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 2 7



horizontally and diagonally. Rakes shall be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight of the concrete as a liquid as well as the working load. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel or concrete of adequate strength shall be used. Bolts passing completely through liquid retaining walls/ slabs for the purpose of securing and aligning the formwork shall not be used.

- c) The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified as directed by him.

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all column forms are plumb and true and thoroughly cross braced to keep them so. All floor and beam centering shall be crowned not less than 8 mm in all directions for every 5 meters span. Bevelled forms 25 mm x 25 mm shall be fixed in the form-work at all corners to provide chamfering of the finished concrete edges. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base of vertical forms and at other places as necessary. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete.

d) Cleaning and Treatment of Forms

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, saw dust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/ or water jet along with wire brushes, brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil or other compound before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 2 8



e) Design

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork. Removing any props or repropping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.

f) Inspection of Forms

Casting of concrete shall start only after the formwork inspection and approval by the Engineer. The concreting shall start as early as possible within 3 days after the approval of the formwork; and during this period, the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

g) Removal of Forms

Before removing any formwork, the contractor must notify the Engineer well in advance to enable him to inspect the concrete if he so desires. The contractor shall record the date on which concrete is placed in each part of the work; and the date on which the formwork is removed there from. The contractor shall be responsible for the safe removal of the formwork; and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him. Forms for various types of structural components shall not be removed before the minimum periods as detailed below:

SCHEDULE OF REMOVAL OF FORM

Part of Structure	Ordinary Portland Cement Concrete				Rapid Hardening Portland Cement Concrete			
	Temperature ($^{\circ}\text{C}$)				Temperature ($^{\circ}\text{C}$)			
	Above 40°C	40°C to 20°C	20°C to 5°C	Below 5°C	Above 40°C	40°C to 20°C	20°C to 5°C	Below 5°C
	Days	Days	Days	Days	Days	Days	Days	Days
a) Columns & Walls	2	1	1	Do not remove forms until	1	1	1	Do not remove forms
b) Beam sides	3	2	3		2	1	1	



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 2 9



c) Slabs, 125 mm	10	7	8	site cured test specimen develop atleast 50% of the specified 28 days strength	7	4	5	until site cured test specimen develop atleast 50% of the specified 28 days strength
d) Slabs over 125 mm thick and soffit of minor beams	18	14	16		12	8	9	
e) Soffit of main beams	24	21	22		14	10	12	

Wherever exposed surfaces of concrete can be effectively sealed to prevent loss of water, the periods specified for temperature above 40oC can be reduced to those of the temperature range of 20oC to 40oC.

Construction joints in beams shall be located at the middle of span. In such cases, however, entire span of beam shall have to be kept supported by formwork till its removal for the portion of beam, cast at a later date.

h) Tolerance

The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances :-

i)	Sectional dimension	-	± 5 mm
ii)	Plumb	-	1 in 1000 of height
iii)	Levels	-	± 3 mm before any has taken

deflection
place

The above tolerance shall be for local aberrations in the finished concrete surface, and should not be taken as tolerances for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible. Any error, within the above tolerance limits if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

i) Re-use of Forms

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired and inside surface treated as specified hereinbefore. Formwork shall not be used / re-used if declared unfit or unserviceable by the Engineer.

j) Generally, the “ordinary” class formwork shall be used in places where



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 3 0



ordinary surface finish is required and shall be composed of steel and/ or approved good quality partially seasoned timber. Plywood formwork shall be used in exposed surfaces, where a specially good finish is required and shall

be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilization of used plywood for the “ordinary” class, if it is still in good condition. Ornamental formwork shall be used where ornamental and curved surfaces are required and shall be made of selected best quality well seasoned timber or plywood, which can be shaped correctly. The contractor shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings.

21.11.00 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers / Conduits / Pipe and Other Misc.Embedded Fixtures

The contractor shall build into concrete work all the items as noted below; and shall embed them partly or fully as directed and secure the same as may be required. The materials shall be as specified and be of best quality available according to relevant IS and of approved manufacture to the satisfaction of the Engineer. Exposed surfaces of embedded materials shall be painted with one coat of approved anti-corrosive paint and/or bituminous paint. If welding is to be done subsequently on the exposed surfaces of embedded material, the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line. Necessary templates, jigs, fixtures, supports etc. shall be used as required items to be embedded shall be as follows:

- i) Inserts, hangers, anchors, frames around openings, manhole covers, Frames, floor clips, sleeves conduits and pipes.
- ii) Anchor bolts and plates for machinery, equipment and for structural steel work.
- iii) Dowel bars, etc. for concrete work
- iv) Lugs or plugs for door and window frames occurring in concrete work. v) Flashing and jointing in concrete work.
- vi) Any misc. embedments and fixture as may be required.
- vii) Convextra-GP2, Sikka grout or equivalent grouting material shall be used as per manufacturer’s specification.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 3 1



Correct location and alignment, as per drawings/instructions of all these embedded items shall be entirely the responsibility of the contractor.

21.12.00 Precast Concrete

The precast concrete shall be similar as for the cast-in-place concrete described herein. All precast work shall be carried out in a yard which shall be dry, properly levelled and having a hard and even surface. It shall be paved with concrete or masonry as needed; and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Casing shall be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 days of curing and can be removed for erection after 28 days of curing. The moulds shall be of steel or of timber lined with G.I. sheet metal.

Lifting hooks as necessary shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection. Precast concrete units, when ready, shall be transported to site by suitable means. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling and plumbing shall be done as per instructions of the Engineer. The contractor shall render all help with instruments, materials and men to the Engineer for checking the proper erection of the precast units.

21.13.00 Sampling and Testing

The contractor shall carry out all sampling and testing as per IS for the following items:

a) Cement

Representative samples shall be taken from each consignment of cement received from the manufacturer / supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths as per IS:269. Soundness Tests shall also be carried out as required. No cement from a particular consignment / batch shall be used on the works unless satisfactory 3 days and 7 days test results for compressive strength are known. These tests shall be of great importance as their results shall have bearing on the acceptance of concrete or otherwise.

b) Aggregates

The contractor shall carry out any or all the tests of aggregates as required as per IS:2386 Parts-I to VIII. The acceptance criteria of the samples tested shall be as per the relevant IS.

c) Water



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 3 2



Water for concrete works shall be tested as per IS: 3550 by the contractor at regular intervals and whenever directed by the Engineer. The final acceptance criteria in case of doubt shall be as per IS: 3025 & IS: 456.

d) Admixture

Air Entraining Agents (AEA): Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cylinder cube crushing strength vis-à-vis quantity of A.E.A. used for all types of concrete shall be established by the contractor by carrying out sufficiently large number of tests. After than, at regular intervals and whenever directed by the Engineer, the contractor should check up, the actual percentages of air entrained and corresponding crushing strengths to correlate with the earlier test results. Tests for establishing the various properties of any other admixtures which may be required to be added shall be carried out by the contractor.

e) Concrete

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be as per IS:516 and IS:1199 with the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed apart from other tests as per IS:516. Sampling procedure, frequency of sampling and test specimen shall conform to clause 15 of IS: 456. To control the consistency of concrete from every mixing plant, slump tests and / or compacting factor tests in accordance with IS:1199 and as per clause 7.3.7(f) above shall be carried out by the contractor every 2 hours. Slumps corresponding to the test specimens shall be recorded for reference. The acceptance criteria of concrete shall be in accordance with clause 16 of IS:456. Concrete work found unsuitable for acceptance shall have to be dismantled and replacement shall be done as per specification by the contractor. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good by the contractor to the satisfaction of the Engineer.

f) Concrete for Equipment or Steel Structures Foundations

Concrete for equipment foundation, whether principal or auxiliary, shall be poured continuously so that the structure becomes monolithic, particular care being exercised to see that the base slabs, if any, are of compact impervious construction. Tunnels, passages apertures and so forth shall be provided in accordance with the drawings for the installation of mechanical and electrical equipment, pipes or cables. The top elevation of the equipment foundations or parts shall be accurately cast to 20/50 mm (or more as may be specified on the drawings) above the level required for grouting and it shall be pneumatically chiseled of and well roughened just prior to the erection of the equipment concerned. All embedded anchor bolts or bolt sleeves shall be accurately and firmly set with the aid of approved templates, steel supports



and / or other accessories. For holding the embedded bolts or sleeves in the correct position during concreting, template shall have to be of steel of suitable section approved by the Engineer in Charge. Two (2) sets of templates shall have to be provided, one to hold the bottom and the other the top of the bolts or sleeves. The bottom template shall be securely and rigidly fixed by providing anchorage arrangement and by welding to the lowest part of the steel reinforcement and other structural supports. The top templates shall be securely fixed by tying with guy wires and turn buckle arrangement to firm and rigid adjoining structures and stagings.

Bolt pockets, where required, shall be cast with wooden taper wedges. These shall be withdrawn at an appropriate time when the concrete has set, the pockets cleaned roughened and then covered or blocked thoroughly to prevent debris getting into these. The exposed portions of bolts and embedded parts shall be kept well greased and adequately protected from damage throughout construction. Any damages found shall have to be corrected at the contractor cost. The Purchaser shall have the right to use the foundations, pads, piers, slabs, floors and all concrete work as needed for other works or equipment erected prior to its "Taking over".

21.14.00 Acceptance Criteria

- a) Standard deviation shall be based on test results; and determination of standard deviation shall conform to clause 14.5 of IS:456. The strength requirements and acceptance criteria shall conform to clause 15 of IS:456. Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to clause 16 of IS:456.
- b) **Load Test**
 - i) Load tests of structural members as required, when the strength of test specimen results fall below the required strength, as per „Load Test on Parts of Structures”, clause 17.6 of IS:456. If load testing is decided by the Engineer, the member under consideration shall be subjected to a test load equal to 1.25 (one and a quarter) times the specified live load used for design and this load shall be maintained for a period of 24 (twenty four) hours before removal. The detailed procedure of the test shall be decided by the Engineer. Load tests shall not be made until the structure is at least 56 days old.
 - ii) If the member shows evident failure, such changes as necessary to make the structure adequately strong, shall be made by the contractor, if permitted under Statutory Regulations to the discretion of the Engineer, the structure under test or a portion thereof may be retained as such without any modification by derating its load bearing capacity, provided the design criteria allows such derating.
 - iii) A reinforced concrete beam, floor or roof shall be deemed to have passed the test, if the maximum deflection at the end of 24 hours does not exceed the deflection given in clause 17.6 of IS: 456. If a portion of the structure is



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 3 4



found to be unacceptable, it shall be dismantled and replaced by a new structure as specified. If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same shall be made good, by the contractor to the satisfaction of the Engineer.

21.15.00 Tolerances

The permissible tolerances are as follows :-

- a) Tolerances for RC buildings
- b) Variation from the plumb
- c) In the lines and surfaces of columns, piers, walls and in arises 5mm per 2.5m but not more than 25mm.
- d) For exposed corner columns and other conspicuous lines:

In any bay upto 5m	=	5mm
In 10m or more	=	10mm
- e) Variation from the level or from the grades indicated on the drawings:
 - i. In slab soffits, ceilings, beam soffits and in arises:

In 2.5m	=	5mm
In any bay upto 5m	=	8mm
In 10m or more	=	15mm
 - ii. For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines:

In any bay upto 5m	=	5mm
In 10m or more	=	10mm
 - i. Variation of the linear buildings lines from established position in plan and related position in plan and related position of columns, walls and partitions.

In any bay upto 5m	=	10mm



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 3 5



DESEIN

Volume-VI (B) : Civil, Structural & Architectural Works

- In 10m or more = 10mm
- ii. Variation in the sizes and locations of sleeves, openings in walls and floors = 5mm
(Except in the case of and for anchor bolts.)
- iii. Variation in cross-sectional dimensions of columns and beams the thickness of slabs and walls:-
- Minus = 5mm
Plus = 10mm
- f) Footings
- g) Misplacement or eccentricity
- 2% of footing width in the direction of misplacement but not more than 50mm
- h) Reduction in thickness
- Minus = 5% of specified thickness subject to a maximum of 50mm
- i) Variation in steps
- In a flight of stairs
- Rise = 3mm
Tread = 5mm
- In consecutive steps
- Rise = 1.5mm
Tread = 3mm
- j) Tolerances in other concrete structures
- i) Variation of the constructed linear outline from established position in plan.
- In 5 m = 10mm
In 10m or more = 15mm



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 3 6



- ii. Variations of dimensions to individual structure features from established positions:
- | | | |
|------------------------|---|------|
| In 20m or more | = | 25mm |
| In buried construction | = | 50mm |
- iii. Variation from plumb, from specified batter or from curved surfaces of all structures:
- | | | |
|--------------------------|---|-------------------------|
| In 2.5 m | = | 10mm |
| In 5m | = | 15mm |
| In 10m or more | = | 25mm |
| In buried – construction | = | Twice the above amounts |
- iv. Variation from level or grade indicated on drawings in slab, beams, soffits, horizontal grooves and visible arises:
- | | | |
|--------------------------|---|-------------------------|
| In 2.5 m | = | 5mm |
| In 7.5m | = | 10mm |
| In buried – construction | = | Twice the above amounts |
- v. Variation in cross-sectional dimensions of columns, beams, buttresses, piers and similar members:
- | | | |
|-------|---|------|
| Minus | = | 5mm |
| Plus | = | 10mm |
- vi. Variation in the thickness of slabs, walls, arch section and similar members:
- | | | |
|-------|---|------|
| Minus | = | 5mm |
| Plus | = | 10mm |
- vii. Misplacement of eccentricity:
2% of footing width in the direction of misplacement but not more than 50mm.
- viii. Reduction in thickness:
5% of specified thickness subject to a maximum of 50mm.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 3 7



Tolerance in other types of structures shall generally conform to those given in clause 2.4 or recommended practice for concrete formwork (ACI347).

ix. Tolerance in fixing anchor bolts shall be as follows:

(i) Anchor bolts without sleeves +1.5mm in plan.

(ii) Anchor bolts with sleeves +5.0mm in elevation.

a) For bolts upto and including 25mm dia +mm in all directions.

b) For bolts 32mm dia and above +3mm in all directions.

(iii) Embedded parts +5mm in all directions.

21.16.00 Special Conditions For Construction of TG Foundation

a) Scope

i) The work to be performed under this contract consists of providing all materials except those supplied by the Purchaser, shuttering, staging, inserts, construction equipment, labour and all incidental items not shown or specified but reasonably implied or necessary for the proper completion of the work, all in the strict accordance with the drawings, schedules and specifications and including revisions and amendments thereto and such detailed drawings as may be provided by the Consultant, during the execution of the work.

ii) It is not the intent to specify completely herein all the details of designs and construction of the structure. However, the structure shall conform in all respects to high standards of Engineering, design and workmanship and be capable of performing in continuous commercial operation upto contractors guarantee in the manner acceptable to the Purchaser / Consultant who will interpret the meaning of drawings and specifications and shall have the power to reject any work or materials which in his judgment are not in full accordance therewith.

b) Form Work

i) All forms shall be abundantly wetted on both sides before concrete is poured. The date of removing forms for each individual stage of construction shall be fixed by the Purchaser / Consultant.

ii) The minimum period for striking of formwork shall be as follows:-



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 3 8



- Vertical sides of beams and pedestals -7 days
- Bottom of beams / slabs -28 days

However, the vertical faces shall be loosened after 24 hours of completion of concreting the supports.

- iii) Concrete surface shall not normally be patched or otherwise treated after the removal of forms. Where the surfaces exposed on stripping is not of a satisfactory nature, owing to the contractors failure to take necessary precaution before, during or after the concrete placing, such surfaces shall be worked and finished in accordance with the instructions of the Purchaser / Consultant at the cost of the contractor. The pores shall be filled in with a neat solution of cement and water applied by brush and when dry the surface shall be rubbed down with carborundum stone. The cost of the above treatment shall be deemed to be included in the unit rate entered by Contractor. The top surface of the T.G. deck shall be float-finished, unless otherwise specified to the required levels. There must be no surface grouting or treating which might draw the “fines” to the top. All shuttered surfaces shall be left as they strip without removing boards or panel markings.

Any serious honey combing will render the concrete work liable to rejection and cutting out and re-concreting wholly or partly as the Engineer in Charge directs. All costs involved in repairing defect shall be borne by the Contractor.

- iv) The arrangement and method for movement of workers during TG construction to various levels of the TG foundations shall be submitted well in the advance to the Engineer- in – Charge for his approval far taking up the work.
- v) In addition to the above paras the contractor shall also satisfy all other requirements for formwork mentioned in elsewhere in the specification.

c) Staging

- i) The entire staging for supporting the formwork, walkways and platforms for placing concreting equipments such as vibrators, etc., shall be of structural steel. The staging shall be designed for the worst combination of loading as specified hereinafter.
- ii) The Contractor shall submit 6 copies of design calculations and drawing to prove adequacy of the staging for approval of the consultant. On receipt of final approval, the contractor shall supply 20 copies of approved drawings for distribution.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 3 9



- iii) The staging shall be so designed that no load from platforms are passed on to the formwork at the top.
- iv) All platforms, walkways etc. shall be clear of the formwork and at least 200 mm above it. The width of platforms and walkways shall be at least 1.2 metres for easy movement of labour both ways.
- v) The platforms shall be of planks or bamboo mats (clamped with steel strips suitably stiffened to avoid springing).
- vi) The form work and staging shall be designed for a live load of 1000 Kg/m².
- vii) Unit weight of green concrete shall be considered as 2500kg/m³ for design of form work and staging.
- viii) The staging shall be braced in both the directions.
- ix) The staging shall be supported on rigid surfaces at ground level.
- x) The staging shall be sufficiently rigid to prevent any distortion in the form work.

d) Special Precautions

- i) The contractor shall take all precautions to ensure concreting of TG Raft, columns and TG Deck in one pour each. Concreting shall be continuous and no break in concreting shall be permitted.
- ii) The Contractor shall prepare a scheme for concreting giving details of number of mixers, labour, vibrators, pouring schedule and obtain prior approval of the same from the Engineer-in-Charge before starting of concreting.
- iii) The Contractor shall ensure that at no time the temperature of the green concrete exceeds 38 degree C by taking proper precautions. If required, ice shall be added to control the temperature at no additional cost to the Purchaser.
- vi) Approved “Retarders” shall be used by the contractor in the proportions specified by the manufacturer for total concreting work of the TG foundation. The cost of the admixture shall be included in unit rates quoted by the Bidders.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 4 0



e) Test for Soundness of Concrete

- i) After completion of the construction of TG foundations and all major machine foundation like BFP, FANS, MILLS etc, the contractor shall get the Deck and column tested for soundness of concrete by “ultrasonic wave – non – destructive test method” from reputed research institutions like “SERC-CHENNAI” “CWPRI – POONA”, at no extra cost to the Purchaser.
- ii) If the test report calls for any rectification in the concrete works by way of pressure grouting or otherwise, the same shall be carried out by the contractor at no additional cost to the Purchaser to the satisfaction of the Purchaser / Consultant
- iii) If require, any additional test to establish the adequacy of the rectification works carried out shall be done by the contractor at no extra cost to the Purchaser

f) List of Codes and Standards

All work under this specification shall conform to the latest revisions of Indian Standard specifications and Codes of Practice:

IS : 216	-	Indian Standard Specification for Coal Tar Pitch
IS : 226	-	Indian Standard Specification for Structural Steel [Standard quality]
IS : 269	-	Indian Standard Specification for Ordinary, and Low Heat Portland Cement
IS : 383	-	Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
IS : 432	-	Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement
IS : 455	-	Indian Standard Specification for Slag Cement and Reinforced Concrete
IS : 456	-	Indian Standard Code of Practice for Plain and Reinforced Concrete
IS : 516	-	Indian Standard Specification for Methods of Test for Strength of Concrete.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 4 1



DESEIN

Volume-VI (B) : Civil, Structural & Architectural Works

IS : 1139	-	Indian Standard Specification for Hot Rolled Mild Steel and Medium Tensile Steel and High Yield Strength Steel Deformed Bars for concrete Reinforcement
IS : 1199	-	Indian Standard Specification for Methods of Sampling and Analysis of Concrete
IS : 1200	-	Indian Standard Specification for Method of measurement Cement Concrete Works. Part-II
IS : 1200	-	Indian Standard Specification for Method of Measurement of Part-V Formwork.
IS : 1332	-	Indian Standard Specification for Bitumen Felts for Waterproofing and Damp-proofing.
IS : 1489	-	Indian Standard Specification for Portland – Pozzolona Cement
IS : 1566	-	Indian Standard Specification for Methods of Sampling and Analysis of Concrete
IS : 1609	-	Code of Practice for Laying Damp proof Treatment using Bitumen felts
IS : 1786	-	Indian Standard Specification for Cold-twisted Steel Bars for Concrete Reinforcement
IS : 1791	-	Indian Standard Specification for Batch Type Concrete Mixers
IS: 2210	-	Indian Standard Specification FOR Design of Reinforced Concrete Shell Structures and Folded Plates.
IS : 2386	-	Indian Standard Specification for Methods of Test for Aggregates for Concrete – Part-I to VIII
IS : 2502	-	Indian Standard Code of Practice for Bending and Fixing of Bars for concrete reinforcement
IS : 2505	-	Indian Standard Specification for Concrete Vibrators, Immersion Type
IS: 2506	-	Indian Standard Specification for Screed Board Concrete Vibrators



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 4 2



DESEIN

Volume-VI (B) : Civil, Structural & Architectural Works

IS : 2514	-	Indian Standard Specification for Concrete Vibrating Tables
IS : 2722	-	Indian Standard Specification for Portable Swing weigh Batchers for Concrete (Single and Double Bucket type)
IS : 2770	-	Indian Standard Specification for Method of Testing Bond in Reinforced Concrete.
IS : 3025	-	Indian Standard Specification for Methods of Sampling and Test (Physical and Chemical) for Water used in Industry.
IS : 3201	-	Indian Standard Specification for Design and for construction of Precast Concrete Trusses.
IS : 3370	-	Indian Standard Specification for Code of Practice Concrete Structures for Storage of Liquids.
IS : 3550	-	Indian Standard Specification for Method of Test for Routine Control for Water used in Industry.
IS : 3558	-	Code of Practice for use of Immersion Vibrators for Consolidating Concrete
IS : 3590	-	Indian Standard Specification for Load Bearing Light Weight Concrete Blocks.
IS : 3696	-	Safety Code for Scaffolding and Ladders
IS : 3812	-	Indian Standard Specification for Fly Ash for use as Admixture for Concrete.
IS : 4031	-	Indian Standard Specification for Method of Tests for Hydraulic Cement.
IS : 4082	-	Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at site.
IS : 4634	-	Indian Standard Specification for Method of Testing Performance of Batch-type Concrete Mixes.
IS : 4656	-	Indian Standard Specification for Form Vibrators for Concrete.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 4 3



DESEIN

Volume-VI (B) : Civil, Structural & Architectural Works

IS : 4925	-	Indian Standard Specification for Concrete Batching and Mixing Plant.
IS : 4926	-	Indian Standard Specification for Ready Mixed Concrete.
IS : 4990	-	Indian Standard Specification for Plywood for Concrete Shuttering work.
IS : 4995	-	Indian Standard Specification for Design of Part-I&II Reinforced Concrete Bins for the Storage of Granular and Powdery Materials.
IS : 5512	-	Indian Standard Specification for Flow Table for use in Tests of Hydraulic Cement and Pozzolanic Materials.
IS : 5513	-	Indian Standard Specification for Vicat Apparatus.
IS : 5515	-	Indian Standard Specification for Compaction Factor Apparatus.
IS : 5751	-	Indian Standard Specification for Precast Concrete Coping Blocks.
IS : 5816	-	Indian Standard Specification for Method of Test for Splitting Tensile Strength of Concrete Cylinders.
IS : 5891	-	Indian Standard Specification for Hand Operated Concrete Mixers.
IS : 6452	-	Indian Standard Specification for High Alumina Cement for Structural Use.
IS : 6909	-	Indian Standard Specification for Supersulphated Cement.
IS : 6923	-	Indian Standard Specification for Method of Test for Performance of Screed Board Concrete Vibrators.
IS : 6925	-	Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures.
IS : 7242	-	Indian Standard Specification for Concrete Spreaders.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 4 4



DESEIN

Volume-VI (B) : Civil, Structural & Architectural Works

IS : 7246	-	Indian Standard Specification for Table Vibrators for Consolidating Concrete.
IS : 7251	-	Indian Standard Specification for Concrete Finishers.
IS : 7320	-	Indian Standard Specification for Concrete Slump Test Apparatus.
IS : 7861 Part-I&II	-	Indian Standard Specification for Recommended Practice for Extreme Weather Concreting
IS : 7969	-	Safety Code for Storage and Handling of Building Materials.
IS : 8041E	-	Indian Standard Specification for Rapid Hardening Portland Cement.
IS : 8112	-	Indian Standard Specification for high strength Ordinary Portland Cement.
IS : 8142	-	Indian Standard Specification for Determining Setting time of Concrete by Penetration Resistance.
IS : 8989	-	Safety Code for erection of Concrete Framed Structures.
IS : 9013	-	Indian Standard Specification for Method of Making, Curing and Determining Compressive Strength of Accelerated-cured Concrete Test Specimens.
IS : 9077	-	Code of Practice for Corrosion Protection of Steel Rails in RB and RCC Construction.
IS : 9103	-	Indian Standard Specification for Admixtures for Concrete.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 4 5



22.00.00 CONSTRUCTION OF SHELL BY SLIP-FORM METHOD

22.01.00 Shell construction has to be done by slip form shuttering technique. Type of slip form proposed should be indicated in the offer with sketches, drawings and construction statement as explained hereinafter. Number, type and capacities of jacks, the control system and achievable rate of progress in mm/hour should also be indicated. The chosen scheme shall be of a past proven design. A certified performance record of the scheme should be submitted with the offer to guarantee workability of the scheme both from execution time and safety point of view.

22.02.00 The Contractor should furnish a brief but comprehensive statement indicating the planning & programme and method of work to be followed, for the approval of Purchaser at the time of submitting tender. This statement shall include the following items:

- i) Type and description of slip-form equipment and its accessories
- ii) Design of scaffolding and staging
- iii) Description of materials including admixtures to be used for construction.
- iv) Manpower planning, construction spaces required, standby arrangement.
- v) Rate of slip-forming
- vi) Proposed workability requirement of concrete and type of cement and admixture to be used
- vii) Quality assurance programme
- viii) Method of transportation of material
- ix) Method of curing and rectification of defects
- x) Planned interruption, if proposed, and activities during planned interruption. Treatment of construction joint.
- xi) Contingency solution for unplanned interruption
- xii) Time of completion

22.03.00 While selecting the Contractor, due consideration will be given to the merit of the above mentioned statement proposed by the Contractor and minimum time of completion, apart from his past experience in such types of work as also technical and



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 4 6



financial resources of the Contractor.

22.04.00

Notwithstanding what have been specified in earlier clauses, following guide lines are being presented which should be kept in view by intending Contractor, while quoting for slip form method of construction.

- a) Care to be taken to prevent dragging of concrete along with upward movement of the shuttering. For this purpose following steps are advisable.
 - i) Shutter plates have to be smooth and should be thoroughly Before fixing them in position all the surfaces which will be in contact with concrete to have a coat of epoxy paint.
 - ii) In areas where concrete thickness is 750 mm or more rate of should be such that minimum slipping of shuttering is 100 mm hour.
 - iii) Mix design should be so done that it will be self-lubricant at contact face of shutter and concrete and thus reduce friction cement of approved manufacturer (conforming to relevant specification) may be used for the purpose. An optimum ratio coarse / fine aggregate should be established to suit the depending on availability of aggregates.
 - iv) Mix design also should be so done that it has a slump of 50mm at the point where concrete is placed under an ambient temperature of around 40 Deg.C. This will also keep vibration by needle vibrators to required minimum. Slump should not drop down to zero in less than 45 min. Suitable retarding agent and plasticizer of approved manufacture may be added in mix to achieve this purpose. These admixtures to be properly identified by preliminary tests both for Performance and for compatibility with particular type of cement Proposed to be used.

Additional steps like spraying of water over the shutters and keeping down the temperature of coarse aggregates by continuous spraying of water over those may be resorted to if ambient temperature is more than 40°C.

- b) Care must be taken to prevent twist, which predominantly occur in the initial stages because of low slipping rate, in the horizontal plane of slip-form assembly. A thorough check on this aspect must be kept at every 15 minutes interval. One person should exclusively be assigned to this work together with rectifying any defect.
- c) Every endeavor has to be made so as not to occur any tilt in the shutter assembly. To achieve this following steps need be taken:
 - i) Performance of jacks has to be closely observed and any defective one needs immediate replacement. Difference in levels of opposite aggregates offer better performance in slip form technique. These help to keep down water



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 4 7



/ cement ratio and also offers better lubrication between concrete and shutter surface. 40 mm down size of coarse aggregates should be preferably be used unless reinforcement detailing calls for lesser size aggregates.

- d) From the creep point of view, shrinkage as well as initial setting property of concrete, cement content should not preferably be more than 400 kg per cum of concrete.
- e) Minimum compressive strength (after 4 to 6 hours of mixing) of concrete immediately below the shutter as slip form proceeds should be between 0.1 to 0.2 Newton/sq.mm.
- f) Large diameter vibrator needles should not be used for vibrating concrete. Sizes of these needles should preferably be restricted to 25 mm diameter and to 40 mm diameter – only in exceptional cases. Atleast two nos. standby vibrator units should always be maintained on top of working deck at all times during the entire period of slip form operation.
- g) It is preferable to have membrane curing compounds sprayed on fresh surfaces emerging out of shutter panels for ensuring proper curing at greater heights.

In case such spraying is not envisaged then elaborate arrangement has to be made for adequate supply of water both on inside and outside vertical surfaces with spraying arrangement, necessary length of pipelines and pump of adequate head to serve the purpose. It is always advisable to have a standby pump for effective utilization of the system.

- h) If slip forming is carried out in summer, rate of slipping should be around 400 mm per hour. If lesser value is contemplated appropriate retarders should be specified.
- i) Exact number and capacity of jacks as well as spacing of yoke frames are to be determined taking into account various loadings including self weight of the system, dead and live loads on working and other platforms, horizontal load on formwork, wind load etc.

It is desirable that jacking system, based on which the entire slip form system works, should consist of jacks 3 tonne / 6 tonne capacity and a hydraulic pump with necessary pipe connections.

Spacing of yoke legs should preferably be kept within 2 meters to prevent overloading on jacks and consequent failure resulting in twist of the formwork.

Jacking rods should be of 25 mm diameter for 3 tonne jacks and 32 mm



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 4 8



diameter for 6 tonne jacks.

- j) Atleast 30% spare jacks and jacking rods should be kept ready during the entire operation. It is obligatory to maintain spare hydraulic pump along with a set of loose pipes in perfect working condition on top of working deck.
- k) In sections where thickness is 500 mm or more it is prudent to go in for two nos. of jacks for each slip form yoke.
- l) For effective utility of this technique following areas need careful attention at the very conceptual stage:
 - i Detailed quality assurance programme
 - ii Advance planning and preparations
 - iii Arrangement for on site supervision and adequate access facilities.
- m) Construction methods including description and types of different equipment proposed to be used, structural arrangement and analysis of the system, description and type of different materials, planned interruptions, descriptions and frequency of various checks and tests for slip form technique as well as for material, method of preparing, transporting and pouring of concrete, solution for probable defects during slipping, sequence of operations during planned interruptions etc. should be prepared before hand by executing agency and to be approved by Engineer before starting the actual work.
- n) Placing and binding of reinforcement is also a very critical item and needs special attention. From practical considerations not more than two or three layers of horizontal steel can be tied at a time and this causes a definite limitation in placement of reinforcement.

Vertical reinforcements should be kept vertical by providing suitable holders within the slip form system.

- o) It is desirable to have a break of atleast one day for every two weeks of continuous operation. Such break should be utilized for various maintenance activities, removal of jacks rods etc.
- p) Numbers and locations of hoists for lifting concrete, reinforcement and other materials have to be planned well in advance. Capacity of hoists should be such as to match with hourly requirement of concrete and reinforcement. It felt necessary one hoist may be exclusively earmarked for transporting concrete.

For movement of personnel supervising the work a separate hoist must be arranged for.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 4 9



- q) The system being operative round the clock it is obligatory to have adequate lighting arrangement both on various platform levels as well as on ground below. Arrangement has to be made for facilitating continuous upward movement of the entire system along with slip form.
- r) Winches for lifting men and material and mixers, if located within unsafe area around chimney, should be protected by adequate shelter from possible damage.
- s) Proper telecommunication system has to be established between the personnel working on top of chimney and control room below.
- t) A small laboratory should be maintained at site for testing different materials like cement, coarse and fine aggregates. A cube testing machine may also be installed at site for getting quick feed back results.
- Apart from using plumb bobs, level and theodolite instruments for survey purpose arrangement should also be kept for lasers.
- u) In case of interruption in the course of slipping of formwork following measures should be taken:
- i Provision of a key and additional reinforcement at the junction of new and old concrete.
 - ii Slip form system should be brought up freely to have a minimum overlap of 100 mm or so over previously cast concrete.
 - iii Washing of old concrete surface with compressed air and water jet and thereafter pouring a layer of neat cement grout.
 - iv Clearing of shuttering panels of loose materials, concrete etc. by compressed air and applying a coat of epoxy paint, if felt necessary by Engineer.
 - v Neatly preferable the interface of old or new concrete as soon as it comes out of shutter panel.
- v) It is preferable to suspend the construction work under high wind condition.
- w) It is of utmost importance that for effective implementation of this system an Engineer fully conversant with slip form technique with enough experience in planning and control of formwork should be in overall command of the site and he should be ably supported by well trained mid level supervisory staff, skilled workers and operators.



- x) Operation of slip form method of construction is a continuous one and it demands continuous / intermediate inspection of accuracies in line, level, dimensions and position and immediate rectification of any noticed deviation. All these ask for personnel of high quality having constant vigilance over the construction activity.
- y) While all the activities in effective implementation of the work needs utmost care keeping safety of men and material in mind it is obligatory that all activities should be carried out under the guidance of a qualified and trained safety engineer.

Safety measures as listed below must be adhered to but should not be limited to only these:

- i. Safety helmets and belts to be provided to all supervising staff and workers.
- ii. Safety nets to be provided below both inside and outside platforms as instructed by Engineer.
- iii. Hand railing and toe guard to be provided around all openings and platforms.
- iv. Regular maintenance of equipment, checking of hoists, scaffolding etc.
- v. Passenger hoist must have multiple ropes with adequate factor of safety.
- vi. Emergency lights, coloured lamps to be provided in accordance with relevant Indian Standards and as supplemented in the specification and to be operative in case of sudden power failure emergency standby generator must be kept ready during the entire period of slip form method or construction.
- vii) Emergency vehicles, first aid facilities must be kept ready during the entire period of work.

22.05.00 Construction tolerances

The following shall be the limit of construction tolerances to be strictly adhered to by the contractor:

- Wall thickness : (+) 10mm
- Shell diameter : (+) 10mm for every 3m diameter without any abrupt changes but in no case more than (+) 40mm.
- Verticality : 1 in 1000 subject to a maximum of 75 mm.

In addition, no two points 10m apart vertically shall be more than 20mm out



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 5 1



of plumb w.r.t. each other

22.06.00

Although deviations in general will not be encouraged, the Contractor, however may mention in his offer, the additions to or deviations from drawings/ technical conditions/schedule of items issued with the tender papers and any other special requirement implied with the adoption of the slip form method, which may include but need not be limited to the following items as applicable.

- i. Particular requirement of type and brand of cement, if any.
- ii. Special admixture to be added to concrete
- iii. Any change required in the geometry of the chimney including the shell thickness or side slope from that shown in the NIT drawing.
- iv. Any change/special requirement in the arrangement of reinforcement.
- v. Implications if any of necessary in-situ bending of rebars for /brackets etc. and straightening/cleaning of the same prior to casting of brackets.
- vi. Any additional constructional opening in the shell required at ground level for concreting.

All deviations from specification must be justified and tender price shall include all such variation / deviation. Such deviation without assigning any reason will be rejected.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 5 2



23.00.00 FABRICATION OF STRUCTURAL STEEL WORK

23.01.00 The details of fabrication, shop testing, painting and delivery to site of structural steel work including supply of all consumable stores, bolts, nuts, washers, electrodes and other materials as required including field connections are indicated below to be performed by the contractor:

- a) Preparation & submission of complete detailed fabrication drawings and erection marking drawings as required including design calculations.
- b) Furnish all materials, labour, tools & plant and all consumables required for fabrication and supply of all necessary bolts, nuts, washers, tie rods and welding electrodes for field connections.
- c) Furnish shop painting of all fabricated steelwork as specified.
- d) Suitably mark, bundle and pack for transport all fabricated materials.
- e) Prepare and furnish detailed bill of materials, dispatch lists (including bought out items) as required for fabrication of structural steelwork.
- f) Load and transport all fabricated steelwork to site with field connection materials.
- g) Maintain a fully equipped fabrication shop at site for modification and repairs as required.

No work under this specification will be provided by any agency other than the contractor, unless specifically mentioned otherwise elsewhere in the contract.

23.02.00 Codes and standards

The work should conform to the requirements of the following latest relevant Indian standard specifications and codes of practice:

IS : 800	-	Code of practice for general construction in steel.
IS : 80	-	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.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 5 3



DESEIN

Volume-VI (B) : Civil, Structural & Architectural Works

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: 228	-	Method of chemical analysis of pig Iron, cast Iron & plain carbon and low alloy steel
IS: 817	-	Code of practice for use of Structural steel in General building construction.
IS: 818	-	Code of practice for use of metal arc welding for general construction in mild steel.
IS: 819	-	Code of practice of resistance spot welding for light assemblies in mild steel.
IS:823	-	Code of practice for manual metal arc welding for mild steel.
IS: 919	-	Recommendations for limits and fits for engineering.
IS 1161	-	Specifications for steel tubes for structural purposes.
IS1181	-	Qualifying test for metal arc welders
IS1599	-	Method of bend tests for steel products other than sheet strip wire & tube.
IS 1731	-	Dimension for steel flats for structural & general engineering purposes.
IS 7205	-	Safety code for erection steel work.
IS2595	-	Code of practice for radiographic testing.
IS : 822	-	Code of practice for inspection of welds.
IS : 1182	-	Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.
IS : 1200 (Part - 8)	-	Method of measurement of steel work and iron work.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 5 4



DESEIN

Volume-VI (B) : Civil, Structural & Architectural Works

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 : 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 : 3644 and	-	Code of practice for ultrasonic pulse echo testing by contact immersion method.
IS : 3757	-	High Strength Structural Bolt
IS : 4000	-	High strength bolts in steel structure
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).



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 5 5



DESEIN

Volume-VI (B) : Civil, Structural & Architectural Works

IS : 8629	-	Code of practice for protection of iron steel & structures (Part - I to III) from atmospheric corrosion.
IS : 9595	-	Recommendation for metal arc welding of carbon manganese steels.
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	-	Code of practice for painting of ferrous metal in building (Part - I & II).
IS : 2074	-	Ready mixed paint, air-drying red-oxide zinc chrome priming.
IS : 2339	-	Specification for aluminum 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.
BS 4465	-	Specification for water cooling towers.
ACI	-	Reinforced concrete cooling towers shall – practice & Commendatory

23.03.00 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. The method of painting, marking, packing and delivery of all fabricated materials shall be as approved by the Engineer.

23.04.00 Materials to be used

Standard structural steel sections shall be used instead of fabricated steel sections as far as possible.

- a) All steel materials required for the work shall be supplied by the contractor.
All steel materials shall comply with the following IS:-
- i) IS:801 - Cold formed light gauge steel structural member.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 5 6



- ii) IS:2062 - Grade – A, Structural Steel for plate thickness upto 20mm
- iii) IS:2062 - Grade – B (Killed), Structural Steel for plate thickness above 20mm
- iv) IS:2062 - Grade – C, for crane gantry girder in turbine hall.
- v) IS:806 - Steel tubes in general building construction.

b) Electrodes

The arc welding electrodes shall conform to the relevant IS; and shall be of heavily coated type having uniform thickness. 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. All electrodes shall comply with the following IS:

- i) IS: 814 - Covered electrodes for metal arc welding structural steel.
- ii) IS:815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel.
- iii) IS:7280 - Base wire electrode for submerged arc welding.

c) Bolts and nuts

All bolts and nuts shall conform to the requirements of IS:1367 - Technical Supply Conditions for Threaded Fasteners. Materials for bolts and nuts shall comply with the following IS codes. Mild steel for bolts and nuts tested to following IS shall have a tensile strength of not less than 44 Kg/mm²; and 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 :

- i) IS:1367 - Technical supply conditions for threaded fasteners.
- ii) IS:1608 - Method for tensile testing of steel other than sheet, strip, wire and tube.
- iii) High tensile steel material shall have the mechanical properties as per IS:1367 or as approved by the Engineer.



d Washers

Washers shall be made of steel conforming to the following IS:

- i) IS:1977 - Structural steel (Ordinary Quality) St-39-0
- ii) IS:2062 - Steel for general structural purpose
- iii) IS:6623 - High Strength Structural Nuts
- iv) IS:6649 - Hardened and tempered washers for high strength structural bolts & nuts.

Paints for shop coat of fabricated steel shall be of epoxy based paint to withstand severe corrosive conditions prevailing at site.

23.05.00 Painting

- a) All steel structures shall receive two primer coats and two finish coats of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two finish coats shall also be applied after erection.
- b) Steel surface which is to painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted to Sa-2½ finish as per SIS05-5900. Primer paint shall be zinc silicate of approved brand . Dry film thickness of each primer coat shall be 50 microns.
- c) Finish paint shall be 2 coats of High built epoxy finish of approved brand. Dry film thickness of each finish coat shall be 90 microns. The undercoat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 300 microns . All paints shall be of approved brand and shade as per the OWNER's requirement.
- d) Joints to be site welded shall have no paint applied within 100 mm of welding zone.

Similarly where Friction grip fasteners are to be used no painting shall be provided. On completion of the joint the surfaces shall receive the paint as specified.
- e) Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly.



Surfaces inaccessible after erection including top surfaces of floor beams supporting gratings or chequered plate shall receive one additional coat of finish paint over and above number of coats specified before erection. Portion of steel member embedded / to be encased in concrete shall not be painted.

23.06.00 Storage of Materials

- a) All materials shall be stored to prevent deterioration ensuring 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. The contractor shall maintain upto date account 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 shall be stacked separately with easily identifiable marks.
- b) The steel used for fabrication 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 should be stored under cover; and suitably painted for protection against weather.
- c) 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].
- d) Bolts, nuts, 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.
- e) Paints shall be stored under cover in airtight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.

23.07.00 Quality Control

23.07.01 The contractor shall establish and maintain quality control procedures for different items of work and materials to ensure that all works are performed as per specification. As far as possible, all inspections by the Engineer shall be made at the contractor's fabrication shop. The contractor shall co-operate with the Engineer 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 & plant, 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.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 5 9



Materials or workmanship not in reasonable conformance with the provisions of this specification would 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:

- i) Steel : Quality, manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.
- ii) Bolts, Nuts : Manufacturer's certificate, dimension & washers checks, material testing.
- iii) Electrodes : Manufacturer's certificate, thickness and quality of flux coating.
- iv) Welders : Qualifying tests
- v) Welding sets : Performance tests
- vi) Welds : Inspection, X-ray, Ultrasonic tests
- vii) Paints : Manufacturer's certificate, physical Inspection Reports.

23.07.02

- a) The dimensions, forms, weights and tolerances of all rolled shapes, bolts, nuts, studs, washers etc. and other members used in the fabrication shall, wherever applicable, conform to the requirements of the latest relevant IS.

b) Fabrication Drawing

The sequence of submission of fabrication drawings for approval shall match with the approved fabrication and erection schedule. It should be ensured that the correctness of general arrangement for centerline dimensions and levels, section sizes, and adequacy of connections including splice joints as to the number of bolts, weld length, size of gusset/end plates are maintained. 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 spec.

The fabrication drawings shall include but not be limited to the following:

- i) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.
- ii) Dimensional drawings of base plates, foundation bolt location etc.
- iii) Details of all connections with supporting calculations.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 6 0



- iv) Any other drawings or calculations that may be required for the clarification of the works.

The fabrication 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 various components of the steelwork, including the location, type, size and extent of welds. These shall also clearly distinguish between fabrication 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 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 IS:813; and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length.

All steel structural wall beam/columns shall be encased with nominal reinforcement and chicken wire mesh fouling / connecting in brick masonry works. Also, chicken wire mesh shall be provided at the junction of RCC and brick work. The wall beam/tie beam shall be provided at every 2.5 meter height of the brick wall.

All columns shall be encased with RCC upto the height of 500 mm above zero level of STG power house building.

23.08.00 Workmanship

- a) All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of IS:800 and other relevant Indian standards or equivalent.
- b) 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 IS:1852. If straightening is necessary, it shall 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.
- c) Cutting shall be effected by shearing, cropping or sawing. Use of a mechanically controlled gas cutting torch is permitted for mild steel only. Gas cutting of high tensile steel is 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



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 6 1



controlled torch shall be permitted if special care is taken and done under expert hand.

To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, subjected to substantial stress or which 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.

- d) Finishing of sheared or cropped edges of plates or shapes of edges gas-cut with 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.
- e) 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.
- f) **Bolted construction:**
 - i) 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 shall 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 black bolts shall be not more than 1.5 mm or 2 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 to IS:919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thicknesses 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.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 6 2



- ii) Drifting to enlarge unmatched 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 to 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 nor 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 connection as may be specified.

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 indicated on the drawings.

g) Welded Construction

- i) Welding shall be in accordance with relevant IS. Welding shall be done by experienced and good welders qualified by tests in accordance with IS:817. Surfaces 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.
- ii) 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.
- iii) 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



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 6 3



welded to other parts of the member. Long girders or girder sections shall be made by shop splicing not more than 3 sub-sections, each made in accordance with this paragraph. Welded assemblies shall be stress relieved by heat treating in accordance with the provisions of the relevant IS.

- iv) 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 joint in a manner ensuring soundness. Where possible, this should be done by use of extension bars or run-off plates which need not be removed upon weld completion. 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 conform to the welds made, and the methods of correcting defective work shall conform to the relevant IS.

- v) If welding is to be undertaken at low temperature, adequate precautions as recommended in relevant IS shall be taken. 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 IS.
- vi) Where required, intermediate layers of multiple-layer welds shall be peened with light blows from a power hammer, using a round-nose tool. Peening shall be done after the weld is cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld & base metal from over peening.
- vii) The equipment shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of type and capacity as recommended by the electrode manufacturer.
- viii) Column splices and butt joints of compression members 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



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 6 4



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 mm.

- ix) Bases and caps fabricated out of steel plates, 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. The ends of lacing bars shall be neat and free from burrs. 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. Provision shall be made for all necessary steel bearing plates to take up reaction of beams & columns and the required stiffeners & gussets whether or not specified. Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances.
- x) All shop connections shall be welded as specified. Certain shop connections, may be changed to field connections if desired by the Engineer for convenience of erection; and the contractor shall make the desired changes. The steelwork shall be temporarily shop-erected complete 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 facilitating the check of interchangeability.

23.09.00 Shop Painting

- a) The steelwork concealed by interior building finish need not be painted; steelwork to be encased in concrete shall not be painted. All other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned as below, by brush, spray, roller coating, flow coating or dipping. Before leaving the shop, all steelwork 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 having no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners; and shall be cleaned of dirt and other foreign material by through sweeping with a fiber brush. After completion of the pre- cleaning, the metal surface shall be immediately painted with epoxy based paint.
- b) Inaccessible surfaces 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. Contact surfaces shall be cleaned as per para (a) above before assembly.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 6 5



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

- c) All the grills shall be galvanized

23.10.00 Testing, Acceptance Criteria and Delivery

- a) The contractor shall carry out testing as per IS. The contractor shall get the specimen tested in a laboratory approved by the Engineer and test results shall be submitted to the Engineer in triplicate within 3 days after completion of the test. All electrodes shall be procured with test certificates. The correct grade and size of electrodes not deteriorated in storage shall only be used. The testing of welding shall be performed as under with quantum of minimum non-destructive tests to be conducted during fabrication and after erection as below:
- i) Ultrasonic test should be performed on the columns; girders; Built-up beam fabricated with plates.
 - ii) Fillet welds at junction of flange & web of built-up beams, columns, all shear connections of main beams and all butt welds shall be 100% ultra sonic tested
 - iii) 100% radiographic test shall be performed for butt weld joints of crane girder & its supporting columns, deaerator supporting beams and columns. The minimum percentage of Radiographic test to be carried out at other locations shall be 25 percent.
 - iv) Dypenetration test, Ultrasonic test, Radiographic test shall be carried out at any other location also, if required as per Engineer's approval.

In cases, the test results shows deficiency, the Engineer shall have option to reject or instruct any remedial measures to be carried out by the contractor.

- b) All bolts, nuts and washers shall conform to the relevant IS. If desired by the Engineer, representative samples of these materials should be tested in an approved laboratory and in accordance with the procedures described in relevant IS. All paints and primers shall be of standard quality; and shall conform to the provisions of the relevant IS. The paint shall be epoxy based. The tolerances on the dimensions of individual rolled steel components shall be as per IS:1852. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures subjected to dynamic loading (like wind,



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 6 6



seismic etc.) and thin walled construction (like box girders) shall be as per IS:7215.

- c) Should any structure or part of a structure be found not to complying to the provisions of the 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.

When all tests to be performed in the contractor's shop have been successfully carried out, the steelwork will be accepted forthwith; upon receipt of which, the items shall be shop painted, packed and dispatched. No item should 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 Purchaser to accept the work, should it, on further tests before or after erection, be found not in compliance with spec.

- d) The contractor should deliver the fabricated structural steel materials to site with all necessary field connection materials in a sequence permitting an efficient and economical performance of the erection work. The Purchaser may prescribe or control the sequence of delivery of materials, at his own discretion. 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.

23.11.00 Inspection of Welding

The extent of quality control in respect of welds of structural elements shall be as follows:

a) Visual Examination

All welds shall be 100% visually inspected to check the following:

- i) Presence of undercuts
- ii) Surface cracks in both welds and base metals.
- iii) Unfilled craters
- iv) Improper weld profile and size
- v) Excessive reinforcement in weld



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 6 7



- vi) Surface porosity

Before inspection, the surface of weld metal shall be cleaned of all slag, spatter matter, scales etc. by using wire brush or chisel.

b) Dye penetration Test (DPT)

This test shall be carried out for all fillet welds and groove welds to check the following:

- i) Surface cracks
- ii) Surface porosities

c) Ultrasonic Testing

Ultrasonic test shall be conducted for all groove welds and heat affected zone in dynamically loaded structures and for other important load bearing butt welds in statically loaded structures as desired by Purchaser to detect the following:

- i) Cracks
- ii) Lack of fusion
- iii) Slag inclusion
- iv) Gas porosity

Ultrasonic testing shall be carried out in accordance with American National Standard ANSI/AWS D1.1-92 Chapter 6 Part-C.

Before Ultrasonic test is carried out, any surface irregularity like undercuts, sharp ridges etc. shall be rectified. Material surface to be used for scanning by probes must allow free movement of probes. For this purpose, surface shall be prepared to make it suitable for carrying out ultrasonic examination.

d) Radiographic Testing (X-ray and Gamma-ray Examination)

This test shall be limited to 2% of length of welds for welds made by manual or semi-automatic welding and 1% of length of weld if made by automatic welding machines. The location and extent of weld to be tested by this method shall be decided by Purchaser to detect the following defects:

- i) Gas porosity



- ii) Slag inclusion
- iii) Lack of penetration
- iv) Lack of fusion
- v) Cracks

Radiographic testing shall be conducted in accordance with American National Standard ANSI/AWSD1.1-92.

Any surface irregularity like undercuts, craters, pits, etc. shall be removed before conducting radiographic test. The length of weld to be tested shall not be more than 0.75 x focal distance. The width of the radiographic film shall be equal to width of the welded joint plus 20 mm on either side of the weld.

EPC Contractor shall provide testing equipment for conducting non-destructive tests for confirming the integrity of welding wherever necessary as directed by the Purchaser.

e) Acceptable Limits of Defects of Weld

Limits of acceptability of welding defects shall be as follows:

i) Visual inspection and Dye penetration test

The limits of acceptability of weld defects detected during visual inspection and dye penetration test shall be in accordance with clause 8.15.1 and clauses 9.25.3 of American National Standard ANSI / AWS D1.1-92 respectively, for statically and dynamically loaded structures.

- ii) Ultrasonic testing The limits of acceptability of weld defects detected during ultrasonic testing shall be in accordance with clause 8.15.4 and clause 9.25.3 of American National Standard ANSI/AWS D1.1-92 respectively for statically and dynamically loaded structures.

iii) Radiographic testing:

The limits of acceptability of weld defects detected during Radiographic testing shall be in accordance with clause 8.15.3 and 9.25.2 of American National Standard ANSI/ AWS D1.1-92 respectively for statically and dynamically loaded structures.

f) Rectification of Defects in Welds

In case of detection of defects in welds, the rectification of the same shall be done as follows:



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 6 9



- i) All craters in the weld and breaks in the weld run shall be thoroughly filled with weld
- ii) Undercuts, beyond acceptable limits, shall be repaired with dressing so as to provide smooth transition of weld to parent metal.

Welds with cracks and also welds with incomplete penetration, porosity, slag inclusion etc., exceeding permissible limits shall be rectified by removing the length of weld at the location of such defects plus 10 mm from both ends of defective weld and shall be re-welded. Defective weld shall be removed by chipping hammer gouging torch wheel. Care shall be taken not to damage the adjacent material.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 7 0



24.00.00 ERECTION OF STRUCTURAL STEELWORK

24.01.00 The works related to 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 are detailed below:

- a) Providing all construction & transport equipment, tools, tackles, consumables, materials, labour and supervision as 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.
- c) Transportation of all fabricated structural steel materials from site storage yard, handling, rigging, assembling, bolting, welding and satisfactory installation in proper location as per approved erection drawings. If necessary suitable temporary approach roads should be built for transportation.
- d) Checking centerlines, 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 as per drawings.
- f) Painting of the erected steel structures.
- g) 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.
 - v) Refabrication of parts damaged beyond repair during transport and handling or refabrication of parts which are incorrectly fabricated.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 7 1



- 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 drilled in incorrect location during fabrication

24.02.00

- a) The work shall conform to the latest revisions of the following IS Codes:

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-12840	:	Tolerance for erection of Steel Structures

- b) Conformity with designs: The contractor should erect the fabricated steel structures, align all the members, complete all field connections as per approved drawings. All works shall conform to the provisions of the relevant IS. The testing and acceptance of the erected structures shall be in accordance with the provisions of this specification.

24.03.00

- a) The contractor should take delivery of all the materials at site. He shall unload the materials and perform all formalities such as checking of materials and attend to insurance matters as specified above.

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. All field connection materials such as bolts, nuts, washers and electrodes, other consumables such as oxygen and acetylene gas, paints, fuels, lubricants, oil, grease and any other material as required for the execution of the works shall be supplied by the contractor for erection work.

- b) All materials shall be stored preventing deterioration and ensuring 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. The contractor should establish a suitable yard at site for storing the fabricated steel structures and other materials. The yard shall have proper facilities such as drainage, lighting, suitable access for large cranes, trailers and other heavy equipment. 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. 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.
- c) The contractor shall establish and maintain quality control procedures for different items of work and materials; and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the following:



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 7 2



- i) Erection : Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.
- ii) Painting : Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

24.04.00 Workmanship

- a) The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be efficient, dependable, in good working condition. The method and sequence of erection shall have the prior approval of the Engineer. The Erection shall arrange in most economical method; and sequence available to him consistent with the drawings.
- b) Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install, 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 during the course of the erection of the steel framing, arrangement for installation by the erector shall be made.

The responsibility of the contractor in respect of temporary bracings and guys shall cease when the structural steel is once located, plumbed, leveled, 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 erection

- c) Positioning and leveling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be as per approved drawings. Anchor bolts and other anchor steel shall be embedded. 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, the contractor shall set proper screed bars to maintain proper level. Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance allowable. No permanent field connections by bolting or welding shall be carried out until proper alignment and plumbing has been attained.
- d) All relevant portions in respect of bolted construction for fabrication of



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 7 3



structural steelwork shall also be applicable for field bolting as below:

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 light 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. High tensile bolts shall be tightened to provide the required minimum bolt tension by any of the following methods:-

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 as below 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.

Bolts length not Bolt length exceeding 8 times dia or 200mm	Bolts length not Bolt length exceeding 8 times dia or 200mm	Remarks
½ turn	2/3 turn	Nut rotaion is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotaion – 30 over or under

Bolts shall 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 shall be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

Torque Wrench tightening: When torque wrenches are used to provide the



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 7 4



bolt tensions, the bolts shall be tightened to the torques as below. 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.

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 shall 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 as per IS.

- e) Field Welding: All field assembly and welding shall be carried out as specified for fabrication work, 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.
- f) Holes, cutting and fitting: No cutting of sections, flanges, webs, cleats, bolts, welds etc. shall be done. 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. 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.

24.05.00

Drifting

Correction of minor misfits and reasonable amount of reaming and cutting of excess stock shall be considered as permissible. For this, light drifting shall 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.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 7 5



Any shop work error 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.

24.06.00 Testing and Acceptance Criteria

- a) Loading tests shall be carried out on erected structures 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 be dismantled and replaced with suitable member. On the basis of the tests, the Engineer will decide and his decision will be final. 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.

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 below:-

- i) 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.
- ii) 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.



b) Structure of same design:

Where several identical same design structures exists as a prototype, one structure shall be fully tested, 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.

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 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.

c) Repair for subsequent test and use after strength tests: The structure passed the "Strength Test" as above 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 above.

24.07.00 Tolerances

Considering expected variation in the finished dimensions of structural steel frames, these shall be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabrication tolerances for the finished parts; and the rolling tolerances for the profile dimensions permitted under the specification for fabrication of structural steelwork shall be as indicated below:

Component	Description	Variation Allowed
a	For Buildings Containing Cranes	
i) Main Column	a) Shifting of column axis at foundation level with respect to building line	
	i) In longitudinal direction	(+/-) 3.0mm
	ii) In lateral direction	(+/-) 3.0mm
	b) Deviation of both major column axis from vertical between foundation and	



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 7 7



DESEIN

Volume-VI (B) : Civil, Structural & Architectural Works

Component	Description	Variation Allowed
	other member connection levels :	
	i) For a column upto including 10M	(+/-) 3.5 mm and from true height vertical
	ii) For a column greater than 10M but less than 40M height	(+/-) 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 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
ii) 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 whichever is the least
	b) Lateral displacement of top chord at centre of span from vertical plane running through centre of supports.	1/250 of depth of truss or 20 mm whichever is the least.
iii) Cranes Girders & Tracks	a) Difference in levels of crane rail measured between adjacent columns.	2.0 mm
	b) Deviation to crane rail gauge	(+/-) 3 mm
	c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermit welding.	1.0 mm



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 7 8



Component	Description	Variation Allowed
	d) Deviation of crane rail axis from centre line of web.	(+/-) 3.5 mm
iv) 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.	
b For Buildings without Cranes		
The maximum tolerances for line and level of the steel work shall be ± 3 mm on any part of the structure. The structure shall not be out of plumb more than 3.5 mm on each 10 m section of height and not more than 7 mm per 30 m section. These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.		



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 7 9



25.00.00 MASONRY AND ALLIED WORKS

25.01.00 The masonry and allied works associated with the offered power plant cover furnishing, installation, repairing, finishing, curing, protection, maintenance and handing over of all the associated works for use in structures as per the locations shown in approved drawings in accordance with latest IS:2212/IS:2250/ IS:5134.

25.02.00 Brick masonry

i) All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings.

ii) **Mortar**

Mix for mortar shall be as specified. Cement sand mortar cement and sand in 1:4 proportions shall be mixed dry in a mechanical mixer; and then water added and mixed further to achieve working consistency. Surplus mortar droppings from masonry, if received on surface free from dirt shall be mixed with fresh mortar with additional cement. No mortar which has stood for more than half an hour shall be used.

iii) **Brick**

Fly ash Bricks shall be soaked by submergence in clean water for at least 2 hours in approved vats before use. Bricks shall be laid in English bond. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks are placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool with green mortar to provide bond for plaster or pointing. Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. 2 brick thick or more brickwork shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

iv) **Exposed Brickwork**

Almost all the brickwork shall be plastered with cement mortar. Brickwork in superstructures uncovered by plaster shall be executed by skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons should check workmanship frequently with plumb, spirit level, rule and



string. All brick work shall be cleaned at the end of day's work. In case of face bricks involvement the brickwork shall be in composite shape with face bricks on the exposed face and balance in routine bricks, maintaining the bond fully; using carborandum stone for rubbing down. Where face bricks are not needed, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean and pointed as specified.

v) **Reinforced Brickworks**

Reinforcements shall be as specified. The reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S. bars are used as reinforcement, these shall be lapped with dowels if left in R.C. columns or welded to steel stanchions. For partition walls 2 reinforcement bars shall be placed at every fourth layer.

vi) **Encasement of Structural Steel**

The fixtures shall generally be embedded in mortar and masonry units shall be cut as required. Encasement of structural steel shall be done by brick masonry work round flanges, webs etc. and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh with a lap of 50 mm.

vii) All wall beams shall be provided with gunniting of 50 mm thick allround with nominal reinforcement and chicken mesh. Also, chicken wire mesh shall be provided at the junction of RCC & brick work. The wall beam/tie beam shall be provided at every 2.5 meter height of the brick wall. Chicken wire mesh shall be provided at the joints of brick masonry and RCC beams/column.

vii) **Curing**

The brick masonry works shall be cured for a period of fourteen (14) days after laying and the plaster shall be cured for a period of seven (7) days.



26.00.00 ARCHITECTURAL FINISHES

26.01.00 Plastering

- a) The plastering work including the application of cement punning (Neru) or plaster of Paris treatment on brick or concrete faces with architectural features shall be executed as per in accordance with the following latest IS codes: POP shall be used only on inside surfaces of ceiling and walls for aesthetic and architectural requirement.

IS:1542 : Sand for plastering

IS:1661 : Code of practice for application of cement and cement lime plaster finishes.

IS:2333 : Plaster of Paris

IS:2402 : Code of practice for external rendered finishes

IS:2394 : Code of practice for application of lime plaster finishes

- b) Mortar for plastering shall be mixed in the proportion in a dry state and then wetted and mixed thoroughly to obtain the required consistency. The mortar shall be mixed in an approved manner including machine mixing in batches for its consumption within half an hour of mixing. Any mortar for partially set plaster shall be rejected and removed from site. The mix for plastering shall be as follows:

Brick wall:

- i) Outside plaster (or rough side): 20 mm thick in 2 coats, 1st coat of 12 mm thick in C:M 1:3 & 2nd coat of 8 mm thick in C:M 1:2 sand faced.
- ii) Inside plaster (or plain face) : 12 mm thick (1 cement : 3 sand)
- iii) Concrete ceiling: Plaster : 6 mm thick (1 cement : 3 sand)

- c) Before application of plaster, the surface shall be prepared as per IS:1661. In all plaster work, mortar shall be applied in an uniform layer slightly more than the required thickness and well pressed into the joint and in the surface and rubbed & levelled with a flat wooden rule to give required thickness.



Plaster, when more than 15 mm thick, shall be applied in two coats, base coat followed by the finishing coat. Thickness of base coat shall be just sufficient to fillup all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The under-coat shall be thicker than the upper coat. The overall thickness of the plaster shall not be less than the minimum thickness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key.

The method of application shall be "thrown on" rather than "applied by trowel".

The finished surface shall be true to line & plumb; and the contractor shall make up any irregularity in the masonry/concrete work with plaster. The mortar shall adhere to the surface intimately when set; and there should be no hollow sound when struck.

All vertical edges of pillars, door jambs etc. shall be chamfered or rounded off. All corners must be finished to their true angles or rounded. Any plastering damaged shall be repaired and left in good condition at the completion of the job.

- d) All plastered surfaces after laying and sufficiently hardened shall be cured for a minimum period of seven days and shall be protected from excessive heat and sunlight by suitable approved means.
- e) Plaster of Paris Finish: The plaster of Paris shall be calcium sulphate hemi-hydrate variety. Its initial setting shall be less than 13 minutes. The material shall be mixed with water to workable consistency. Plaster of Paris shall be applied to the surface in the uniform layer slightly more than 2 mm thick and shall be finished to an even and smooth surface with a steel trowel. Thickness of finish shall not be less than 2 mm. All corners, arises, angle and junctions shall be carefully and neatly finished.

26.02.00 Wall Cladding

26.02.01 Permanent colour coated sandwiched insulated metal cladding system

- a) Permanent colour coated sandwiched (insulated) M.S. / High tensile steel metal cladding of approved colour combination shall be provided for main plant building and any other building with metal cladding where thermal insulation is required as per thermal requirements.
- b) Troughed zinc-aluminum alloy coated (both sides) M.S. sheet having 0.6mm minimum thickness (or high tensile steel sheet of 0.5 mm minimum thickness) shall be used on external face (outer face) of cladding system. Weight of coating shall not be less than 150gms /sq.m. The outer side (exposed face) shall be permanently colour coated with Polyfluro Vinyl Coating (PVF2) of Dry Film Thickness



(DFT) 20 microns (min) over primer. Inner side of external sheet shall be provided with suitable pre-coating of minimum 7 microns.

- c) Galvanised M.S. sheets of minimum 0.6 mm 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 microns (min) 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 180 gm/sq.m.
- d) The permanent colour coated sheet shall meet the general requirements of IS:14246 and shall conform to class 3 for the durability.
- e) Inner sheet shall fixed directly to side runner and Z spacers made of at least 2 mm thick galvanized sheet of grade 375 as per IS:277. Inner sheet shall be fixed at the rate not more than 1.50m centre top centre to hold the insulation and external sheeting.

26.03.0

Permanent colour coated non-insulated metal cladding system

- a) Permanent colour coated (non-insulated) M.S / High tensile steel metal cladding of approved colour combination shall be provided for bunker building and cladding over parapet walls of buildings where metal cladding is specified 0.8mm with galvanization rate of 275 gm/sqm.
- b) Troughed zinc-aluminum alloy coated not less than 150 gm/sqm M.S. sheet having 0.6mm minimum thickness (or high tensile steel sheet of 0.5 mm minimum thickness) shall be used for cladding system. The outer side (exposed face) shall be permanently colour coated with with PVF2 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 requirements of IS: 14246 and shall conform to class 3 for the durability. For roof sheeting the specification remains same as that of side cladding except the thickness and galvanization. The minimum thickness of roof sheeting shall be 0.8mm with galvanization rate of 275 gm/sqm.

26.04.00

Roof Decking And Suspended Ceiling

- a) The roof decking includes furnishing of cold rolled formed troughed profile sheets manufactured from tested quality CR rolls conforming to IS:513 including fixing. The profile sheet section shall be obtained from feeding strips of uniform coil thickness through successive pairs of shaped rollers, each pair of rollers progressively forming the sheet until finished section is obtained.
In general the troughed profile shall have minimum depth of valley 44mm and center to center of valley about 130mm. The thickness of sheet shall be 0.8 mm (minimum). To suit the spacing of purlin, the length of sheet may vary between 1.50 to 2.00 m. The overall minimum width of sheet



shall be 824.20mm and covering width as 780mm i.e. side overlap shall be 22.10 mm.

- b. Pre-Treatment & Phosphating: The pre-treatment process shall conform B to medium class-B conforming to IS:3618. Next operation of rust removal shall be done by dipping in a tank containing highly diluted hydrochloric acid (HCL); and traces of HCL shall be removed by double rinsing in a water tank for about 5 minutes each. Subsequently sufficient conditioning shall be done by dipping in the next tank containing surface conditioner. Hot phosphating shall be accomplished in the next tank followed by water rinsing and finally passivated by heat process in the passivation tank. Thereafter traces of moisture shall be removed by hot compressed air before application of primer and final paint coating as required. In general the pre- treatment stages shall be as under :

Sl.NO	STAGES	CHEMICALS	PROCESSING	PROCESSING
1	Degreasing	Cleaner	55 to 75° C	3 to 10 mins
2	Water Rinsing	-	Room Temp	-
3	Derusting	Rust remover	R. Temp to 60°c	1 to 10 Mts
4	Water Rinsing	-	Room Temp	-
5	Surface conditioning	Surface conditioner	Room Temp	15 to 30 sec
6	Phosphating solution	Phosphating	50 to 55° C	3 to 5 Mins
7	Water Rinsing	-	Room Temp	-
8	Passivation solution	Passivation	Room Temp	15 to 30sec
9	Water Rinsing	-	Room Temp	-
10	Defonised water	-	Room Temp	-
11	Drying	-	-	-

After pre-treatment, the sheet shall be painted with a coat of zinc chromate red oxide primer on both faces.

26.05.00 Flooring

The nominal total thickness of floor finish shall be 50 mm including under bed and topping. The flooring shall be laid on already matured concrete base. The under bed for floors shall consist of cement concrete 1:2:4 with stone chips 12.5 mm down graded as coarse aggregates. The under bed shall be provided with appropriate slope towards catch pit for floor drainage.

26.05.01 False Flooring System

Removable type false flooring system shall be provided in computer rooms and control rooms as required. RCC floor slab shall be sunk to a depth 800 mm which shall be height of the false floor system. The flooring shall consist of fire resistant phenol formaldehyde bonded particle board panels 600x600x35mm size, mounted on steel pedestals of adjustable height and supporting steel grid system to provide under floor space. 2 mm thick flexible anti-static pvc topping on top and



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 8 5



pvc strip edging on sides of each panel shall be provided .

26.05.02 PVC Floor Finish

Two mm thick PVC as per IS:3462 laid as per IS:5318 over concrete under bed of 48 mm .

26.05.03 Carborandum Tiles

Polished heavy duty cement concrete tiles (carborandum) of 300x300x22 mm thick manufactured as per IS:1237 using colouring pigment and hard chips like carborandum, quartz etc shall be laid as per IS:1443 over concrete under bed to result in overall thickness of 50 mm.

26.05.04 Terrazzo Tiles

Tiles shall generally be of size 250 x 250 x 20 mm laid over concrete bedding to result in an overall thickness of 50 mm.

26.05.05 Granolithic flooring

- a) Granolithic flooring (cement concrete flooring in 1:1:2) with non metallic floor hardener topping 12 mm thick with a total thickness of 50 mm shall be provided in maintenance and unloading area of Station building, Mill and bunkerbay, Workshop floors, operating floor
- b) Granolithic flooring without floor hardener shall be provided in all MCC and switch gear rooms which are not air-conditioned.
- c) Granolithic flooring shall also be provided in areas which are not provided with any special finish. Areas which are likely to be subjected to oil spillage shall be provided with two coats of oil resistant painting over Granolithic flooring.

of pump house.

26.05.06 Heavy Duty Ceramic Tiles

Heavy duty anti skid ceramic tiles with matt finish shall be used in toilets, pantry, dining hall of canteen, locker rooms etc. The tiles shall be 300 x 300 x 7 mm of approved shade brand and colour. Dado in toilets and pantry ,locker rooms etc shall also be of similar finish.

26.05.07 Acid / Alkali resisting Tiles

Battery rooms, and other areas coming into contact with acid / alkali vapors or fumes shall be given acid / alkali resistant tiles 25 mm thick, jointed with acid / alkali resistant cement slurry. Bedding shall



comprise of potassium silicate mortar conforming to IS:4832 (Part-I) and resin based mortar like epoxy for jointing. Total thickness of flooring shall be 50 mm. Ceramic unglazed vitreous tiles conforming to IS:4457 with minimum thickness of 20 mm may also be used as acid / alkali resistant tile. The above specification do not apply to D.M. Plant.

26.05.08 Integral floor finish

For cable vaults room, floors of wagon tripler shed, reclaim hopper shed, crusher house, junction towers, pent house shall be provided with floor finish integral to the concrete base shall be provided as per IS:2571.

26.05.09 Cast-in-situ Terrazzo

Cast in situ terrazzo flooring shall be laid as per IS:2114, using white cement or cement with colouring pigment. Chequered finish shall be provided for treads. Total thickness of the finish shall be 25 mm.

26.05.10 Acid / Alkali resistant Tiling / Brick lining in D.M Plant

- a) Bitumen primer followed by 12 mm thick bitumastic layer, 6 mm thick potassium silicate mortar bedding and 38 mm thick alkali / acid resistant bricks as per IS:4860 shall be provided for CPU regeneration area, Chemical house floor, effluent drains, floors around equipment & chemical handling vessels, chemical storage area for the floor, curbs and sumps, all as per the acid / alkali proofing specialist Contractor's requirement.
- b) For floor of neutralizing pit the finish shall be as follows.
 Bitumen primer followed by 18 mm thick bitumastic layer, 6 mm thick potassium silicate mortar bedding and 75 mm thick acid / alkali resistant brick as per IS:4860.
- c) For walls of neutralizing pit, the same specification as 1.10.2 shall apply except that thickness of the brickwork shall be 115 mm with suitable pilasters at 2000 mm c/c.
- d) Special instruction to be followed for acid resistant lining in neutralizing pit shall be as follows.
 - i) The structures shall be tested for water tightness.
 - ii) Surface on which lining is to be applied shall be prepared as per IS:2395.
 - iii) Joints between acid resistant bricks / tiles shall be filled with resin type mortar conforming to IS:4832 (Part II). Seal coat of ready made epoxy paint shall



be provided at the joints to cover up any porosity.

- iv) Acid resistant bricks shall be laid with 6 mm wide and 20 mm deep pointing. Pointing shall be with epoxy / furane / CNSL as per the requirement of the agency guaranteeing the performance of lining.
- v) Under side of all precast slabs / steel covers over effluent drains shall be given two coats of epoxy coating, 150 microns thick.
- vi) Acid / alkali resistant treatment shall extend at least 1 meter on all sides from the outermost periphery of pedestals / saddles for indoor installations and 2 meters all round for outdoor installations.

26.05.11 Glazed vitrified tiles

Polished vitrified tiles shall be of 600 mm x 600 mm x 7.5 mm in size and shall be approved shade, brand and colour and shall be laid with CM 1:3. These are proposed in the following areas:

Operating floor, Control room area including control room, computer room, control equipment room, SWAS Room and Conference room, senior executive room – The floor shall be vitrified tiles of size 2 feet X 2 feet

26.05.12 Miscellaneous

- a) PVC nosing / Aluminum angle nosing with minimum size (150 x 25 x 3) shall be provided for edge protection of R.C.C. stair treads.
- b) Angles 50x50x6 mm(min) with lugs shall be provided for edge protection of cutouts / openings in floor slabs, edge of drains covering gratings, edge of R.C.C cable / pipe trenches and at any other place where breakage of edges / corners is expected.
- c) Floors of switchgear rooms shall have embedded steel channel suitable for easy movement of breaker panel.

26.06.00 Skirting / Dado

- a) 150 mm skirting matching with floor finish shall be provided in all areas unless specified otherwise elsewhere.
- b) Toilets & locker rooms shall be provided with dado of 2100 mm high.
- c) For main Control room and control equipment room minimum 5 mm thick decorative coloured ceramic tiles shall be provided upto false ceiling level.



- d) For battery room and other areas coming in contact with acid / alkali spillage/ fume, dado of acid / alkali resistant tiling as per IS:4457 shall be provided to a height of 2100 mm set in potassium silicate mortar and joints pointed with resin bonded mortar.
- e) Staircase wall shall be given dado of cast in situ terrazzo to a height of 2100mm. If Entrance lobby and lift area in Service building and Admin building shall be provided with granite tile dado to a height upto false ceiling level.

26.07.00 Doors, Windows, Ventilators, Louvers Etc.

26.07.01 Unless specified all doors, windows and ventilators of air conditioned areas, entrance lobby of all buildings and windows/ventilators provided on the outer face of all buildings shall have, electro colour coated (anodized) aluminum framework with glazing. All doors of office areas shall be of factory made pre-laminated particle board (MDF exterior grade). All other doors (unless otherwise specified) shall be of steel.

Main entrance of the control room and control equipment room shall be provided with air-locked lobby with provision of double doors / glazed panels of aluminum frame work with toughened safety double glass glazing conforming to IS 2553 hermitically sealed and separated by 12 mm thick cup for thermal insulation. Doors shall be of double swing type or sliding type.

For common control building, double glazed wall panels with aluminum frame shall be provided between air-conditioned and non air- conditioned areas and on the side of control room and control equipment room facing the operating floor to have a clear view.

Single glazed panels with aluminum frame work shall be provided as partition between two air-conditioned areas wherever clear view is necessary.

Coal conveyor galleries shall have steel windows/ventilators shall be as per IS 1038

All steel doors shall consist of double plate flush door shutters. The door shutter shall be 45 mm thick with two outer sheets of 18 G rigidly connected with continuous vertical 20 G stiffeners at the rate of 150 mm centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 18 G. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, etc.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 8 9



Steel windows and ventilators for coal conveyor gallery shall be as per IS:1361 and for all other areas as per IS:1038. Windows of coal galleries shall be provided with wire mesh.

Wherever functionally required rolling shutters with suitable operating arrangement Manual / Electric shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS:6248.

All windows and ventilators on ground floor of all buildings located in isolated areas shall be provided with suitable anodized aluminum grill.

Fire proof doors with panic devices shall be provided at all fire exit points as per the recommendations of Tariff Advisory Committee (TAC). These doors shall generally be as per IS:3614 (Part I and Part II). Fire rating of the doors shall be as per TAC requirements. However minimum rating shall be 2 hours. These doors shall be double cover plated type with mineral wool insulation.

Hollow extruded section of minimum 3mm wall thickness as manufactured by INDAL or equivalent shall be used for all aluminum doors, windows and ventilators.

All door sizes shall be decided carefully, keeping in view the size of the machinery/panels to be erected inside the building. In any case opening height shall not be less than maximum height of machinery/panel installed inside the building.

IS Codes

Following are some of the important IS codes (latest edition) applicable to this section:

- IS:204 (Part-II) : Tower bolts non ferrous metals
- IS:208 : Door handles
- IS:2002 (Part-I) : Flywood face panels
- IS:1341 : Steel butt hinges
- IS:1868 : Anodic coatings on aluminum and its alloys
- IS:3564 : Door closers (hydraulically regulated)
- IS:5187 : Flush bolts
- IS:6315 : Floor springs (hydraulically regulated) for heavy doors



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 9 0



IS:7195	: Hold fast
IS:7452	: Hot rolled steel sections for doors, windows and ventilators
IS:10019	: Mild steel stays and fasteners
IS:1038	: Steel doors, windows and ventilators
IS:1361	: Steel windows for industrial ventilators
IS:1948	: Aluminum doors, windows and ventilators
IS:1949	: Aluminum windows for industrial buildings
IS:4351	: Steel door frames
IS:3614 (Part-I)	: Fire check doors
IS:10451	: Steel sliding shutters (top hung type)
IS:4021	: Timber door, window and ventilator frames
IS:1003 (Part-I)	: Timber paneled and glazed shutters– door shutters.

26.07.02

Wall paneling

All the exposed structural steel i.e. wall, columns, bracings in STG control room and air-conditioning areas shall be provided with wooden wall paneling. The wall panel shall consist of teak wood batten grid of size 600x600 mm or as per site requirement. The size of batten shall be 2 inch x 1 inch. BWP grade plywood conforming to IS:710 shall be fixed on this grid. The Vanner of approved quality and shade shall be fixed on the plywood as exterior finish with suitable adhesive. The entire work shall be carried out to the satisfaction of engineer.

26.08.00

Glass and Glazing

All ventilators and windows on external face of turbine building, conveyor gallery, pump house, compressor house, DG set building, transfer points, workshop building, fire escape staircase and those buildings located in fire prone areas shall be provided with wired glass of minimum 6 mm thickness conforming IS:5437.

Glazing in control room between AC and Non AC areas shall be double glazing consisting of two 6 mm thick clear toughened safety glass conforming to IS:2553, hermetically sealed and separated by 12 mm thick gap for thermal insulation.

For single glazed aluminum partitions and doors, Float glass or flat transparent sheet glass of minimum 6 mm thickness shall be used.



Ground glass / frosted glass of minimum 4 mm thickness shall be used for all windows / ventilators in toilets.

Unless specified otherwise in this specification minimum thickness of plain sheet glass used for windows/ventilators shall be 4 mm.

Float glass or flat transparent sheet glass shall conform to IS:2835. All

glazing work shall conform to IS:1083 and IS:3548

26.09.00 False Ceiling and Under Deck Insulation

All air conditioned areas shall be provided with the suspended false ceiling system. Under deck insulation system shall be provided on the under side of the roof / floor slab of the air conditioned areas based on the functional requirement. Ceiling of air washer room shall also be provided with under deck insulation.

Aluminum false ceiling system shall comprise of 84 mm wide 12.5 mm 6 deep closed type plain panels of approved colour, roll formed out of 0.5 mm thick corrosion resistant aluminum alloy AA 5050 fixed on roll formed carriers. Additional hangers and height adjustment clips shall be provided for return air grills, supply air diffusers, light fixtures, AC ducts etc.

Gypsum board false ceiling system shall consist of 600x600x12 mm board with one coat of primer and two or more coats of acrylic emulsion paint. The suspension system shall consist of 6 mm dia galvanized steel rods suspended from ceiling supporting aluminum grid of 38x25x1.5 mm and cross tie of 25x25x1.5 mm and aluminum angle of 25x25x1.5 mm.

Suitable M.S channel (minimum ISMC100) grid shall be provided above false ceiling for movement of personnel to facilitate maintenance of lighting fixtures, AC ducts etc.

CONTRACTOR shall prepare a layout of the false ceiling system incorporating light fixtures, supply air diffuser, return air grills, fire protection sprinklers etc. such that the ceiling looks aesthetically pleasing. Work shall commence only after the OWNER approves the layout.

Under deck insulation shall comprise of 50 thick PUF material of density 36 kg/cubic meter . This mat shall be backed with 0.05 mm thick aluminum foil and 24 Gx25 mm wire mesh netting. They shall be fixed to ceiling or wall as the case may be with 100x50x6 slotted mild steel plate welded to M.S. plate inserts embedded at the soffit of the slab at 600 mm c/c and 14 G steel wire drawn through slots and fixed to wire netting.



26.10.00 Painting

Details furnished here in below are the minimum acceptable standard for painting. Superior finish if any required by CONTRACTOR to Enhance overall appearance will be permitted if such finish meet with the technical requirements.

Water proof cement based paint as per IS:5410 shall be provided on external faces of walls, sunshades etc.

Inside surfaces shall be provided with Acrylic washable distemper for all areas as per IS:428 except for Control room, Control equipment rooms, all air conditioned areas for which Acrylic emulsion paint shall be provided as per IS:5411.

Inside surfaces shall be provided with Acrylic distemper as per IS:428 for plant buildings like Workshop, Permanent stores, D.G. house, Compressor house, pump houses, Ash handling pump house etc.

Walls in D.M.Plant shall be provided with chlorinated rubber based paint as per IS : 9862 over walls. Walls above Dado in battery rooms shall also be provided with similar painting.

All plastered ceilings shall be provided with acrylic washable white distemper as per IS:42.

Oil resistant paint as per IS:161 shall be provided for oil canal and oil equipment room.

All wood work shall be provided with fire resistant transparent paint as per IS : 162 over french polish as per IS:348 or flat oil paint as per IS : 137.

Painting for structural steel have been specified else where in this document.

Following general instruction for painting shall be followed.

- i) For painting on concrete, masonry and plastered surfaces IS:2395 parts I and II shall be followed.
- ii) For painting on wood work IS:2338 part I & II shall be followed.
- iii) All paints shall be of brand and make to the approval of OWNER.
- iv) A minimum of two finishing coats of paint over a primer shall be provided to give a smooth uniform finish for the painted surface.
- v) All painting on masonry or concrete surfaces shall preferably be applied by rollers.



- vi) Thinner shall not be used with textured paint (sandtex matt etc) finish.
- vii) All fire exits shall be painted in Post office red colour shade which shall not be used anywhere except to indicate emergency or safety measure.

26.11.00

Sanitary Facilities

Toilet and shower facilities shall be provided for personnel in finished areas of all major buildings and in other areas as determined by project requirements.

Janitor closets and cleaning material storage areas shall be provided in finished areas of all major buildings.

Minimum one toilet block with all the facilities shall be provided on each floor of main plant building and service building. Separate toilets for ladies shall be provided wherever required. Attached toilets shall be provided for all senior executive rooms and conference rooms. One toilet shall be provided in the boiler area. All other buildings where toilet is specified shall have one toilet block each. The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be provided shall be as stipulated below. IS: 1172 shall be followed for working out the basic requirements for Water supply, drainage and sanitation. In addition, IS: 2064 and IS: 2065 shall also be followed.

Each toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of chromium plated brass (fancy type).

- i) WC (Indian type) Orissa pattern (580x440 mm) as per IS: 2556 (Part-3) and 1 no. bibcock with all fittings including flushing arrangement of appropriate capacity and type-1 no.
- ii) WC (western type) 390 mm high as per IS: 2556 (part 2) with toilet paper roll holder and bibcock and all fittings including, flushing system of appropriate capacity and type-1 no.
- iii) Urinal with all fittings with photo voltaic control flushing system as per IS: 2556 (Part-6, Sec. 1) – 2 nos. (Minimum).
- iv) Wash basin (oval shape) with all fittings as per IS: 2556 to be fixed on concrete platform finished with 12 mm thick polished granite stone – 2 nos.
- v) 1200x900x5.5 size Bathroom float glass mirror with beveled edges including all fittings.
- vi) Stainless steel towel rail (600x20 mm) – 2 nos.
- vii) Stainless steel liquid soap holder cum dispenser – 2 nos.
- viii) Provision for installation of water cooler.
- ix) Provision of ventilation shaft.
- x) Attached toilets provided for senior executive rooms and conference rooms shall have 1 WC, 1 Urinal, 1 washbasin, 1 mirror, 1 no. towel rail, 1 liquid soap holder cum dispenser.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 9 4



WC shall be of western type 390 mm high as per IS: 2556 (Part-2) with toilet paper roll holder and all fittings including flushing valve of appropriate capacity and type. All toilets shall have at least 1 no. of exhaust fan. Final no. of exhaust fans shall be decided as per ventilation requirements to maintain hygienic conditions in the toilet.

- xi) Unless specified all fittings and fixtures in the toilets shall follow technical specification.
- xii) In main Turbine generator building, Service building and Administrative building at least one toilet block shall be provided for ladies.
- xiii) Other buildings which are not specifically mentioned if found necessary shall be provided with adequate toilet facilities in accordance with NBC (National Building Code (latest)). Final requirement shall be as indicated by the owner.

All sanitary fittings and plumbing fixtures shall be of the best quality and make, and shall be subject to Owner's approval. All water supply fittings in toilets, kitchen etc viz., Bib cocks, pillar cocks, P-traps, towel rail, shower rose, gratings etc., shall be of best quality chromium plated brass of approved make.

Supreme B class stoneware pipes or equivalent shall be used for sanitary works above ground level.

26.12.00

Chemical Resistant Treatment Battery Room

- a) Battery room floors and other surfaces as required shall be provided with acid/alkali resistant tiles and treated suitably as detailed below by supplying & furnishing of all labour, materials & equipment in accordance with the following latest codes:
 - 1. IS:3384 : Specification for bitumen primer for use in water proofing & damp proofing
 - 2. IS:4443 : Code of practice for use of resin type chemical resistant mortars
 - 3. IS:4457 : Specification for ceramic unglazed vitreous acid resistant tiles.
 - 4. IS:4832 : Specification for chemical resistant mortars (Part I to III).
 - 5. IS:4971 : Recommendation for selection of Industrial floor finishes.
- b) The surfaces to be treated against acid shall be levelled smooth, dry & clean. The entire surface shall be tapped by wooden hammer to determine hollows if any. In case hollows are found, they shall be suitably sealed with concrete or other approved materials.
- c) The unsatisfactory surfaces shall be replaced by new concrete or other suitable material after ensuring proper bond between the new and old surface. Surface to be prepared shall be wetted for 24 hours; use of epoxy resins for bonding fresh concrete during repairs shall be permitted with Engineer's subject to its execution as per Manufacturer's instructions. All patched areas shall be properly cured by sprinkling water for a period of not less than 10 days.



26.13.00

Acid/Alkali Resistant Tiles on Floors & Walls

- a.) The surface after preparation shall be applied with a coat of bitumen primer conforming to IS:3384 (latest). The primed surface shall be subsequently applied with a uniform coat of bitumen conforming to IS:1580.
- b.) For bedding of tiles, potassium silicate based cement mortar [15 mm thick] as per IS:4832 shall be used spreading on the back & two adjacent sides of the tile. The tile shall be pressed on the floor or wall & push against floor or wall until the joint in each case of 6 mm thick & 6 mm width is maintained with spacers. Before the bedding mortar sets completely, the jointing material shall be removed to a depth of 20 mm. After the bedding mortar is properly set, the joints shall be cured with resin type mortar filling up the entire length of the joint. The excess mortar shall be trimmed off to make the joints smooth & place. Seal coat shall then be applied over the epoxy mortar to cover up porosity that may be left in mortar. Acid resistant tiles shall be provided for a height of at least upto lintel level on all the walls of battery room. The rest of the battery room walls & ceiling shall be provided with 2 coats chlorinated rubber paint. The tiles used for flooring & walls shall be 20 mm thick conforming to IS 4457. Tiles of approved quality and shade shall be used.

Acid curing shall be carried out as per manufacturer's directions using the safety precautions normally used when handling acids. The mortar joints shall be cured with 20 to 25 percent hydrochloric acid or with 30 to 40 percent sulphuric acid no sooner than 2 days and not later than 6 days after the masonry units are bonded with the mortar. The curing time shall be at least 60 minutes.

Performance guarantee: The contractor shall be responsible for the safety, suitability & efficient functioning of all the acid resistant treatment. He should guarantee for efficient performance of the treatment for a period of five years time from the date of the completion. During the guarantee period, if at any stage, it is found that any of such treatments has given way or has not been functioning satisfactorily, the same shall be made good by the contractor at his own cost.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 9 6



27.00.00 WATER SUPPLY, DRAINAGE AND SANITATION

27.01.00 The technical details of permanent water supply, storm water drainage, sewerage disposal system and sanitary appliances required for proper supply drainage, disposal and completion of buildings are detailed below:

27.02.00 Sewerage Pipes

a) Glazed Stoneware Pipes

Glazed stoneware pipes of diameter not exceeding 150 mm can be used in localized areas not subjected to any traffic loads. The glazed stoneware pipes with spigot and socket ends shall conform to IS: 651 Grade “A” or “AA” as specified. These shall be sound, free from visible defects such as fine cracks or hair cracks. The glaze of the pipe shall be free from erasing. The pipes shall give a sharp clear note when struck with a light hammer. There shall be no broken blisters. The pipes shall be handled with sufficient care to avoid damage to them.

b) HDPE soil, waste, vent pipes and fittings

- i) HDPE soil, waste, vent pipes and fittings shall be of “Approved make” conforming to I.S. 4984-1995. The outer and inner surfaces of the pipes and fittings shall be smooth and clean and shall in all respects be free from cracks, pin holes, laps or other imperfections, which may impair the strength and durability of the pipes and fittings. The ends of the pipes shall be reasonably square to their axes.
- ii) The clamps for fixing the pipes to the external wall shall be of approved design and shall fit closely round the pipe or accessory directly beneath the socket.
- iii) The HDPE. soil, waste and vent pipes shall normally be fixed externally to the wall or in suitably designed shafts as per alignment shown on the drawings or as directed by the Engineer. The pipes shall be fixed and kept in position by means of brackets or holder clamps which shall be securely embedded in the wall. For vertical runs, each pipe shall hang freely on its own brackets fixed just below the socket. For horizontal runs, an additional clamp shall be provided at the centre. The brackets or clamps should be of such a design so as to maintain a minimum distance of 50 mm between the surface of the pipe and the wall.



- iv) The soil, waste or vent pipes shall be carried up, above the roof by a least 1.5 m and shall have a cowl of suitable design at the upper end.

c) RCC Pipes

- i) RCC pipes shall be used below ground level for sewage disposal. Pipes connecting toilet facilities to manholes shall be minimum 100 mm diameter NB. Pipes connecting various manholes shall be minimum 150 mm diameter NB. RCC Hume pipes shall be supplied and laid as required as per latest editions of the following IS codes:

IS : 458 : Concrete pipes (with and without reinforcement)

IS : 783 : Code or practice for laying of concrete pipes

IS : 4111(Part-1) : Code of practice for ancillary structure in sewerage system

- ii) The contractor shall supply the RCC hume pipes [to class NP3/NP2 of IS:458 as required] of various diameters along with fittings required for carrying out the work. The contractor should furnish manufacturer's test certificates from recognized authorities. PCC encasement shall also be provided whenever required as per design requirement.

iii) Alignment, Levels and Grade

The work shall be carried out in conformance to the alignments, levels and grades specified. The layout and levels shall be made by the contractor from one reference grid and bench mark given by the Engineer with the assistance of instruments, materials and men for checking the detailed layout and levels as and when required. Making of reference layout and level pillars along the pipeline route and maintaining them upto completion of the work shall be the Contractor's responsibility.

iv) Laying of Pipes

The laying of RCC pipes shall conform to IS:783. To suit the site conditions, the pipes should be laid as per drawings and instructions of the Engineer. Under the culvert condition, the pipe shall be laid under embankment and may project wholly or partly above the original ground surface.

Under trench condition, the pipe shall be laid in the excavated trench which shall be refilled with thoroughly tamped earth after laying and jointing of pipes in an approved manner. Adequate sand field



cushioning shall be provided below pipes. Minimum depth of cushion shall be 600 mm.

Under open condition, the pipe shall be laid such that it projects wholly or partly above original ground surface, there being no super imposed over burden on the pipe.

v) Bedding and Supports

Under culvert condition, the pipes shall be laid generally on “First Class bedding” as per IS:783. Under trench condition, the pipes shall be laid generally on “First Class Bedding” as per IS:783. If shown on the drawing or so instructed by the Engineer, the pipes shall be laid on concrete cradles, conforming to IS:783. Minimum crushing strength shall be 140 Kg/sqm. Under open condition, the pipes shall be supported over rigid C.C. pedestals constructed at intervals not greater than the length of one individual piece of pipe, as per drawings and instructions of the Engineer. In no case shall the joint between two pieces of pipe shall lie at center of the span between the supports. The pedestal shall be of plain/reinforced concrete with a properly shaped out top to receive the pipe. Manholes shall be provided as per latest IS:4111 (Part-I) for pipe drains at the change of diameter of pipe, alignment and direction at a max. spacing of 30 m c/c upto 900 mm diameter and 45 m c/c for higher diameters of the pipe. Each manhole shall be provided with a heavy duty C.I. cover as per IS:1726.

d) Jointing

i) Glazed Stoneware Pipes

The cement mortar for jointing shall be 1:3 (1 cement: 3 fine sand) with spun yarn in neat cement. Tarred gasket or hemp/ spun yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be placed well into the socket of the pipe previously laid. Then pipe shall be adjusted and fixed in the correct position and gasket/ spun yarn caulked tightly so as to fill not more than ¼ th of the total depth of the socket.

The remainder of the socket shall be filled with stiff mixture of cement mortar in the proportion of 1:1 (1 cement: 1 fine sand). When the socket is filled, a fillet shall be formed round the joint with a trowel forming an angle of 45 Degree with the barrel of the pipe. After a day's work any extraneous material shall be removed from the inside of the pipe. The newly made joints shall be cured.



ii) Jointing of RCC pipes

IS : 783 provisions shall be followed for jointing of pipes; and every possible care shall be taken to ensure that the joints made are leak proof. Curing of joints shall be done for a period of 10 days.

e) Testing of Joints

i) Stone Ware Pipes

Stone ware pipes used for sewers shall be subjected to test pressure of 1.5M head of water at the highest point of the section under test. The test shall be carried out by suitably plugging the low end of the drain and the ends of the connection if any and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of vertical pipe jointed to it so as to provide the required test head. Or this may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

ii) RCC pipes

All RCC pipe joints shall be checked for water tightness as per relevant IS code.

27.03.00

Internal Work

a) All water supply pipes for internal plumbing of buildings shall be of GI pipe of medium class conforming to IS : 1239 of approved make. Galvanizing of pipes shall conform to IS : 4736.

b) The pipes and sockets shall be cleanly finished, well galvanized in and out and free from cracks, surface flaws, laminations and other defects; all screw threads shall be clean and well cut. The ends shall be cut cleanly, and square with the axis of the tube. The thickness and weight of pipes and sockets shall be in accordance with IS : 1239.

All screwed tubes and sockets shall have pipe threads conforming to latest IS:554. Screwed tubes shall have taper threads while the sockets shall have parallel threads.

c) The pipe fittings shall be of malleable cast iron or mild steel tubes complying with all the appropriate requirements of clause No.3 or as specified. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended. The fittings shall have screw threads at the ends conforming to IS: 554 (latest edition).



Female threads on fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be taper.

d) Cutting, Laying and Jointing

Where the pipes have to be cut or rethreaded, the ends shall be carefully filled out so that no obstruction to bore is offered. The ends of the pipes shall then be threaded conforming to IS: 554 (latest edition) with pipe dies and tapes carefully in such a manner as well not result in slackness of joints when the two pieces are screwed together. The tapes and dies shall be used only for straightening screw threads which have become bent or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in a water tight joints. The screw threads of pipes and fittings shall be protected from the damage until they are fitted.

The pipes shall be cleaned and cleared of all foreign matter before being laid. In joining the pipes, the inside of the sockets and the screwed end of the pipes shall be oiled and rubbed over with white lead; and a few turns of spun yarn wrapped round the screwed end of the pipe. The end shall then be screwed in the sockets, tee etc. with the pipe wrench. Care should be taken that all the pipes and fittings are properly jointed so as to make the joints completely water-tight; and pipes are kept at all times free from dust and dirt during fixing. Bore from the joint shall be removed after screwing. After laying, the open ends of the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

Any threads exposed after joining shall be painted or in case of underground piping thickly coated with approved anticorrosive paint to prevent corrosion.

e) Fitting

- (i) For internal work, the galvanized pipes fittings shall be done by means of standard pattern holder bat clamps, keeping the pipes about 1.5 cm. clear of the wall. When it is found necessary to conceal the pipes chasing may be adopted or pipes fixed in the ducts or recesses etc. provided there is sufficient space to work on the pipes with the usual tools. The pipes shall not be buried in walls or solid floors, where unavoidable pipes may be buried for short distances provided adequate protection is given against damage and where so required joints are not buried. Where directed by the Engineer, a steel tube sleeve shall be fixed at a place a pipe is passing through a wall or floor for reception of the pipe and to allow freedom for expansion and contraction and other movements. In case the pipe is embedded in wall or floors, it



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 0 1



should be painted with anticorrosive bitumastic paint of approved quality. The pipe should not come in contact with lime mortar or lime concrete as the pipe is affected by lime. Under the floors the pipes shall be laid in layer of sand filling done under concrete floors.

- ii) All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable. The pipes shall be fixed to walls with standard pattern holder bat clamps of required shape and size so as to fit tightly on the pipes when tightened with screw bolts. The clamps shall be embedded in brick work in cement mortar 1:3 (1 cement : 3 coarse sand) and shall be spaced at regular intervals in straight lengths as indicated below :-

Size of pipe (mm)	LENGTHS	
	Horizontal runs (m)	Vertical runs (m)
15	2	2.5
20	2.5	3
25	2.5	3
32	2.5	3
40	3	3.5
50	3.5	3.5
65	3.5	5
80	3.5	5

The clamps shall be fixed at shorter lengths near the fittings as directed by the Engineer.

- iii) For G.I. Pipes 15mm to 25 mm dia, the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However, for bigger dimension pipes, the holes shall be carefully made of the smallest size as directed by the Engineer. After fixing the pipes, the holes shall be made good with cement mortar 1:3 (1 cement and 3 coarse sand) and properly finished to match the adjacent surface.

27.04.00

Trenches and Other Excavations



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 0 2



Width of the trench at the bottom shall be such as to provide 200 mm clearance on either side of the pipe for facility of laying and jointing.

Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the spoil bank shall not be allowed to endanger the stability of the excavation. Spoil may be carted away and used for filling the trench behind the work.

Turf, top soil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement.

All excavation shall be properly timbered, where necessary.

Efficient arrangements for dewatering during excavation and keeping it dry till backfilling shall be made to the satisfaction of the Engineer. Sumps for dewatering shall be located away from the pipe layout.

Where the excavation proceeds through roads necessary permissions shall be secured by the Contractors from the appropriate authorities.

Special care shall be taken not to damage underground services, cables etc. These when exposed shall be kept adequately supported till the trench is backfilled.

The backfilling shall be done only after the pipeline has been tested and approved by the Engineer. Special care shall be taken under and sides of the pipe during handpacking with selected material. At least 300 mm over the pipe shall also be filled with soft earth or sand. Consolidation shall be done in 150 mm layers. The surface water shall be prevented from getting into the filled up trench. Traffic shall not be inconvenienced by heaping up unduly the backfilling material to compensate future settlement. All future settlements shall be made good regularly to minimise inconvenience of traffic where applicable.

27.05.00

Sanitary Appliances

a) Water Closet

- (i) **Water closet Pan** : The water closet shall be of Orissa pan/European type of approved make, Vitreous China conforming to IS: 2556 Part- III. The closet shall be of size as specified. The flushing rim shall be integral with the pan and shall be Self draining type. The closet shall be provided with a self cleaning trap of the same material as the pan. The trap shall be either a “P” or “S” outlet and with a vent hole. The effective depth of the water Seal shall not be less than 50 mm.



- (ii) The pan shall be fixed in position as shown on the drawing. It shall be embedded on a suitably prepared surface rendered smooth with neat cement or cement plaster so that uniform support is provided to the pan. The pan shall normally be at the floor level unless otherwise specified. The WC pan shall be fixed to the trap by means of a cement mortar joint as in the case of SW pipes; and the entire job carried out so that the effective seal is always kept maintained the vent of the trap being connected to Anti siphonage pipe.
- (iii) While laying flooring, a section about 1 x 1.5 m or less of the part of the floor where WC is to be fixed shall be left out. This shall be finished only after the pan has been fixed and laid in position. The pan shall be kept suitably protected against all damages. It shall include both pan and trap, as well as fixing materials as needed.

b) Flushing Cisterns for Water Closets

The flushing cistern for water closet shall be PVC low level type of 10 Ltr. capacity (IS 2556 mark) with PVC bend of approved make. The cistern shall be secured on wall or supported on steel brackets which shall be well embedded in the wall. The height of the bottom of the cistern from the top of the pan shall be 30 cm for low level cistern. The cistern shall be provided with brass balcock with ball to IS:1703. It shall include brackets, screw, flush pipes, brass ball cock with ball as needed.

- c) The Urinal shall be of first quality, WVC flat back (Large) or half shall type IS 2556 of size as specified of approved make. The urinal shall be fixed in position by means of four plugs embedded in wall and screws, the top of urinal lip being 65 cm from the floor level. Urinal bring a soil fitment should be connected to soil pipe. Each urinal shall be provided with 25 mm dia B Class GI Waste pipe connected to the pan by suitable joint and shall discharge in to a drain connected to a soil pipe through a trap. The flushing of urinal shall be with all fittings including voltaic control flushing system as per IS:2556 (Part-6 Section-1).
- d) The wash basin (oval shape) with all fittings as per IS:2556 made of vitreous China clay to be fixed on a concrete plat form finished with 12 mm thick polished granite stone. The basin shall be provided with single tap connection. The washbasin shall have an integral soap holder recess or recesses which shall drain into the bowl.

Each Wash Basin shall be provided with :



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 0 4



- i) 32 mm ϕ CP brass waste fitting with CP brass chain and 32 mm dia plug.
- ii) 25 mm ϕ galvanized waste pipe "B" class discharging into a drain suitably connected to waste fitting by means of brass check nuts.
- iii) 15 mm ϕ CP pillar taps of superior quality to IS-8994 of approved make.

The basin shall be connected to the waste pipe discharge in to drain, by means of the waste fittings and check nuts, the join being completely leak proof. The tap shall be connected to the water supply system by means of a lead connection. A stop cock shall be provided to regulate supply to the wash basin. It shall include fixing material complete with brackets, waste coupling, waste pipe, NP pillar tap, CC chamber and grating.

- e) Wall to wall bath room mirror (5.5MM thick) float glass with beveled edges including all fittings shall be provided.
- f) All toilets shall have at least one No. of exhaust fan. The No. of exhaust fan shall be decided as per ventilation requirements to maintain the high hygienic conditions in the toilet.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 0 5



28.00.00

SWITCHYARD CIVIL WORKS

28.01.00

The structural and civil works associated with erection and commissioning of station switchyard shall be executed as detailed below. The scope covers design, engineering, fabrication, galvanizing, supply and erection of:

- a) Lighting mast, towers, beams, equipment lattice support, equipment pipe support inclusive of all fixtures such as nuts, bolts, hangers, shackles, clamps, anti-climbing devices, bird guards, step bolts/ladders, number plates, danger and phase plates, inserts in concrete, foundation bolts, base plates, stiffeners, dampers, fixtures for supporting and operating mechanism boxes, control cubicles etc.
- b) Framed RCC switch yard building with brick cladding shall be provided to accommodate various equipments including GIS as per electrical drawing. Roof shall be of RCC. Size of building of building shall meet electrical requirements.
- c) Cable tray supports, cable trays, embedments in cable trenches, bolts and nuts and any other accessories etc.
- d) R.C.C. cable trench and pipe trenches with necessary precast R.C.C. covers with lifting facilities, sump pit, cable trays, supports etc. [wherever trenches cross road, the section below such crossings shall be designed as per Indian Road Congress Drainage of these trenches shall be suitable designed]. All precast slabs for trenches shall be provided with MS edge protection angle on all sides (min. size of angle 50x50x6 mm). The RCC trench edges shall be provided with MS angle protection (min. size of angle 50x50x6 mm)
- e) Drainage and lighting of the area [cable trench should not be used for drainage purpose]. An approved system for draining the transformer and oil collection, and disposal system shall be provided.
- f) For prevention of vegetation, the graded ground shall be covered with fly ash brick pavement over 300 mm ash filling is to be provided in the switchyard area. Each fly ash layer shall be compacted/ consolidated by using ½ ton roller with 4 to 5 passes and suitable water sprinkling. The method of application of chemicals used for soil sterilization/anti-weed treatment shall be as per manufacturer's recommendations. Also, the RCC pathway shall be provided in switchyard as per the requirement.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 0 6



- g) Transformer foundations; RCC roads within switchyard, fire protection walls and chain link fencing for switchyard. RCC paving shall be provided in Transformer yard.

28.02.00

General Requirements

28.02.01

Steel shall conform to IS:226/IS2062. Where plate cut pieces are used to form a part of either flange plates or web plates of fabricated columns with butt joints, length of such pieces shall not be less than 3 (three) meters. When cut pieces out of rolled sections are to be joined by butt welding, the length of such pieces shall not be less than 3 (three) meters and the total number of pieces of any member shall not exceed three. The steel structures for the switchyard shall be double dip galvanized with zinc coating not less than 0.91 kg/m².

All foundations for the switchyard structures (except transformer) shall be designed as per relevant IS:4091 "Code of practice for design and construction of foundations for transmission line towers and poles" and IS-456 (latest) "Code of practice for plain and reinforced concrete". All the foundations shall be protected by as per clause 6.11 of this specification.

28.02.02

Transformer/ shunt reactor foundations

The transformer/shunt reactor foundations shall be designed as per relevant IS Code. This shall include collection of oil, drainage of oil along with rain water collected in such foundation; as well as necessary cable connection works.

28.02.03

- a) The steel girders shall be designed for static tension dead load of conductors, insulators, and accessories, erection load, short circuit forces, wind/seismic loads and secondary stresses. The girders shall be connected with lattice columns by bolted joints.
- b) The fabrication and erection of the works shall be carried out generally as per IS:802 Part-II, IS:800. All materials shall be completely shop fabricated. Towers, beams etc. shall be trial assembled at shop keeping in view the actual site condition for convenient pre-assembly during erection. Necessary match marks shall be made on these components before dismantling in the shop.

28.02.04

Bolting

Every bolt shall be provided with a steel washer under the nut so that no part of the threaded portion of the bolt is within the thickness of the parts bolted together. Notwithstanding anything to the contrary contained in IS:1363, IS:1364 and IS:1367 the unthreaded length of



the bolt shank shall be equal to total thickness of metal being bolted together plus 2 mm. The threaded length shall be equal to at least the diameter of bolt plus 6 mm.

- a) Cable and pipe trenches shall be in R.C.C. with removable R.C.C. covers. (The top of trench shall be kept 150 mm above the grade level). The bed of trenches shall be slope 1 in 200 to drain water into a collection sump suitably. All trenches shall be given a slope of 1 in 500 along run of the trench. Cable trenches crossing the road shall be designed for class “AA” loading as per IRC standard. However, the design shall also be checked for class “A” loading as per IRC standard. All precast slabs for trenches shall be provided with MS edge protection angle on all sides (min. size of angle 50x50x6 mm). The RCC trench edges shall be provided with MS angle protection (min. size of angle 50x50x6 mm) Surcharge load of 2T /sqm. Shall be considered in design of trenches in switchyard area.
- b) The design of foundation and all trenches should take care of sub-soil water pressure as per relevant IS Codes. If the ground water table is above the base level of the trench, PVC water stops (minimum 230 mm wide and 5 mm thick) should be provided at all construction and expansion joints to the approval of the Engineer.

28.02.05 All anchors, anchor bolts, insert pipes, conduits, sleeves, bolts, etc. required to be embedded in concrete shall be placed in position before concreting. These inserts shall be welded to the nearest reinforcement to keep them in position.

28.02.06 a) The fence around switchyard area shall comprise of 12 gauge G.I. chain link fencing of mesh size 75 mm to a height of 2.4 m above the toe wall with a 600 mm high galvanized concertina at the top such that total fence height of 3.0m above toe wall level is achieved. Toe wall shall be minimum 200 mm above the formation level.

- b) The chainlink fencing shall comprise of size 2400x2000 mm size panel made from 75x75mm & 8 gauge GI chainlinks (including PVC coatings) and 50x50x6 mm angle including fixing the chainlink in angle frame by means of 40x3mm. MS flat welded to angle frame drilling to holes in angle frame & flat and fixing the same with angle post in the level and plumb by means of 10 mm dia bolts frames and flat & nuts, 3 coats of epoxy base paint to achieve required 250 DT to angle iron etc. completed.

This chainlink fencing panel shall be fixed with the fence posts of 65x65x6 MS angles spaced as per requirement.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 0 8



- c) Above the chain link fencing panel 3 horizontal rows of barbed wire of gauge 12/14 with 3 diagonal rows shall be fixed as per drawing.
- d) All fence posts shall be 65 x 65 x 6 MS angles spaced at 2.5 m c/c distance. All straining posts i.e. end posts shall be 65 x 65 x 6 angles. Suitable concrete foundations for the angle iron posts and stays shall be provided based on the prevailing soil conditions. Toe walls either of bricks of minimum 50kg/cm² compressive shall be provided between the fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the switchyard formation level with PCC coping (M-20) and minimum 300 mm below the switchyard formation level. All gates shall be of hot dipped galvanized structural steel as specified.
- e) All structural steel work for the fencing shall be painted with chlorinated rubber paint over a suitable primer or epoxy based paint (of total DFT 250 microns) to withstand severe marine/corrosive exposure condition for protection.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 0 9



29.00.00

GALVANIZING

- a) Structural steel works and pipe supports wherever required other than that of fencing shall be hot double dip galvanized after fabrication as per relevant IS codes. Galvanising of the towers shall be as per IS:4759 and 2633 and as given in the following paras. Zinc required for galvanizing shall be arranged by the contractor. Purity of zinc to used for galvanizing shall be 99.5% as per IS:209. All burrs and irregular edges shall be ground smooth before galvanizing.
- b) After completion of all shop work, structural material shall be punched with the erection marks and be hot dip galvanized including the portion to be embedded in concrete. Each grillage member including stubs shall also be fully galvanized. Before galvanizing, the steel section shall be thoroughly cleaned of any paint, grease, rust, scale, acid, alkali or such other foreign matters likely to interfere with the galvanizing process or with the quality and durability of the zinc coating. Pickling shall be carefully done and shall be proper.
- c) The weight of the zinc coating shall be at least 0.9 kg/ sq.m including stub members. The galvanized surfaces shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel, globules, spiky deposits, 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.
- d) There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized steel member shall withstand in copper sulphate solution as per IS:2633. When the steel section is removed from the galvanizing kettle, excess spelter shall be removed by 'bumpng'. The process known as 'wiping' or 'scrapping' shall not be used for this purpose.
- All bolts, nuts, washers etc. shall be hot dip galvanized. Excess spelter from bolts, nuts etc. shall be removed by centrifugal spinning of bolts and nuts. Threading after galvanizing, shall not be permitted. Nuts, however, may be tapped, but not to cause appreciable racking of the nuts on the bolts. Spring washers shall be electro-galvanised.
- e) Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specification or lack of quality control in any manner in the galvanizing plant shall render the entire production in the relevant shift liable to



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 1 0



rejection. All the towers, pipe supports and accessories shall be treated with sodium dichromate or an approved equivalent solution after galvanizing, so as to prevent white storage stains.

- f) Similar If the galvanizing of any member is damaged, the galvanizing shall be redone in the manner as stated above to Engineer's approval. The contractor shall also furnish sufficient quantity of appropriate paint, for repairing galvanized surfaces, damaged in transit.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 1 1



30.00.00

PILING

30.01.00

The detailed design, preparation of construction drawings, installation and testing of piles forming foundations to buildings and structures are detailed below conforming to the latest IS:2911 – Code of Practice for Design and Construction of Pile Foundations : Part I Concrete Piles and IS:2911 Part : IV Load test on piles and to this Specification. The contractor shall be responsible for all aspects of the pile performance installed including demonstration of the adequacy of his design by testing. During detailed design the contractor shall submit the proposed firm to undertake piling work with details piling system, method of installation, summary of design basis, number, type and size of construction plant items to be employed for the work including crane, piling equipment, concreting equipment and proposal for installation & testing of trial piles and tests on work piles.

30.02.00

Prior to installation of trial piles, the contractor shall submit final details of the trial piling installation including specifications, detailed design calculations and construction drawings for the trial piling together with associated equipment to be provided for construction and testing of the same. Design report discussing the overall results of the tests on trial piles and concluding with and justifying the proposed definition of reference piles; specification, with fully detailed construction drawings, supporting calculations for the final design of the working piles, and the field control procedures the contractor intends to use to verify that pile installation satisfies the requirements of his design should also be submitted.

30.03.00

Design Criteria

The following shall be the design criteria for the working piles :

- a) Piles shall be designed in line with approved soil investigation report as single vertical piles acting under a design load as deemed fit.
- b) Driving formula (where relevant) may be adopted inter alia as a criteria for acceptance. But the minimum founding requirements shall be based on recognized methods of soil mechanics design, appropriate to the type of pile.
- c) The piles shall be designed for a minimum factor of safety of 2.5 against failure under the design load specified.
- d) Piles shall be designed for a limiting settlement of a single pile under vertical design load of 8 mm at the head.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 1 2



- e) Piles shall be designed to resist a maximum force due to critical load combination in any direction applied to the head of the pile at cut-off level. For this design condition it shall be assumed that the pile head is effectively as a fixed-end by the pile-cap.

30.04.00

Tolerance

Setting out shall be carried out from the main grid lines of the proposed structure. Immediately before installation of the pile, the pile position shall be marked with suitable identifiable pins or markers. For a pile head cut-off, at or above ground level, the maximum permitted deviation of the pile head cut off center from the center point, shown on the setting out drawing shall be 75 mm in any direction. For a pile head cut-off below ground level, an additional tolerance will be permitted as below on the assumption that the pile head would have been within tolerance if the cut-off had been at ground level. The maximum permitted deviation of the finished pile from the vertical is 1 in 75. Forceful corrections to concrete piles shall not be made.

30.05.00

The contractor shall carry out the work to minimize noise and disturbance.

If during the execution of the work, damage is likely to be, caused to mains, services or adjacent structures, the contractor shall submit proposal for repair or avoidance of such damage. The contractor shall ensure that damage does not occur to completed piles.

30.06.00

Records

The contractor shall keep records as below of the installation of each pile and shall submit record to the Engineer.

Table 1.0

a)	Piles reference number (location)	*
b)	Piles cut off level	*
c)	Pile type	*
d)	Nominal cross-sectional dimensions or diameter	*
e)	Pile design capacity	*
f)	Standing groundwater level	*
g)	Date and time of driving, red riving or boring	*
h)	Date of concreting	*
i)	Ground level at commencement of installation of piles	*
j)	Working level	*
k)	Depth from working level to pile toe	*
l)	Toe level	*
m)	Depth from working level to pile head level	*
n)	Length of temporary / permanent casing	*
o)	Type weight, drop and mechanical condition of hammer	*



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 1 3



p)	Number of type of packings used and type and condition of	*
q)	Record of blows per 300 mm over complete drive	*
r)	Set of pile or pile tube in mm per 10 blows or number of	*
s)	Temporary compression of ground and pile from time of	*
t)	Length and details of reinforcement	*
u)	Grade and slump of Concrete mix and control test	*
v)	Volume of concrete installed in pile	*
w)	Method of placing concrete	*
x)	Number of blows to form bulb where appropriate	*
y)	Level of water or drilling fluid at commencement of	*
z)	All information regarding obstructions delays and other	*

30.07.00

Driven Cast-in-situ Concrete Piles

- a) Installation of piles shall be carried out as per layout construction drawings in accordance with latest IS codes as below:
- i) IS:456-2000 : Code of practice for plain and Reinforced Concrete
 - ii) IS:2911-Part I : Code of Practice for Design and Section-I Construction of pipe foundation
 - iii) IS:2911-Part IV : Test load on piles
- b) The sequence of installation of piles shall be to the approval of the Engineer.
- c) The equipment and accessories required for the pile driving shall be standard type. The capacity of the pile frame shall be selected after considering the size and weight of the casing to be handled, the location of the work and the hardness of driving. The steel casing used for installing the piles shall be straight and shall have sufficient wall thickness and strength to prevent damage, distortion etc. Detachable shoes used with the temporary steel casing shall be fabricated steel or cast iron, double rimmed and of requisite strength, and of the standard sizes used with the respective steel casing. The shoe shall be co-axial with the steel casing. Casings distorted from true uniform shape whether caused by driving or earth and water pressure resulting in a reduction of the cross sectional area of the pile in excess of 10 percent shall not be used in the works. The nominal casing size shall be 500 mm diameter.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 1 4



- d) The pile shall be driven to a set proposed by the contractor. The final set values shall be repeated thrice before terminating the pile at that level. All relevant data with back up, computations pertaining to “set” shall be submitted before commencing piling work for Purchasers approval. Any sudden change in rate of penetration shall be brought to the notice of the Engineer.

e) **Control of Pile Driving**

Protection of pile heads and selection of pile hammer shall be as per IS:2911 Part I. The pile shall be driven as accurately as possible to the vertical. Piles shall be installed with due consideration for the safety of adjacent structures by a method leaving their strength unimpaired and which develops and retains the required load bearing capacity. In the case of piles close to existing plant and structures, the Engineer may specify suitable precautions which may call for additional working hours for the rig. The quipment and methods for installing piles shall be such that the loss of energy is limited to a minimum. Should the deviation of the installed pile be greater than the specified tolerances, the Engineer may at his discretion order the installation of additional piles after checking the design load on the pile group of which the particular pile forms part. Care shall be taken not to damage the piles by over driving. Any sudden change in the rate of penetration shall be noted and informed to the Engineer. Jetting of Pile by means of water shall not be permitted.

- f) After complete installation of the casing before concreting, the contractor shall inform the Engineer to inspect the casing for proper plumb location and other conditions. Only after approval concreting should proceed. Level readings shall be taken on each pile after driving and again after all the piles in a group are driven. Piles which are found to have resin shall be driven to the original depth and set.

- g) The main longitudinal reinforcing bars in piles shall be in one continuous length. In long piles, joints shall be permitted in main longitudinal bars but these shall be kept to a minimum. Joints in adjacent bars shall be staggered at least 1 meter part along the length of the pile. Joints in reinforcement shall be such that the full strength of the bar is effective across the joint.

Longitudinal reinforcement shall be provided for the full length of the pile extending above pile cut off level to provide adequate bond length into the pile cap. The minimum area of longitudinal reinforcement within the pile shaft shall be 0.4 percent of cross-sectional area of the pile on the basis of the nominal casing diameter. Longitudinal reinforcement shall be formed into a rigid cage to resist deformation during handling and installation by the use of links or helical reinforcement. The minimum diameter of links



and helical reinforcement shall be 6 mm spaced at 150 mm and not more than 300 mm. The longitudinal reinforcement shall project 52 times its diameter; above the cut off level of the pile to ensure adequate bond length inside the pipe cap. Minimum 6 Nos. of longitudinal reinforcement shall be provided. Reinforcement provided in pile shall be symmetrical about any axis on the pile cross section. The diameter of longitudinal reinforcement shall not be less than 12 mm. Lap or splice joints shall be provided with sufficient link bars to resist eccentric forces. Minimum cover to main reinforcement in the pile shall be 75mm.

h) The method of placing and the workability of the concrete shall be such that continuous monolithic concrete shaft of the full cross-section is formed. Mechanical vibrators shall not be used to compact concrete. Concrete in piles shall be of design- mix with minimum grade M25 with minimum cement of 400 kg/cum water cement ratio within 0.45 to 0.55 using super plasticized Sikament 170 or equivalent. Generally the slump of the concrete shall be within the range 100 to 150 mm. The contractor shall ensure the minimum specified strength in accordance with IS:456, IS:10262 & SP. 23 shall be followed as guidance for mix design. Compaction of test cubes shall be done under same condition as followed for concreting of piles.

i) In soft clays or loose sands ,or where there is likelihood of danger to green concrete due to driving of adjacent piles, the designed reinforcement should be provided up to the full pile depth, regardless of whether or not it is required from uplift and lateral load considerations. Refer clause 5.11.2 of IS : 2911 (Part I / Sec-1)

j) Cleaning out of casing

Before placement of concrete ,it shall be ensured that the inside of the casing is free from sludge or any foreign matter. The contractor shall ensure that water does not enter the casing tube/pile shoe at the end of driving & during the concreting operations. The existence of water inside casing tube after driving and before executing the concrete operation, if any shall be checked by the contractor by suitable probe & concreting of pile work shall be allowed to proceed if water level is less than 15 cm measured above the inner surface at the top of the shoe. If the water level is more than 15 cm, contractor shall take remedial measures viz. bailing or pumping to reduce the depth of water before concreting & if it is not possible to do so then the contractor shall re-drive the casing at no extra cost to the Purchaser.

k) Concrete Level – finishing of pile head

The cut-off level shall be as shown on the construction drawings. Concrete shall be cast to minimum of 500 mm above the cut-off level, or local ground water level, whichever is higher. Withdrawal of temporary casing



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 1 6



shall be carried out in stages during the concrete placing operation with utmost care maintaining an adequate head of concrete above the bottom of casing at each stage of withdrawal so as to prevent the inflow of soil and water into the bore. Section of empty hole remaining above the head of the pile shall be temporarily backfilled with sand or other approved material prior to excavation for pile cap construction.

l) Trimming of pile heads

Following excavation subsequently for pile cap construction, the contractor shall carefully remove excess concrete above specified cut-off level, without damaging the remainder of the pile including the projection reinforcement. Any cracked or defective concrete occurring below specified cut-off level shall be cut away and made good with new concrete properly bonded to the old. Piles that are defective shall be pulled out or left in place as judged by Engineer without affecting performance of adjacent piles. Also the contractor shall be bound to install additional piles to substitute the defective ones as per the directions of the Engineer.

m) The dynamic cone penetration tests shall be carried out for a depth of at least 2 meters from the termination depth. The number of such tests shall be as follows

- a. One number dynamic cone penetration test for each pile group consisting of more than four piles.
- b. For TG and Chimney pile groups the number of dynamic cone penetration tests shall be one per cent of the total number of piles.

30.08.00

Load Tests on Piles

a) Load test shall be in accordance with IS:2911 Part IV (latest revision) Initial load tests on “Trial Piles” shall be executed in advance of works pile construction and shall comprise vertical load tests at locations as directed. Load test on trial piles shall also include lateral load test and uplift load tests as directed by the Engineer. 6 number of trial piles shall be tested from each capacity of the pile. Out of the six (6) nos. of piles to be tested for two (2) nos. each capacity shall be tested for vertical load, two (2) nos. for lateral load and two (2) nos. for uplift load.

Routine load tests on “Works Piles” shall be vertical load test and lateral load tests on piles as directed by the Engineer. Number of routine tests to be conducted on work piles shall be equal to one and half (1.5) percent of the total number of piles used in the work for vertical load tests as well as lateral load tests.



- b) Load tests shall not normally be undertaken by the contractor within 28 days after the installation of the piles in position. However, the contractor may be allowed by the Engineer to use rapid hardening cement or add necessary admixtures to enable him to conduct the tests within a lesser period. Before any load test is done, the proposed arrangement for carrying out the load tests including the preparation of the structure to receive the loads and the type of loading to be adopted shall be furnished by the contractor.

c) **Vertical Load Test on Trial Piles**

Load tests to verify the contractor's design shall be carried out on piles of different capacities proposed to be used. The contractor shall commence testing as early as possible after installing the piles. The test shall be carried out by applying series of loads on RC cap over single pile. The load shall be applied by means of standard hydraulic jack reacting against a loaded platform which shall be preloaded platform which shall be preloaded to three times the estimated safe load carrying capacity of the pile. Reading of settlement and rebound shall be recorded with four dial gauges of 0.01 mm sensitively and resting on diametrically opposite ends of the pile cap. The dial gauge shall be fixed to a datum bar whose ends rest-upon non-movable supports. The supports for datum bar with reference to which the settlement of the pile is measured shall be at least 5 times diameter of pile away from the pile.

The test shall be conducted by the cyclic loading method. The test load shall be applied in equal increments of about one-fifth of the estimated safe load. Each stage of loading or unloading shall be maintained till the rate of movement of the pile cap is not more than 0.02 mm per hour. However, load shall be maintained for longer periods at 1 to 1.5 times the assumed safe capacity, and at final loads as directed by Engineer. The safe load on pile shall be the least of the following :

- i Two third of the final load at which the total settlement attains the value of 12 mm.
- ii Two third of the final load at which the net settlement attains a value of 6 mm.
- iii 50 per cent of the final load at which the total settlement equals one-tenth of the pile diameter.

d) **Lateral Load Test on Trial Piles**

The test pile shall be decided by the Engineer. The test pile shall be cut off at the proper level and provided with a cap with vertical plane sides having



an adequate area for proper seating of the jack and dial gauge. The lateral load shall be applied on the pile at or approximately at cut off level and the deflection shall be measured at a point diametrically opposite to the point of load application. The loading shall be applied by the hydraulic jack of adequate capacity, abutting the pile horizontally and reacting against a suitable system. The reaction may be provided by the well of the excavated pit when the test is being conducted below ground level or by a neighbouring pile in which case thrust pieces shall be inserted on either end of the jack to make up the gap. Lateral load applied on the pile shall be measured by a calibrated pressure gauge mounted on the jack, having a least count of 500 kg. Deflection of the pile head shall be measured by four dial gauges, fixed to datum bars & having a least count of 0.01 mm. The datum bars shall be provided with rigid supports. Loading shall be applied in increments of 500 kg. Each stage shall be maintained for a period till the rate of movement of the pile head is not more than 0.02 mm/hour or 1 hour whichever is greater .

Loading shall be continued till one of the following occurs :

- i. Deflection of pile head exceeds 12 mm.
- ii. The applied load on the pile is three times the assumed lateral load capacity of the pile.

The safe load shall be smaller of the following :

- i. Half the final load for which the total deflection is 12 mm.
- ii. Load at which the total displacement corresponds to 5 mm.

e) Pull-out Test

The test piles shall be decided by the Engineer. The test pile shall be built upto the proper length and the head provided with suitable arrangements for anchoring the load applying system. Loads shall be applied using a approved reaction system, uplift forces on the pile shall be applied directly to the test pile or through a lever system. The reaction shall be provided by neighbouring piles or blocks may be constructed for the purpose. Hydraulic jacks shall be used for load application. Load applied by the hydraulic jack shall be measured by a calibrated gauge with a least count of 100 Kg. Movement of the pile shall be measured by dial gauges, fixed to datum bar and having a least count of 0.01 mm. Four dial gauges placed diametrically opposite shall be used. Datum bars shall be provided with rigid supports. The load shall be applied along the longitudinal axis of the pile using method approved by the Engineer. Loading shall be applied to the pile top in increment of one-fifth of the expected safe capacity. Each stage shall be



maintained for a period till the rate of movement of the pile head is not more than 0.02 mm per hour or four hours whichever is greater. Loading shall be continued till one of the following occurs :

- i. Yield of soil pile system occurs causing progressive movement of pile exceeding 12 mm.
- ii. The loading on the pile top equals three times the estimated safe load or as specified in the case of separate test pile.

The safe capacity of the pile should be least of the following :

- i. Two third of the load at which the total displacement is 12 mm or the load corresponding to a specified permissible uplift, and
- ii Half of the load at which the load displacement curve shows a clear break (downward trend)

f) Routine Test on Working Piles

Three tests shall be carried out on working piles upto one and half times the design load and the maximum settlement of test loading in position being not exceeding 12 mm as per IS:2911 (Part IV). In case a pile fails under or during the load test, the Engineer shall select two additional piles in lieu of each of such failed pile and the contractor shall carryout load tests on such additional piles.

30.09.00

Cast-In-Situ Piling Bored

The following specification deals with the requirements of materials, workmanship and installation of Bore Cast-in-situ reinforced concrete piles.

The materials and workmanship shall conform with the provision of the latest IS:456, IS:2911 (Part I, Section 2) & IS:2911 (Part 4).

Care shall be taken while boring piles so that no existing foundations / sub-structures are disturbed by providing suitable arrangements like shoring etc.

a) Sequence of Piling

The sequence of piles installed shall be such that the adjacent piles already installed are not disturbed nor their carrying capacity reduced by subsequent boring operation. In a group the installation of the piles shall normally proceed from the center of the group towards the periphery.

b) Control of Alignment



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 2 0



Piles shall be installed as accurately as possible as per the designs and drawings either vertically or to the specified batter. Great care should be exercised in respect of installation of single pile or piles in two pile group. For vertical piles a deviation of 1.5 percent should not normally be exceeded. Piles should not deviate more than 75 mm or D/10 whichever is more in case of piles having diameter more than 600 mm from their designed positions at the working level of the piling rig. In the case of a single pile in a column, positional tolerance should not be more than 50 mm (100 mm in case of piles having diameter more than 600 mm).

For piles carried to substantial depth, the design should provide for the worst combination of the above tolerance in position and inclination. In case of piles deviating beyond these limits and to such an extent that the resulting eccentricity cannot be taken care of by a redesign of the pile cap and ties, the piles shall be replaced or supplemented by one or more additional piles, as directed by the Engineer, at no extra cost.

Any deviation from the designed location, alignment or load capacity of any piles shall be noted and brought to the attention of the Engineer and rectification and supplemental works carried out to the satisfaction of the Engineer at no extra cost.

A minimum length of one meter of temporary casing shall be inserted in each bored pile unless otherwise specifically desired. Additional length of temporary casing may be used depending on the condition of the strata etc.

Drilling mud of suitable consistency may also be used instead of temporary casings for stabilizing sides of the holes.

In case, a bored pile is stabilized by drilling mud the bottom of the hole shall be cleaned very carefully before concreting work is taken upon. The cleaning of the hole shall be ensured by careful operation of boring tool and / or flushing of the drilling mud thorough the bottom of the hole. Flushing of bore holes before concreting with fresh drilling fluid/ mud is preferred.

In case a holes is bored by use of drilling mud, the specific gravity of the mud suspension near about the bottom of the hole shall, wherever practicable, be determined by suitable interval of piles and recorded. Consistency of the drilling mus suspension shall be controlled throughout the boring as well as concreting operations in order to keep the hole stabilized as well as to avoid concrete getting mixed up with the thicker suspension of the mud.

The concreting operatings should not be taken up when the specific gravity of bottom slurry is more than 1.2. Concreting shall be done by tremie method in all such cases.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 2 1



The top of concrete in a pile shall be brought above the cut-off level as per cl. 7.8 of IS: 2911 (Part 1/sec.2).

In case, defective piles are formed, they shall be removed or left in place, if so directed by the Engineer, if these do not affect the performance of the adjacent piles or the cap as a whole. Additional piles shall be provided to replace them as directed by the Engineer.

Any deviation from the designed location alignment or load capacity of any pile shall be noted and adequate measures taken well before the concreting, of the pile cap and plinth beam if the deviations are beyond the permissible limit.

During chipping of the pile top manual chipping may be permitted after three days of pile casting, pneumatic tools for chipping shall not be used before seven days after pile casting.

After concreting the actual quantity of concrete shall be compared with the average obtained from observations actually made in the case of a few piles initially cast. If the actual quantity is found to be considerably less, special investigations shall be conducted and appropriate measures taken.

The bentonite suspension used for piling work shall satisfy the following requirements:

- i. The liquid limit of bentonite when tested in accordance with IS:2720 (Part V) shall be more than 300 percent and less than 450 percent.
- ii. The sand content of the bentonite powder shall not be greater than 7 percent.
- iii. Bentonite solution should be made by mixing it with fresh water using pump for circulation. The density of the freshly prepared Bentonite solution should be between 1.034 and 1.10 gm/ml depending upon pile dimensions and type of soil in which the pile is to be installed. However, the density of bentonite solution after mixing with deleterious materials in the pile bore may be up to 1.25 gm/ml.
- iv. The marsh velocity when tested by a Marsh cone should be about 37 seconds.
- v. The differential free swell shall be more than 540 percent.
- vi. The PH value of the bentonite suspension shall be between 9 & 11.5.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 2 2



30.10.00

Codes and Standards

The following Indian Codes and Standards (Latest) shall be used for design of the structural elements:

IS:456 : Code of Practice for plain and Reinforced concrete

IS:875 : Code of Practice for Design loads (other than earthquake) for Buildings and structures.

IS:2911: Code of Practice for Design and Construction of Pile Foundations – Bored Cast-in-situ Piles (Part 1/sec. 2)

IS:2911 : Code of Practice for Design and Construction of Pile Foundation – Load Test on Piles (Part 4)

IS:1786 : Code of Practice for HYSD bars

IS:2751 : Code of Practice for welding of mild steel bars used for reinforced concrete construction

IS:2062 : Steel for general structural purposes

SP:16 : Design Aids for Reinforced Concrete to IS:456.



2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/ P & E/ EE/ E/OT. No.03 /2013-14
Vol. VI : 1 2 3





TITLE:
TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D1

REV.NO. 00 DATE 13/02/2018

SHEET 1 OF 23

SECTION - D
SUB-SECTION - D1
EARTHWORK IN EXCAVATION AND BACKFILLING

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION - D1
REV.NO. 00 DATE 13/02/2018
SHEET 2 OF 23

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.0	SCOPE	3
2.00.00	GENERAL	3
3.00.00	EXECUTION	6
4.00.00	TESTING AND ACCEPTANCE CRITERIA	19
5.00.00	RATES AND MEASUREMENTS	19
6.00.00	INFORMATION TO BE SUBMITTED BY THE BIDDER	20



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION - D1
REV.NO. 00 DATE 13/02/2018
SHEET 3 OF 23

**STANDARD TECHNICAL SPECIFICATION FOR EARTHWORK IN
EXCAVATION AND BACKFILLING**

1.0.0 SCOPE

This specification covers earth work excavation in all types of soil, soft rock and hard rock including setting out, clearing and grubbing, shoring, dewatering, back filling around foundations/pipelines to grade, watering, compaction of fills, testing, approaches, disposal of surplus earth, protective fencing, lighting etc relevant to the structures and locations covered under this contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the contractor unless specified otherwise shall include but not be limited to the following.

a) Supplying and providing all labour, supervision services, earth moving machineries, surveying instruments including facilities as required under statutory labour regulations, materials, scaffolds, equipment, tools and plants, transportation, etc. required for the work.

b) Preparation and submission of working drawings showing the approaches, slopes, berms, shoring, sumps for dewatering including drainage, space for temporary stacking of soils, disposal area, fencing etc and all other details as may be required by the engineer.

c) To carry tests and submit to the Engineer, test results of fill materials and degree of soil compaction of fill whenever required by the Engineer to assess the quality of fill.

d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc. including procurement of necessary licenses from proper authorities.

2.2.0 Work to be provided by others

No work under this specification will be provided by any agency other than the contractor unless specifically mentioned elsewhere in the contract.



TITLE:
**TECHNICAL SPECIFICATION FOR
 EARTHWORK IN EXCAVATION AND
 BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001		
VOLUME -		
SECTION - D	SUB-SECTION - D1	
REV.NO. 00	DATE 13/02/2018	
SHEET 4	OF	23

2.3.0 Codes and Standards

All works shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes unless specified otherwise.

IS-1200	Method of measurement of building and civil engineering works, Part-I: Earthwork
IS-2720	Method of test for soils (Relevant parts)
IS-3764	Excavation work - Code of safety
IS-4081	Safety code for blasting and related drilling operations
IS-4701	Indian Standard Code of Practice for earthwork on Canals
IS:6922	Criteria for safety and design of structures subject to underground blasts
IS: 3764	Excavation work – code of safety

In case of conflict between this specification and those (IS Codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by this specification/IS Codes, any other standard practice as may be specified by the engineer shall be followed.

2.4.0 Conformity with Designs

The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.

2.5.0 Materials

2.5.1 General

All materials required for the work shall be of the best commercial variety and approved by the engineer.

2.5.2 Material for Excavation

For the purpose of identifying the various strata encountered during the course of excavation, refer clause no. 3.4.0 for the classification of earth strata.

2.5.3 Material for Filling

Material to be used for back filling shall be free from vegetations, roots, salts, rubbish, lumps, organic matter and any other harmful chemicals etc and shall be got approved by the engineer. Normally excavated earth shall be used for back filling. In case such earth contains deleterious salts, the same shall not be used. All clods of earth shall be broken or removed. Where the excavated material is mostly rock and if filling with the same is permitted by the engineer in writing, then the filling with rock shall be done in the following



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION - D1
REV.NO. 00 DATE 13/02/2018
SHEET 5 OF 23

manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any approved earth to fill the voids as far as possible and the mixture shall then be used for filling.

In case the earth required for backfilling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc shall be borne by him. The selected earth from the borrow areas shall be got approved by the engineer. The borrowed material shall be free from roots, vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods etc. The contractor shall obtain and submit necessary clearances/permissions from the concerned authorities for the borrow areas/materials acquired to the engineer.

If specified, the back filling shall be done with clean well graded sand from approved quarries free from harmful and deleterious materials.

2.6.0 Quality Control

All works shall confirm to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

Sl. No.	Activity	Check
1	Lines, levels & grades	a) By periodic surveys b) By establishing markers, boards etc
2	Back filling	(a) On quality of fill material (b) On moisture content of back fill (c) On degree of compaction achieved

2.7.0 Information regarding site conditions

Surface and Sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawing or otherwise furnished to the Contractor shall be taken as a guidance only and variation therefrom shall not affect the terms of the contract. The Contractor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and / or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D1

REV.NO. 00 DATE 13/02/2018

SHEET 6 OF 23

likely to come up during the execution of the contract so that he may evolve a realistic programme of execution.

3.0.0 EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and back filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of slopes, shoring, approaches, dewatering, drainage, berms etc. for the approval of engineer.

3.1.0 Setting out

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the same shall be rectified by the contractor at his own risk and cost.

3.2.0 Initial Levels

Initial levels of the ground either in a definite grid pattern or as directed by the Engineer will be taken by the Contractor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-sections for volume measurement or for cross-checking the depths obtained from tape measurements. All records of levels, measurements etc. and also any drawing, cross-section etc. made therefrom, shall be jointly signed by the authorised representative of the contractor and the Engineer before the commencement of work and they shall form the basis of all payments in future.

3.3.0 Clearing and Grubbing

The area to be excavated shall be cleared out of fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Trees upto 300mm girth shall be uprooted. Trees above 300mm girth to be cut shall be approved by the engineer and marked. Cutting of trees shall include removing roots as well. After the tree is cut and roots taken out, the pot holes formed shall be filled with good earth in 250mm layers and compacted unless directed otherwise by the engineer. The trees shall be cut in to suitable pieces as instructed by the



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001			
VOLUME -			
SECTION - D		SUB-SECTION - D1	
REV.NO.	00	DATE	13/02/2018
SHEET	7	OF	23

engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timber, fire woods etc shall be the property of the owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

3.4.0

Classification

All earthwork shall be classified under the following categories:

No distinction will be made whether the material is dry or wet.

a) **Ordinary Soil**

This shall comprise vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick and shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category.

b) **Hard Soil**

This shall include :

- i) stiff heavy clay, hard shale, or compact moorum requiring grafting tool or pick or both and shovel, closely applied ;
- ii) gravel and cobble stone having maximum diameter in any one direction between 75 and 300 mm ;
- iii) soling of roads, paths, etc., and hard core ;
- iv) macadam surfaces such as water bound, and bitumen/tar bound;
- v) lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar, below ground level ;
- vi) soft conglomerate, where the stones may be detached from the matrix with picks ; and
- vii) generally any material which requires the close application of picks, or scarifiers to loosen and not affording resistance to digging greater than the hardest of any soil mentioned in (i) and (vi) above.

c) **Soft and Decomposed Rock**

This shall include :

- i) limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with crowbars ;
- ii) unreinforced cement concrete which may be broken up with crowbars or picks and stone masonry in cement mortar below ground level ;
- iii) boulders which do not require blasting having maximum diameter in any direction of more than 300 mm, found lying loose on the surface or embedded



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION - D1
REV.NO. 00 DATE 13/02/2018
SHEET 8 OF 23

in river bed, soil, talus, slope wash and terrace material of dissimilar origin ;
and

iv) any rock which in dry state may be hard, requiring blasting, but which when wet becomes soft and manageable by means other than blasting.

d) Hard Rock (requiring blasting)

This shall include :

i) any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is required ;

ii) reinforced cement concrete (reinforcement cut through but not separated from the concrete) below ground level; and

iii) boulders requiring blasting.

e) Hard Rock (blasting prohibited)

Hard rock requiring blasting as described under (d) but where blasting is prohibited for any reason and excavation has to be carried out by chiselling, wedging or any other agreed method.

In case of any dispute regarding classification, the decision of the Engineer shall be final.

3.5.0 Excavation for Foundations and Trenches

3.5.1 General

All excavation shall be done to the minimum dimensions as required for the safety and working facility. In each individual case, the contractor shall obtain prior approval of the engineer for the method he proposes to adopt for the excavation including dimensions, side slopes, shoring, dewatering, drainage and disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. All excavation in open cuts shall be made true to the line, slopes and grades as shown on the drawings and/or as directed by the engineer. No material shall project within the dimension of minimum excavation lines marked. Boulders (if any) projecting out of the excavated surfaces shall be removed if they are likely to be a hindrance to the work/workers in the opinion of the engineer.

Method of excavation shall in every case be subject to the approval of the engineer. The contractor shall ensure the stability and safety of the excavation, adjacent structures, services and works etc including the safety of the workmen. If any slip occurs, the contractor shall remove all the slipped materials from the excavated pit without any extra cost to the engineer/owner. All loose boulders and semi detached rocks which are not inside but so close to the area to be excavated and may liable to fall or otherwise endanger the



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION - D1
REV.NO. 00 DATE 13/02/2018
SHEET 9 OF 23

workmen, equipment of the work etc during excavation in the opinion of the engineer shall be stripped off and removed away from the area of excavation. The method to be used for removal shall be such that it should not shatter or render unstable or unsafe the portion which was originally sound and safe. In case any material not required to be removed initially but later to become loose or unstable in the opinion of the engineer shall also be promptly and satisfactorily removed.

The rough excavation may be carried out upto a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up as instructed by the engineer. If the excavation (in all types of soil and rock) is done to a depth greater than that shown on the drawing or as directed by the engineer, the excess depth up to the required level shall be filled with cement concrete not leaner than 1:4:8 or richer as directed by the engineer at the own risk and cost of the contractor. In case where excavation in soil, soft rock (including weathered rock) and hard rock are involved, the excavation in each stratum shall be carried out separately with the approved methodology and as per the instructions of the engineer.

All excavated materials such as rock, boulders, bricks, dismantled concrete blocks etc shall be the property of the owner and shall be stacked separately as directed by the engineer. All gold, silver, oil, minerals, archeological and other findings of importance, trees cut or other materials of any description and all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of the owner and the contractor shall duly preserve the same to the satisfaction of the engineer/owner. The contractor shall deliver the same to such person or persons as may be authorized or appointed from time to time by the owner to receive the same.

Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.

3.5.2

Excavation in All Type of Soil and in Soft Rock

The excavation in all type of soil, soft rock including decomposed rock etc shall be carried out as per the approved proposal and as directed by the engineer. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. Foundation pits shall not be excavated to the full depth unless construction is imminent. The last 150mm depth shall be excavated once concreting work is imminent. At the discretion of the engineer, the full depth may be excavated and the bed be covered with lean concrete as specified after watering and compacting the bed. As the excavation reaches the required dimensions, lines, levels and grades



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION - D1
REV.NO. 00 DATE 13/02/2018
SHEET 10 OF 23

etc, the work shall be got checked and approved by the engineer. In cases where deterioration of the ground, upheaval, slips etc are expected, the engineer may order to suspend the work at any stage and instruct the contractor to carry out the protection works before the excavation will be restarted.

3.5.3 Excavation in Hard Rock

Hard rocks shall normally be excavated by means of blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is not stable against sliding, necessary supports such as props, bracings or bulkheads shall be provided and maintained during the period of construction. Where the danger of falling loose rock/boulder from the excavated surfaces deeper than 2m exist, steel mesh anchored to the lower edge of the excavation and extending over and above the rock face adequate to retain the dislodged material shall be provided and maintained.

3.5.4 Blasting

Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations).

No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to transport the explosives as and when required for the work in a safe manner to the work spot.

Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION - D1
REV.NO. 00 DATE 13/02/2018
SHEET 11 OF 23

3.5.4.1 Materials

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

3.5.4.2 Storage of Explosives

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine. Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100m distance from any magazine.

Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION - D1
REV.NO. 00 DATE 13/02/2018
SHEET 12 OF 23

provided at the magazine for this purpose and should be careful

- * not to put their feet on the clean floor unless the magazine shoes on.
- * not to touch the magazine shoes on ground outside the clean floor.
- * not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

3.5.4.3 Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

3.5.4.4 Use of Explosives

The contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001			
VOLUME -			
SECTION - D		SUB-SECTION - D1	
REV.NO.	00	DATE	13/02/2018
SHEET	13	OF	23

responsibilities.

Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001			
VOLUME -			
SECTION - D		SUB-SECTION - D1	
REV.NO.	00	DATE	13/02/2018
SHEET	14	OF	23

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc shall be taken during blasting operations.

3.5.4.5 Restrictions in Blasting

- a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
- b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
- c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.
- d) No large scale blasting operations will be resorted to when the excavation reaches the last one metre and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
- e) The last blast shall not be more than 0.50 m in depth.
- f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiselling or any other suitable method as approved by the engineer.

3.5.5 Disposal

The excavated spoils shall be disposed of in any (or all) of the following manner as directed by the engineer.

- a) By using it straightway for backfilling.
- b) By stacking it temporarily to use for backfilling at a later date during execution of the contract.
- c)
 - i) By either spreading
 - or
 - ii) By spreading and compacting at designated disposal areas.
- a) By selecting the useful material and stacking it neatly in designated areas as indicated by the engineer for use in backfilling by some other agency.

3.5.6 Disposal of Surplus Materials

All surplus material from excavation shall be removed and disposed of from the excavation site to the designated disposal area indicated by the engineer.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION - D1
REV.NO. 00 DATE 13/02/2018
SHEET 15 OF 23

All good and sound rocks obtained from excavations and all assorted materials of dismantled structures are the property of the owner and if the contractor wants to use it, he shall have to obtain it from the engineer at a mutually agreed rate. All sound rocks and other assorted materials like excavated bricks etc shall be stacked separately.

3.5.7 Protection

The contractor shall notify the engineer as soon as the excavation is expected to be completed within a day so that he shall inspect it at the earliest. Immediately after approval of the engineer, the excavation must be covered up in a shortest possible time. But in no case the excavation shall be covered up or worked on before approval by the engineer. Excavated material shall be placed 1.5m or half the depth (of excavation) whichever is more from the edge of the excavation or further away if directed by the engineer. Excavation shall not be carried out below the foundation level of the structure close by until the required precautions are taken. Adequate fencing is to be made enclosing the excavation. The contractor shall protect all the underground services exposed during excavation. All existing surface drains in the work area shall be suitably diverted by the contractor before taking up excavation to maintain the working area neat and clean.

3.5.8 Dealing with Surface Water

All working areas shall be kept free of surface water as far as reasonably practicable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water.

No works shall commence until surface water streams have been properly intercepted, redirected or otherwise dealt with.

Where works are undertaken in the monsoon period, the Contractor may need to construct temporary drainage systems to drain surface water from working areas.

3.5.9 Dewatering

All excavation shall be kept free of water and slush. Grading in the vicinity shall be controlled to prevent the surface water running into the excavations. The contractor shall remove any water inclusive of rain water and subsoil water etc accumulated in the excavation by pumping or other means as approved by the engineer and keep the excavations dewatered and/or lower the subsoil water level to 300mm below the founding level until the construction of foundation and backfilling are completed in all respects.

Sumps made for dewatering must be kept clear of the foundations. The engineer's prior approval on the method of pumping to be adopted shall be



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION - D1
REV.NO. 00 DATE 13/02/2018
SHEET 16 OF 23

taken; but in any case, the pumping arrangement shall be such that there shall be no movement or blowing in of subsoil due to the differential head of water during pumping.

3.5.10 Timber Shoring

Close or open type timber shoring as approved by the engineer depending on the nature of sub-soil, depth of pit or trench and the type of timbering shall be adopted. Timbers made out of approved quality shall only be used. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of trenches and pits from collapsing.

3.5.10.1 Close Timbering

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called "polling boards". These shall be of 250mm wide(min.) and 40mm thick(min.) sections as directed by the engineer. The boards shall generally be placed vertically in pairs, one on each side of the cut and shall be kept apart (maximum spacing is limited to 1.20m) by horizontal walers of strong wood cross strutted with wooden struts or as directed by the engineer. The length of wooden struts shall depend on the width of the trench or pit.

In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of excavation and supported by vertical walers which shall be strutted to similar timber pieces on the opposite face of the trench or pit. The lowest board supporting the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed to avoid any slipping out of earth.

The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started from one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried.

3.5.10.2 Open Timbering

In case of open timbering, vertical board of 250mm wide(min.) and 40mm thick(min.) shall be spaced sufficiently apart to leave unsupported strips of maximum 500mm average width. The detailed arrangement, size of timber and the spacing etc shall be subjected to the approval of the engineer. In all other respects, the specification for close timbering shall apply to open timbering as well.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D1

REV.NO. 00 DATE 13/02/2018

SHEET 17 OF 23

3.6.0 Treatment of Slips

The contractor shall take all precautions to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides of the excavations. These precautions along with proper slopes, berms, shoring and control of ground water should cause no slips to occur. If however slips still occur, the same shall be removed by the contractor with his own risk and cost.

3.7.0 Backfilling

3.7.1 General

The material to be used for backfilling shall be approved by the engineer which shall be obtained directly from the excavation, from the nearby areas where excavation work by the same agency is in progress, from the temporary stacks of excavated spoils or from the borrow pits as directed by the engineer. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials etc.

In locations where sand filling is required, the sand used should be clean, well graded and be of the quality normally acceptable for use in concrete.

3.7.2 Filling and Compaction in Pits and Trenches all Around the Structures

As soon as the work in foundation has been accepted, the spaces around the foundation in pits and trenches shall be cleared of all debris, brick bats, mortar droppings etc and filled with approved earth in layers not exceeding 250mm (in loose thickness). Each layer(loose) shall be watered, rammed and properly compacted to the required degree to the satisfaction of the engineer. Earth shall be compacted with approved mechanized compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the engineer. The moisture content of the fill material during compaction shall be controlled near to its optimum moisture content so as to obtain the required degree of compaction. The final surface shall be trimmed and levelled to proper profile as desired by the engineer.

3.7.3 Plinth Filling

The plinth shall be filled with earth in layers not exceeding 250mm (in loose thickness) and each layer shall be watered and compacted to the required degree with approved compaction machine or manually if specifically permitted by the engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted in order to avoid any settlement at a later stage. The finished surface of fill shall be trimmed to the slope intended to be provided for the floor.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D1

REV.NO. 00 DATE 13/02/2018

SHEET 18 OF 23

3.7.4 Filling in Trenches for Water Pipes and Drains

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150mm, watered, rammed and compacted taking care that no damage is caused to the pipe below.

In case of trenches excavated in rock, the filling upto a height of 300mm or the diameter of the pipe whichever is more above the crown of the pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock or ash as per the availability at site and shall be filled in compacted layers not exceeding 150mm. The remaining filling shall be done in layers with the mixture of boulders (of size not exceeding 150mm) and fine material as specified elsewhere in the specification. Each layer shall be watered, rammed and compacted to the required degree and to the satisfaction of the engineer.

3.7.5 Filling in Disposal Area

Surplus materials from excavation which are not required for backfilling shall be disposed of in the designated disposal areas. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250mm thick when loose, watered and compacted with the help of a compacting equipment as per the directions of the engineer. In wide areas, rollers shall be employed and compaction shall be done to the satisfaction of the engineer at the optimum moisture content which shall be checked and controlled by the contractor. In certain cases the engineer may direct the contractor to dispose the surplus materials without compaction which can be done by tipping the spoils from a high bench neatly maintaining a proper level and grade of the bench.

3.8.0 Approaches and Fencing

The contractor should provide and maintain proper approaches for the workmen and inspection. The roads and approaches around the excavation should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the project. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as around the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.

3.9.0 Lighting

Full scale area lighting is to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the fill.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION - D1
REV.NO. 00 DATE 13/02/2018
SHEET 19 OF 23

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 Excavation

On completion of excavation, the dimension of the pits will be checked as per the drawings after the pits are completely dewatered. The work will be accepted after all undercuts have been set right and all over excavations are filled back to the required lines, levels and grades by placing ordinary cement concrete of 1:4:8 proportion and/or richer and/or by compacted earth as directed by the engineer. The choice of the grade of concrete will be a matter of unfettered discretion of the engineer. Over excavation of the sides shall be made good by the contractor while carrying out the backfilling. The excavation work will be accepted after the above requirements are fulfilled and all the temporary approaches encroaching inside the excavation have been removed.

4.2.0 Backfilling

The degree of compaction required will be as per the stipulation laid down in IS:4701 and the actual method of measuring the degree of compaction will be as decided by the engineer. The work of back filling will be accepted after the engineer is satisfied with the degree of compaction achieved.

5.0.0 RATES AND MEASUREMENTS

5.1.0 Rates

a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding section in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the technical specification.

b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way from those shown on the tender drawings.

c) The unit rate quoted shall include minor details which are obviously and fairly intended and which may not have been included in these documents but are essential for the satisfactory completion of the work.

d) The bidder's quoted rate shall be inclusive of supplying and providing all labour, men, materials, equipments, tools and plants, supervision, services, approaches, schemes etc.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001			
VOLUME -			
SECTION - D		SUB-SECTION - D1	
REV.NO.	00	DATE	13/02/2018
SHEET	20	OF	23

f) In case blasting in hard rock is envisaged, the unit rate quoted for earth work shall include the cost of storage and safety arrangements for the materials required for blasting. No separate payment will be made on this account.

5.2.0 Measurements

Method of measurements are specified as below:

a) The length, breadth and depth shall be measured correct to the nearest centimeter if measurements are taken by tape. Rounding of numerical shall be as per relevant IS Codes. If the measurements are taken with staff and level, the levels shall be recorded correct to 5mm. The area and volume shall be worked out in square meter and cubic meter respectively correct to the nearest of two decimal places.

b) For earth work in excavation, the ground levels shall be taken before and after completion of the work in the actually excavated area. The quantity of earth work in excavation shall be computed from these levels in cubic meter.

c) In case of open footings (rafts/ pilecaps/ drains/ cable trench/ pipe trench/ sub soil beams etc.) up to the depth of 2.0 metres, around excavation of 30 cm beyond the outer dimension of footing (not the PCC dimension below footing) shall be measured for payment to make allowances for centering and shuttering. Any additional excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for excavation, backfilling, carriage, dewatering etc. item of work in the schedule of quantities. (Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in item of work in the schedule of quantities).

d) In case of open footings (Rafts/ pilecaps / drains/ cable trench/ pipe trench/ sub soil beams etc.) at a depth of more than 2.0 metre, around excavation of 75 cm beyond the outer dimension of footing (not the PCC dimension below footing) shall be measured for payment to make allowances for centering and shuttering. Any additional excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for excavation, backfilling, carriage, dewatering etc. item of work in the schedule of quantities. (Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in item of work in the schedule of quantities).

e) IN TRENCHES FOR BURIED PIPES & CABLES

Width of Trench

i) Upto one metre depth the authorized width of trench for excavation



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001			
VOLUME -			
SECTION - D		SUB-SECTION - D1	
REV.NO.	00	DATE	13/02/2018
SHEET	21	OF	23

shall be arrived at by adding 25 cm to the external diameter of pipe (not socket/ collar) cable, conduit etc. Where a pipe is laid on concrete bed/ cushioning layer, the authorized width shall be the external diameter of pipe (not socket/ collar) plus 25 cm or the width of concrete bed/ cushioning layer whichever is more.

ii) For depths exceeding one metre, an allowance of 5 cm per metre of depth for each side of the trench shall be added to the authorized width (that is external diameter of pipe plus 25 cm) for excavation. This allowance shall apply to the entire depth of the trench. In firm soils the sides of the trenches shall be kept vertical upto depth of 2 metres from the bottom. For depths greater than 2 metres, the excavation profiles shall be widened by allowing steps of 50 cm on either side after every two metres from bottom. Where the soil is soft, loose or slushy, width of trench shall be suitably increased or side sloped or the soil shored up as directed by the Engineer-in-Charge. However, any additional excavation beyond the limit specified for firm soil herein shall not be measured for payment for excavation, backfilling, carriage, dewatering etc. item of work in the schedule of quantities as these are deemed to be included in item of work in the schedule of quantities.

iii) Where more than one pipe, cable, conduit etc, are laid, the diameter shall be reckoned as the horizontal distance from outside to outside of the outermost pipes, cable, conduit etc.

f) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation, then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

g) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rock so arrived shall be taken as soil.

h) The authorized quantity (calculated on the basis of authorized width/ working space under clause no. 5.2.0 c, 5.2.0 d & 5.2.0 e) or those actually excavated, whichever, are less, shall be measured for payment.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D1

REV.NO. 00 DATE 13/02/2018

SHEET 22 OF 23

i) Tree cutting having girth more than 300mm shall be measured in number and are separately payable as deemed not covered in excavation items of work in the schedule of quantities.

j) Special dewatering of ground water by well point method and side protection work by sheet piling are separately payable as deemed not covered in excavation items of work in the schedule of quantities.

6.0.0 INFORMATION TO BE SUBMITTED BY THE BIDDER

6.1.0 With Tender

Detail of equipments and machineries proposed to be used for excavation, backfilling and compaction shall be submitted along with the tender.

6.2.0 After Award

After award of the contract the successful bidder shall submit the following for approval.

a) Within 30 days of the award of contract, the contractor shall submit a detailed programme of the work as proposed to be executed giving completion dates of excavation for the various foundations and the time required for backfilling and compaction after completion of foundation for the structures. The earthwork programme shall be planned in accordance with the foundation programme. The programme should also show how the excavation and backfilling quantities will be balanced minimizing the temporary stacking of spoils. It is to be noted that the engineer even after initial approval of the programme may instruct the contractor to enhance or to retard the progress of work during the actual execution in order to match with the progress of foundations. The initial programme being submitted by the contractor should have sufficient flexibility to take care of such reasonable variations.

b) Within 15 days of the award of contract, the contractor shall submit the drawings for earth work in excavation and backfilling showing detail of slopes, shoring, approaches, sump pits, dewatering lines, fencing etc for the approval of the engineer.



TITLE:
**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION AND
BACKFILLING**

SPECIFICATION NO. PE-TS-635-600-C001			
VOLUME -			
SECTION - D		SUB-SECTION - D1	
REV.NO.	00	DATE	13/02/2018
SHEET	23	OF	23



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 1 OF 56

CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-635-600-C001

SECTION – D

SUB SECTION – D2

GENERAL TECHNICAL SPECIFICATION

CEMENT CONCRETE (PLAIN & REINFORCED)



**Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301**



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 2 OF 56

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	GENERAL	3
3.00.00	INSTALLATION	12
4.00.00	SAMPLING AND TESTING	41
5.00.00	ACCEPTANCE CRITERIA	43
6.00.00	RATES AND MEASUREMENTS	43
7.00.00	LIST OF I.S.: CODES AND STANDARDS FOR REFERENCE	51



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 3 OF 56

SUB-SECTION – D2

CEMENT CONCRETE (PLAIN & REINFORCED)

1.00.00 SCOPE

1.01.00 General

This specification covers all the requirements, described hereinafter for general use of Plain and Reinforced Cement Concrete work in Structures and locations, cast-in-situ or precast, and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work. Special requirements for structures such as reinforced concrete chimney, cooling towers, etc. have been covered under the respective specifications. Those specifications shall be used in conjunction with this specification.

1.02.00 IS: 456 shall form a part of this specification and shall be complied with unless permitted otherwise. For any particular aspect not covered by this Code, appropriate Code, specifications and/or replacement by any International code of practice as may be specified by the Engineer shall be followed. All codes and Standards shall conform to its latest revisions. A list of IS codes and Standards is enclosed hereinafter for reference. However, should the list be not exhaustive and does not cover any aspect of the work, then relevant Indian and, in its absence, relevant International code shall apply.

2.00.00 General

2.01.00 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified shall include but not be limited to the following

- a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportations, etc. required for the work.
- b) Prepare Bar bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.
- c) Prepare working drawings of formworks, scaffolds, supports, etc.
- d) Prepare shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedments, hangers, openings, frames etc.
- e) Prepare detailed drawings of supports, templates, hangers, etc. required for



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 4 OF 56

installation of various embedments like inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.

As decided by the Engineer some or all of the drawings & schedules prepared under item (b) to (e) above will have to be submitted for approval.

- f) Submit for approval detailed schemes of all operations required for executing the work, e.g. material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.
- g) Design and submit for approval concrete mix designs required to be adopted on the job.

Furnish samples and submit for approval results of tests of various properties of the following:

- i) The various ingredients of concrete
- ii) Concrete
- iii) Embedments
- iv) Joint seals
- i) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications.
- j) For supply of certain materials normally manufactured by specialist firms, the Contractor may have to produce, if directed by the Engineer, a guarantee in approved Performa for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the Contractor, jointly and severally.

2.02.00 Work by others

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Information to be submitted by the Tenderer

2.03.01 With Tender

The following technical information's are required with the tender:

- a) Source and arrangement of processing of aggregates proposed to be adopted.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 5 OF 56

- b) Type of plant and equipment proposed to be used.
- c) Names of firms with which association is sought for to execute the special items of work in the contract.
- d) Types of formwork proposed to be used.

2.03.02

After Award

The Contractor shall submit the following information and data including samples where necessary, progressively during the execution of the contract.

a) Programme of Execution

Within 30 days of the award of contract, the Contractor will submit a Master Programme for completion of the work.

This Master Programme may have to be reviewed and updated by the Contractor, quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.

Detailed day-to-day Programme of every month is to be submitted by the Contractor before the end of the previous month.

b) Samples

Samples of the following materials and any other materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities free of cost, for approval. The Engineer for future reference will preserve approved samples. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying materials of specified qualities:

- i) Coarse and fine aggregates.
- ii) Admixtures.
- iii) Plywood for Formwork.
- iv) Embedded and anchorage materials as may be desired by the Engineer.
- v) Joint sealing strips and other*waterproofing materials.
- vi) Joint filling compounds.
- vii) Foundation quality Rubber Pads.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 6 OF 56

c) Design Mix

Design mix as per specification giving proportions of the ingredients, sources of aggregates and cement, along with test results of trial mixes as per relevant I.S., is to be submitted to the Engineer for his approval before it can be used on the works.

d) Bar Bending Schedules

Bar Bending Schedules in accordance with Clause 2.01.00 (b) and 3.16.01 of this specification.

e) Detailed Drawings and Designs of Formworks to be used

Detailed design data and drawings of standard formworks to be used as per clause 2.01.00 (c).

f) Detailed Drawings for Templates & Temporary Supports for embedment As per Clause 2.01.00 (e).

g) Mill Test Reports for Cement & Reinforcing Steel.

h) Inspection Reports

The Engineer in accordance with Clause 2.04.00 of this specification may desire inspection Reports in respect of Formwork and Reinforcement and any other item of work as.

i) Test Reports

Reports of tests of various materials and concrete as required under Clause 4.0: SAMPLING & TESTING of this specification or as directed by the Engineer.

j) Any other data, which may be required as per this specification or as directed by the Engineer.

2.04.00

Conformity with Design

The Contractor will prepare checklists in approved Form, which will be called "Pour Cards". These Pour Cards will list out all items of work involved. The Contractor will inform the Engineer, sufficiently in advance, whenever any particular pour is ready for concreting. He shall accord all necessary help and assistance to the Engineer for all checking required in the pour. On satisfying himself that all details are in accordance to the drawings and specifications, the engineer will give written permission on the same Pour



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 7 OF 56

Cards allowing the contractor to commence placement of concrete. Details of all instructions issued by the Engineer and the records of compliance by the Contractor, deviations allowed by the Engineer and any other relevant information will be written on accompanying sheets attached to the Pour Cards. The Pour Cards along with accompaniments will be handed over to the Engineer before starting placement of concrete. One of the mix designs developed by the Contractor as per the I.S. Specifications and established to the satisfaction of the Engineer by trial mixes shall be permitted to be used by the Engineer, the choice being dictated by the requirements of designs and workability. The methods of mixing, conveyance, placement, vibration, finishing, curing, protection and testing of concrete will be as approved or directed by the Engineer.

2.05.00 Materials to be used

2.05.01 General Requirement

All materials whether to be incorporated in the work or used temporarily for the construction shall conform to the relevant IS Specifications unless-stated otherwise and be of best approved quality.

2.05.02 Cement

Ordinary Portland cement of grade-43 as per IS:8112/fly ash based Portland puzzolona cement conforming to IS:1489 (Part-1) shall preferably be used in reinforced/plain cement concrete works for all areas other than for the critical structures identified below. However, other types of cement such as ordinary Portland cement conforming to IS:269, Portland slag cement conforming to IS:455 respectively can be used under special circumstances. Cement used in all concrete mixes shall be in general of grade 33/43 unless design requires a higher grade. Ordinary Portland cement shall be used for following structure.

- a) TG foundation top deck and sub structures including raft.
- b) Spring Supporting decks of all machine foundations.
- c) Structures requiring grade of concrete of M30 and above.

In special cases, Rapid Hardening Portland Cement, Low Heat Cement, Sulphate resistant cement, high strength Ordinary Portland Cement etc. may be permitted or directed to be used by the Engineer.

For Brickwork, plaster, flooring and other finishing works, ordinary Portland cement of 33/43 grade shall be used.

2.05.03 Coarse Aggregate

Aggregate of sizes ranging between 4.75 mm and 150 mm will be termed as



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 8 OF 56

Coarse Aggregate. Coarse aggregate for concrete shall be chemically inert, hard, strong durable against weathering, of limited porosity, and free from deleterious materials. It shall be properly graded. Coarse aggregates shall be either crushed gravel or stone. All aggregates shall meet the requirement of IS:383:1970. Only Coarse Aggregate from, approved quarries and conforming to IS-383 will be allowed to be used on the works. Petrographic test shall be carried out by the contractor free of cost for checking the quality of rock from quarry. This test shall be repeated by the Contractor free of cost for change in quarry or as directed by the Engineer. The results shall be checked for reactivity of silica in aggregate with alkalis of cement.

2.05.04 Fine Aggregate

Aggregate smaller than 4.75 mm and within the grading limits and other requirements set in IS: 383 are termed as Fine Aggregate or Sand. Only Fine Aggregate from approved sources and conforming to the above IS Specification will be allowed to be used in works. Sand shall be hard, durable, clean and free from adherent coatings or organic matter and clay balls or pellets. Sand when used as fine aggregate in concrete shall conform to IS:383. For plaster, it shall conform to IS:1542 and for masonry work to IS:2116.

2.05.05 Water

Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts, or other impurities. Generally, IS: 3550 will be followed for routine tests. Acceptance of water shall be as per IS: 456.

2.05.06 Admixture

Only admixtures of approved quality will be used when directed or permitted by the Engineer. The different types of admixtures, which may be necessary to satisfy the concrete mix and the design requirement, shall be as per IS-9103 and may be one of the followings:

- a) Accelerating admixture
- b) Retarding admixture
- c) Water reducing admixture
- d) Air entraining admixture
- e) Water proofing admixture

The contractor shall inform the Engineer about the type of admixture which he is planning to use in different areas within the scope of work for the approval



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 9 OF 56

of the Engineer. The admixture shall be of proven make and from a reputed manufacturer. It should not have any adverse effect on strength, durability of concrete and reinforcement. Super plasticizers conforming to IS: 9103 or ASTM C-494 shall only be used as admixture having the above properties either individually or in a combination as per the direction of the Engineer.

2.05.07 Reinforcement

Reinforcement shall be as per relevant IS Specification as mentioned in the Contract/Drawing/Instructions. All bars shall be of tested quality.

2.06.00 Storage of Materials

2.06.01 General

All materials shall be stored so as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Engineer, shall not be used for concrete and shall be removed from site immediately, failing which, the Engineer shall be at liberty to get the materials removed and the cost incurred thereof shall be realised from the Contractor's dues. The Contractor shall maintain upto-date accounts of receipt, issue and balance (stack wise) of all materials. Storage of materials shall conform to IS: 4082.

2.06.02 Cement

Sufficient space for storage, with open passages between stacks, shall be arranged by the Contractor to the satisfaction of the Engineer.

Cement shall be stored off the ground in dry, leak proof, well-ventilated warehouses at the works in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter.

Cement shall be stored in easily countable stacks with consignment identification marks. Consignments shall be used in the order of their receipts at site. Sub-standard or partly set cement shall not be used and shall be removed from the site, with the knowledge of the Engineer, as soon as it is detected.

2.06.03 Aggregates

Aggregates shall be stored on raised surface constructed by providing planks or steel plates or on concrete or brick masonry pavement. Each size shall be kept separated with wooden or steel or concrete or masonry bulkheads or in separate stacks and sufficient care shall be taken to prevent the material at the



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 10 OF 56

edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the Engineer.

2.06.04 Reinforcement

Reinforcing steel shall be stored consignment-wise and size-wise off the ground and under cover, if desired by the Engineer. It shall be protected from rusting, oil, grease, and distortions.

If necessary, the reinforcing steel may be coated with cement wash before stacking to prevent scale and rust at no extra cost to the Owner. The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

2.07.00 Quality Control

Contractor shall establish and maintain quality control for different items of work and materials as may be directed by the Engineer to assure compliance with contract requirements and maintain and submit to the Engineer records of the same. The quality control operation shall include but not be limited to the following items of work:

a) Admixture:	Type, quantity, physical, and chemical properties that affects strength, workability, and durability of concrete.
	For air entraining admixtures, dosage to be adjusted to maintain air contents within desirable limits.
b) Aggregate:	Physical, chemical and mineralogical qualities. Grading, moisture content and impurities.
c) Water:	Impurities tests.
d) Cement:	Tests to satisfy relevant IS Specifications.
e) Formwork:	Material, shapes, dimensions, lines, elevations, surface finish, adequacy of form, ties, bracing and shoring and coating.
f) Reinforcement:	Shapes, dimensions, length of splices, clearances, ties and supports. Quality and requirement of welded splices.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 11 OF 56

Material tests or Certificates to satisfy relevant IS Specification.

- g) Grades of Concrete: Usage and mix design, testing of all properties.
- h) Batching & Mixing: Types and capacity of plant, concrete mixers and transportation equipment.
- i) Joints: Locations of joints, water stops and filler materials. Dimension of joints, quality, and shape of joint material and splices.
- j) Embedded and Anchorage Items: Material, shape, location, setting.
- k) Placing: Preparation, rate of pouring, weather limitations, time intervals between mixing and placing and between two successive lifts, covering over dry or wet surfaces, cleaning and preparation of surfaces on which concrete is to be placed, application of mortar/slurry for proper bond, prevention of cold joint, types of chutes or conveyors.
- l) Compaction: Number of vibrators, their prime mover, frequency and amplitude of vibration, diameter and weight of vibrators, duration of vibration, hand-spreading, rodding and tamping.
- m) Setting of base & Bearing plates: Lines, elevations, and bedding mortar.
- n) Concrete Finishes: Repairs of surface defects, screening, floating, steel trowelling and brooming, special finishes.
- o) Curing: Methods and length of time.

Copies of records and tests for the items noted above, as well as, records of corrective action taken shall be submitted to the Engineer for approval as may be desired.

3.00.00

INSTALLATION

All installation requirements shall be in accordance with IS: 456 and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification do not



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 12 OF 56

cover all the aspects to the full satisfaction of the Engineer.

3.01.00 Washing and Screening of Aggregates

Washing and screening of coarse and fine aggregates to remove fines, dirt, or other deleterious materials shall be carried out by approved means as desired by the Engineer.

3.02.00 Admixture

All concrete shall be designed for normal rate of setting and hardening at normal temperature. Variations in temperature and humidity under different climatic conditions will affect the rate of setting and hardening, which will, in turn, affect the workability and quality of the concrete. Admixtures including plasticisers of approved make may be used with the Engineer's approval in accordance with IS-456 to modify the rate of hardening, to improve workability or as an aid to control concrete quality. The Engineer reserves the right to require laboratory test or use test data, or owner satisfactory reference before granting approval. The admixture shall be used strictly in accordance with the manufacturer's directions and/or as directed by the Engineer.

3.03.00 Grades of Concrete

Concrete shall be in one of the grades designated in IS: 456. Grade of concrete to be used in different parts of work shall be as shown on the drawing. In case of liquid retaining structures, IS: 3370 will be followed. Minimum cement content shall be as per IS: 456.

3.04.00 Proportioning and Works Control

3.04.01 General

“Design Mix Concrete” and “Nominal Mix Design” is defined as follows for use in this specification:

- Proportioning of ingredients of concrete made with preliminary tests by designing the concrete mix. Such concrete shall be called "Design Mix Concrete".
- Proportioning of ingredients of concrete made without preliminary tests adopting nominal concrete mix. Such concrete shall be called "Nominal Mix Concrete".

As far as possible, design mix concrete shall be used on all concrete works. Nominal mix concrete, in grades M-15 or lower only may be used if shown on drawings or approved by the Engineer. In all cases the Proportioning of ingredients and works control shall be in accordance with IS: 456 and shall be



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 13 OF 56

adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.

3.04.02 Mix Design Criteria

Concrete mixes will be designed by the Contractor to achieve the strength, durability, and workability necessary for the job, by the most economical use of the various ingredients. In general, the design will keep in view the following considerations

- a) Consistent with the various other requirements of the mix, the quantity of water should be kept at the lowest possible level.
- b) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.
- c) The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix.
- d) The finished concrete should have adequate durability in all condition, to withstand satisfactorily the weather and other destruction agencies, which it is expected to be subjected to in actual service.
- e) The mix design shall have required workability and characteristic strength as per IS: 456. The quantity of cement, aggregates, and admixtures shall be determined by mass.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete in structural design. The Contractor will strictly abide by the same in his design of concrete mix installation. Various trials shall be given by the contractor with specific cement content on each trial. In some cases, plasticizers and other admixtures may be necessary to achieve the desired results.

3.05.00 Strength Requirements

The strength requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland Blast furnace slag cement is used, shall be as per IS:456. All other relevant clauses of IS:456 shall also apply.

3.06.00 Minimum Cement Content

The minimum cement content for each grade of concrete shall be as per IS: 456. Contractor has to consider actual environmental exposure condition at



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 14 OF 56

site. Based on various tests results and as per Engineer, the environment condition shall be adopted for which minimum cement content shall be considered. No extra payment shall be made on account of any variation in environment condition.

- a) Sufficient number of trial mixes (to be decided by the Engineer) will be taken at the laboratory for the various designs and graphs of w/c ratio Vs crushing strengths at various ages will be plotted.
- b) All tests will be done in presence of the Engineer who shall be the final authority to decide upon the adoption of any revised minimum cement content. The Contractor will always be responsible to produce quality concrete of the required grade as per the acceptance criteria of IS: 456.
- c) The Engineer will always have the unquestionable right to revise the minimum cement content as decided above, if, in his opinion, there is any chance of deterioration of quality on account of use of lower cement content or any other reason.

3.07.00 Water-Cement Ratio

The choice of water-cement ratio in designing a concrete mix will depend on:-

- a) The requirement of strength.
- b) The requirement of durability.

3.07.01 Strength Requirement

In case of "Design Mix Concrete" the water-cement ratio of such value as to give acceptable test results as per IS: 456, will be selected by trial and error. The values of water-cement ratios for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Engineer. Frequent checks on test will have to be carried out and the water-cement ratios will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the Contractor's responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered.

In case of nominal mix concrete, the maximum water-cement ratio for different grades of concrete is specified in Table-5 of IS: 456 and no tests are necessary. The acceptance test criterion for nominal mix concrete shall be as per IS: 456.

3.07.02 Durability Requirement



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 15 OF 56

Tables 4 & 5 of IS: 456 give the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks, and contact with harmful chemicals. Impermeability may also be an important consideration.

Whenever the water-cement ratio dictated by Durability consideration is lower than that required from strength criteria, the former should be adopted.

In general the water cement ratio between 0.4 and 0.45 will be desirable to satisfy the durability requirement and from the consideration of impermeability of concrete. The contractor may propose lower water cement ratio as mentioned above by addition of a suitable plasticizer/super-plasticizer. Trial mix shall be carried out accordingly. However, the contractor has to propose specifically along with field trials in the event of lower cement content if found suitable along with a plasticizer.

3.08.00 Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments and to give the required surface finish shall depend*on the type and nature of structure and shall be based on experience and tests. The usual limits of consistency for various types of structures are given below:

TABLE-V

LIMITS OF CONSISTENCY

Degree of	Slump in mm with Standard Cone as	Use for which concrete is suitable



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 16 OF 56

workability

per IS: 1199

Min.

Max.

Very low

0

25

Large Mass concrete structure with heavy compaction equipments, roads

Low

25

50

Uncongested wide and shallow R.C.C. structures

Medium

50

100

Deep but wide R.C.C. structures with congestion of reinforcement and inserts

High

100

150

Very narrow and deep R.C.C. structures with congestion due to reinforcement and inserts.

Note: Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer.

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. No extra payment will be made for this additional cement.

The workability of concrete shall be checked at frequent intervals by slump tests.

3.09.00

Size of coarse Aggregates

The maximum size of coarse aggregates for different locations shall be as follows unless otherwise directed by the Engineer

Very narrow space

- 12 mm

Reinforced concrete
Except foundation

- 20 mm

Ordinary Plain concrete and Reinforced
concrete foundations

- 40 mm

Mass concrete

- 80 mm



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 17 OF 56

Lean concrete

- 40 mm

Grading of coarse aggregates for a particular size shall conform to relevant I.S. Codes and shall also be such as to produce a dense concrete of the specified proportions, strength and consistency that will work readily into position without segregation.

Coarse aggregate will normally be separated into the following sizes and stacked separately in properly designed stockpiles

80 mm to 40 mm, 40 mm to 20 mm and 20 mm to 5 mm. In certain cases it may be necessary to further split the 20 mm to 5 mm fraction into 20 mm to 10 mm and 10 mm to 5 mm fractions.

This separation of aggregates in different size fractions is necessary so that they may be remixed in the desired proportion to arrive at a correct internal grading to produce the best mix.

3.09.01

Temperature control of concrete in top decks of machine foundations (i.e. of TGs, BFPs, Fans and Mills) as extra payable over RCC item of BOQ:

The temperature of fresh concrete shall not exceed 23°C when placed. A suitable measuring device for measuring the temperature of concrete as approved by the Engineer shall be used. For maintaining the limiting temperature of the 23°C, crushed ice shall be used as mixing water. The ice shall be formed of water conforming IS: 456. The Contractor shall establish the quantity of crushed ice to be mixed in order to achieve the limiting temperature of 23°C.

3.09.02

Base raft of Turbo Generator foundations and top decks of all machine foundations shall be cast in a continuous operation without any construction joint.

3.10.00

Mixing of Concrete

Ingredients of the concrete mix shall be measured by weight. Concrete shall always be mixed in mechanical mixer. Water shall not normally be charged into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case shall mixing be done for less than 2 (two) minutes and at least 40 (forty) revolutions after all the materials and water are in the drum. When absorbent Aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 18 OF 56

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Owner to allow for loss in the drum.

Regular checks on mixer efficiency shall be carried out as directed by the Engineer as per IS: 4634 on all mixers employed at site only those mixers whose efficiencies are within the tolerances specified in IS: 1791 will be allowed to be employed.

Batching Plant shall conform to IS: 4925. The measuring gauges of batching plant shall be periodically calibrated for which the contractor shall provide standard weights. The accuracy of all gauges shall be within limits prescribed by the Engineer.

When hand mixing is permitted by the Engineer, for unimportant out of the way locations in small quantities, it shall be carried out on a water-tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand-mixing, 10% extra cement shall be added to each batch at no extra cost to the owner.

3.11.00 Conveying Concrete

Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means and placed and compacted in the final position before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or loss of any of the ingredients. For long distance haulage, agitator cars of approved design will be used. If, in spite of all precautions, segregations does occur during transport, the concrete shall be properly re-mixed before placement. During very hot or cold weather, if directed by the Engineer, concrete shall be transported in deep containers, which will reduce the rate of loss of water, by evaporation or loss of heat. If necessary, the container may have to be covered and insulated. Conveying equipments for concrete shall be well maintained and thoroughly cleaned before, commencement of concrete mixing. Such equipments shall be kept free from set concrete.

3.12.00 Placing and Compacting Concrete

Where specifically covered, the relevant I.S. Code will be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. If, however, there is no specific provision in relevant I.S. code for any particular aspect of work, any other standard code of practice, as may be specified by the Engineer, will be



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 19 OF 56

adopted. Concrete may have to be placed against the following types of surfaces:

- a) Earth foundation
- b) Rock foundation
- c) Formwork
- d) Construction joint in concrete or masonry

The surface on or against which concrete is to be placed has to be cleaned thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping, sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. are to be removed by air water jetting or water at high pressure. Earth foundation on which direct placement of concrete is allowed, will be consolidated as directed by the Engineer such that it does not crumble and get mixed up with the concrete during or after placement, before it has sufficiently set and hardened.

Formwork, reinforcement, preparation of surface, embedments, joint seals etc., shall be approved in writing by the Engineer before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Engineer.

Rock foundation or construction joint will be kept moist for at least 72 hours prior to placement. Concrete will be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Engineer will have to be adopted.

Formwork will be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement.

A layer of mortar of thickness 12 mm of the same or less w/c ratio and the same proportion as that of the concrete being placed or cement slurry will be spread thoroughly on the rock Foundation or construction joint just prior to placement of concrete.

After concrete has been placed, it shall be spread, if necessary & thoroughly compacted by approved mechanical vibration to maximum, subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant IS Code of



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 20 OF 56

Practice: In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibrators the contractor may have to employ form vibrators conforming to IS: 4656. For slabs and other similar structures, the contractor will additionally employ screed vibrator as per IS: 2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement, and formwork are not displaced or distorted during placing & consolidation of concrete.

The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green Concrete, which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete.

Slabs, beams, and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Mouldings, throating, drip course, etc., shall be poured as shown on the drawings or as directed by the Engineer. Holes shall be provided and bolts, sleeves, anchors, fastenings, or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the Engineer. Any deviation there from shall be set right by the Contractor at his own expense as instructed by the Engineer.

In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same -at the Contractor's expense.

The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement.

Once the concrete is deposited, consolidated and finished in its final position, it shall not be distributed.

3.13.00 Construction Joints and Cold Joints

3.13.01 Construction Joints



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 21 OF 56

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete certain predetermined stages. These joints will be formed in a manner specified in the drawings/Instruction.

Vertical construction joints will be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12.

Where the location of the joints are not specified, it will be in accordance with the following:

- a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.
- b) Concrete in a beam shall preferably be placed without a joint, but if Provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span.
- c) A joint in a suspended floor slab shall be vertical and at the middle of the span and at right angles to the principal reinforcement.
- d) Feather-edges in concrete shall be avoided while forming a joint.
- e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.
- f) In case the Contractor proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Engineer for study and approval without which no construction joint will be allowed.

3.13.02 Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it:

- a) If the concrete is so green that it can be removed manually and if vibrators



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 22 OF 56

can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.

- b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.
- c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not raise inspite of extensive vibration, the joint, will be left to harden for at least 12 - 24 hrs. It Will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12.

3.14.00 Repairs, Finishes, and Treatment of Concrete surfaces

3.14.01 Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing, and consolidation by experienced workmen.

Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork, poor workmanship and protection will not be accepted and will have to be dismantled, removed and replaced by sound concrete at the Contractor's cost. The Engineer may, at his sole discretion, allow to retain concrete with minor defects provided the Contractor is able to repair it by approved methods at no extra cost to the Owner, All concrete work shall be inspected by the Contractor immediately after the forms are removed & he will promptly report occurrence of any defects to the Engineer. All repair works will be carried out as per the instructions and in the presence of the Engineer or his representative. Generally, repair work will consist of any or all of the following operations:

- a) Sack rubbing with mortar and stoning with carborundum stone.
- b) Cutting away the defective concrete to the required depth shape.
- c) Cleaning of reinforcement & embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement.
- d) Roughening by sand blasting or chipping.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 23 OF 56

- e) Installing additional reinforcement/welded mesh fabric.
- f) Dry packing with stiff mortar.
- g) Plastering, guniting, shotcreting etc.
- h) Placing and compacting concrete in the void left by cutting out defective concrete.
- i) Grouting with cement sand slurry of 1:1 mix.
- j) Repairing with a suitable mortar either cement or resin modified mortars.
- k) Polymer modified patching and adhesive repair & mortar for beams & columns.

3.14.02 Finishing unformed Surface

The contractor shall provide normal finishes in unformed surfaces which can be achieved by screeding, floating, trowelling etc. A few typical and common cases of treatment of concrete surface are cited below

a) Floor

Whenever a non-integral floor finish is indicated, the surface of reinforced concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance. No over trowelling, to obtain a very smooth surface, shall be done, as it will prevent adequate bond with the subsequent finish. If desired by the Engineer, the surface shall be scored and marked to provide better bond.

Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes, ripples, and trowel marks.

A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 24 OF 56

To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowelling.

b) Beans, Columns & Walls

If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the Contractor shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop. Pattern, adequacy, and details of such hacking shall meet with the approval of the Engineer, who shall be informed to inspect such surfaces before they are covered up.

3.15.00 Protection and Curing of concrete

Newly placed concrete shall be protected by approved means from rain, sun, and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days, or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive 'Loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, hessian, canvas, or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of the arrangements made by the Contractor. Quality of water for curing shall be as per IS: 456.

If permitted by the Engineer, liquid curing compound may be used for prevention of premature water loss in concrete and thereby effecting curing of concrete. This type of curing compound shall be sprayed on newly laid concrete surfaces to form a thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall be emulsified paraffin based and shall comply with ASTM requirements for acceptance.

The curing compound shall be applied following the final finishing operation and immediately after disappearance of water from concrete surface. It is important not to apply the curing compound when standing water is still present on concrete.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 25 OF 56

The contractor shall arrange for the manufacturer's supervision at no extra cost.

The Contractor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Engineer's decision regarding the adequacy of curing is final. In case the Engineer notices any lapse on the part of the Contractor, he will inform the Contractor or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the Contractor within 3 (three) hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and recover the cost thereof from the Contractor, or deduct certain amount from contractor's payment for the part where inadequate curing was noticed entirely at the discretion of the Engineer.

3.16.00 Reinforcement

Mild steel round bars, TMT bars, Hot rolled deformed bars or cold twisted deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc, will be used as reinforcement as per drawings and directions. In an aggressive environment an anti-corrosive coating on the reinforcement may be provided as per IS: 9077, as shown on the drawing or as directed by the Engineer.

3.16.01 Bar Bending Schedules

The Contractor shall prepare Bar Bending Schedules showing clearly the arrangements proposed by the Contractor to match available stock of reinforcing steel, progressively, starting within one week of receipt of approval on corresponding design of RCC structure. As decided by the Engineer, some or all the detailed drawings and schedules will have to be submitted for approval. Approval of such detailed drawings by the Engineer shall not relieve the Contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the contract. The contractor for record and distribution shall submit six prints of the final drawings & schedules with one reproducible print.

3.16.02 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete.

3.16.03 Bending

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS: 2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions corresponding with the



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 26 OF 56

final Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the Contractor before any cutting, bending is done.

No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Rebending can be done only if approved by the Engineer. Reinforcing bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat (not exceeding 845°C) may be allowed under very exceptional circumstances except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching.

3.16.04 Placing in Position

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved and adequate means like mild steel chairs and/or concrete spacer blocks. Bars intended to be in contact at crossing points, shall be securely tied together at all such points by No. 20 G annealed soft iron wire or by tack welding in case of Bar larger than 25 mm dia., as may be directed by the Engineer. Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be spaced such that the main bars do not sag perceptibly between adjacent spacers. Before actual placing, the Contractor shall study the drawings thoroughly and inform the Engineer in case he feels that placement of certain bars is not possible due to congestion. In such cases he should not start placing any bar before obtaining clearance from the Engineer.

3.16.05 **Welding / Coupler for Splicing**

Lapping shall normally do splicing of reinforcement. For M.S. reinforcement bars, butt-welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction as per IS: 2751 and IS: 456. For High yield strength deformed bars, lap welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards as per IS: 9417. Welding of High yield strength deformed bar shall not be allowed.

Splicing of reinforcement using mechanical coupler may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian standards for "Reinforcement couplers for mechanical splices of bars in concrete" as per IS: 16172. Corrosion test in the coupler-bar connections exposed to marine or



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 27 OF 56

severe environmental conditions to rule out any risk of galvanic corrosion will be done by the contractor at no extra cost. Proper fitting & fixing of mechanical coupler to rebar shall be ensured at site for each coupled joint as per inspection testing plan developed at site in consultation with manufacturer of coupler. If so required at site, coupler/ threading on rebar shall be such that two bars can be coupled by moving couplers not rebar (as being heavy reinforcement weight and L shaped, it is not feasible to rotate the rebar for fixing up the coupler) at no extra cost.

3.16.06 Control

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS: 456, unless otherwise specified. The laps shall be staggered as far as practicable and as directed by the Engineer. Arrangements for placing concrete shall be such that reinforcement in position does not have to bear extra load and get disturbed. The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Engineer. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar not leaner than 1 (one) part cement to 2 (two) parts sand by –volume and cured in a pond for at least 14 (fourteen) days. The type, shape, size and location of the concrete blocks shall be as approved by the Engineer.

3.17.00 Cold Weather Concreting

When conditions are such that the ambient temperature may be expected to be 5°C or below during the placing and curing period, the work shall conform to the requirement of IS: 456 and IS: 7861.

3.18.00 Hot Weather Concreting

When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS: 7861 and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 38°C while placing. Positive temperature control by precooling, post cooling or any other method, if required, will have to be done by the contractor at no extra cost.

3.19.00 Concreting under water

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of IS: 456.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 28 OF 56

3.20.00 Form Work

3.20.01 General

If it is so desired by the Engineer, the contractor shall prepare, before commencement of actual work, designs and working drawings for formwork and centring and get them approved by the Engineer. The formwork shall conform to the shape, grade, lines, levels and dimensions as shown on the drawings.

Materials used for the formwork inclusive of the supports and centring shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.

The centring shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Rakers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight and horizontal pressure of the concrete as a liquid as well as the working load. In case the contractor wishes to adopt any other design criteria, he has to convince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel and concrete of adequate strength shall be used. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified as directed by him.

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all column forms are in true plumb and thoroughly cross-braced to keep them so. All floor and beam centring shall be crowned



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 29 OF 56

not less than 8 mm in all directions for every 5 metres span. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete.

3.20.02 Cleaning and Treatment of Forms

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, sawdust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil or other compound before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary.

3.20.03 Design

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns, and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork.

Removing any props or repropping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.

3.20.04 Inspection of Forms

Casting of Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 30 OF 56

3.20.05 Removal of Forms

Formwork shall be kept in position after casting of concrete for a minimum period as mentioned in IS: 456, however the period of retaining form in position can be extended as per drawing, instruction of Engineer or as required for satisfactory completion of work without any extra cost. Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if the Engineer so desires.

The Contractor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed there from and have this record checked and countersigned by the Engineer regularly. The Contractor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him without any extra cost to the Owner, The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

If any other type of cement other than ordinary Portland cement and Rapid hardening cement is used, the time of removal of forms shall be revised such that the strength of this cement at the time of removal of forms match with strength of Portland cement at the time of removal of form.

3.20.06 Tolerance

The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this specification or drawings or directed by the Engineer:-

- For -
- | | |
|--------------------------|--|
| a) Sectional dimension - | ± 5 mm |
| b) Plumb - | 1 in 1000 of height |
| c) Levels - | ± 3 mm before any deflection has taken place |

The tolerance given above are specified for local aberrations in the finished concrete surface & should not be taken as tolerances for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

3.20.07 Re-use of Forms



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 31 OF 56

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used if declared unfit or unserviceable by the Engineer.

3.20.08

Classification

Generally, the "ordinary" class formwork shall be used unless otherwise specified.

- a) **Ordinary:** These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber.
- b) **Plywood:** These shall be used in exposed surfaces, where specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilization of used plywood for the "ordinary" class, if it is still in good condition.
- c) **Ornamental:** These shall be used where ornamental and curved surface are required and shall be made of selected best quality well seasoned timbers or of plywood, which can be shaped correctly.

3.21.00

Opening, Chases, Grooves, Rebates, Blockouts etc.

The Contractor shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings or as specified by the Engineer.

3.22.00

Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and other misc. Embedded Fixtures

The Contractor shall build into concrete work all the items noted below and shall embed them partly or fully as shown on drawings and secure the same as may be required. The materials shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to paint with one coat of approved anti-corrosive paint and/or bituminous paint without any extra cost to the Owner. If welding is to be done subsequently on the exposed surface of embedded material, the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 32 OF 56

required or directed by the Engineer.

Items to be embedded

- a) Inserts, hangers, anchors, frame around openings, manhole covers, frames, floor clips, sleeves conduits and pipes.
- b) Anchor bolts and plates for machinery, equipment and for structural steel work.
- c) Steel structurals to be left embedded for future extension, special connection etc.
- d) Dowel bars, etc. for concrete work falling under the scope of other contractors.
- e) Lugs or plugs for door and window frames occurring in concrete work.
- f) Flashing and jointing in concrete work.
- g) Any misc. embedments and fixture as may be required.

Correct location and alignment, as per drawings/instruction of all these embedded items shall be entirely the responsibility of the Contractor.

3.23.00 Expansion and Isolation Joints

3.23.01 General

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter. In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Contractor to get them tested in an approved laboratory free of cost to the Owner. Joints shall be formed true to line, level, shape, dimension, and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work.

3.23.02 Bitumen Board/ Expanded Polystyrene Board

- a) Bitumen Board



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 33 OF 56

Bitumen impregnated fibreboard of approved manufacturer as per IS: 1838 may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

b) Expanded Polystyrene Boards

If required, commercial quality of expanded polystyrene products commonly used for thermal insulations may also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.

3.23.03

Joint sealing strips

Joint sealing strips may be provided at the construction, expansion, and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure. The sealing strips will be either metallic like G.I., Aluminums, or Copper, or non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal joint and will be procured and installed in largest practicable lengths having a minimum number of transverse joints. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. The Contractor is to supply all labour and material for installation -including the material and tools required for jointing, testing, protection, etc. If desired by the Engineer, joints in rubber seals may have to be vulcanized.

a) Metal Sealing Strips

Metal sealing strips shall be either G.I., Aluminium or Copper and formed straight, U shaped, Z shaped or any other shape and of thickness as indicated in the drawing. The transverse joints will be gas welded using brass rods and approved flux and will be tested by an approved method to



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 34 OF 56

establish that it is leak proof. If required, longer lap lengths and different method of brazing which will render it leak proof, will be adopted by the Contractor. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

i) G.I. Strips

G.I. strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The standard of Galvanizing shall be as per relevant Indian Standards for heavy-duty work. At the joints, the overlapping should be for a minimum length of 50 mm.

ii) Aluminium Strips

Aluminium strips shall be minimum 18 SWG thick and 300 mm wide unless specified otherwise and shall conform to IS: 737 of 19000 grades or 31000 grade (Designation as per IS: 6051). A minimum lap of 50 mm length is required at the joints.

iii) Copper Strips

The Copper strips shall be minimum 18 SWC in thickness and 300 mm width unless specified otherwise and shall conform to the relevant Indian Standards. It should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm in length is required at the joints.

b) Non-metallic Sealing Strips

These will be normally in Rubber or P.V.C. Rubber or P.V.C. joint seals can be of shape having any combination of the following features:

i) Plain

ii) Central bulb

iii) Dumb-bell or flattened ends

iv) Ribbed and Corrugated Wings

v) V shaped

As these types of seals can be easily handled in very large lengths unlike metal strips, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer. The method of forming these joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Engineer taking particular care to match the



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 35 OF 56

central bulbs & the edges accurately.

c) Rubber Sealing Strips

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion, and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer:

Specific Gravity	:	1.1 to 1.15
Shore Hardness	:	65A to 75A
Tensile Strength	:	25 - 30 N/Sq.mm
Maximum Safe Continuous Temperature	:	75°C
Ultimate Elongation	:	Not less than 350%

b) P.V.C., Sealing Strips

The minimum thickness of P.V.C. sealing strips will be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion, and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly

Specific Gravity	:	1.3 to 1.35
Shore Hardness	:	60A to SOA
Tensile Strength	:	10 - 15 N/Sq.mm
Maximum Safe Continuous Temperature	:	70 Deg.C
Ultimate Elongation	:	Not less than 275%

3.23.04 Bitumen Compound

When shown in drawing or directed, the gap in expansion joints shall be



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 36 OF 56

thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS: 1834.

3.23.05 Isolation Joints

Strong and tough alkathene sheet or equivalent, about 1 mm in thickness and as approved by the Engineer shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

3.23.06 Pad

Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness - 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

3.24.00 Grouting under Machinery or Structural Steel Bases

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Contractor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stone chips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If specified on drawings, admixtures like Aluminium powder, "Ironite" etc. may have to be added with the grout in required proportions. Premixed non-shrink grout of approved manufacture having proper strength shall be used with Engineer's approval for important machineries.

3.25.00 Precast Concrete

The Specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose. This yard shall be dry, properly levelled and having a hard and even surface. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard,



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 37 OF 56

lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 (seven) days of curing and can be removed for erection after 28 (twenty-eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal. The yard shall preferably be fenced.

Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling, and plumbing shall be done as per instructions of the Engineer. The Contractor shall render all help with instruments, materials, and men to the Engineer for checking the proper erection of the precast units.

After erection and alignment, the joints shall be filled with grout or concrete as per drawings. If centrings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement: sand mortar where called for in the drawings.

3.26.00 Waterproofing of Concrete Structure

3.26.01 General

Where required, waterproofing of concrete structures shall be ensured internally by suitable design of the concrete mix, addition of suitable admixtures in the concrete or mortar at the time of mixing and/or installing water bars at the joints. In addition to the above measures, the structures shall be made watertight by adopting "structural waterproofing" as per specification. The design, material, and workmanship shall conform to the relevant I.S. Codes where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If desired by the Engineer, test certificates for the materials and samples shall be submitted by the Contractor free of charge. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

3.26.02 Water Bar/Seal/Special Treatment of Construction Joint

Water bearing structures and underground structures may have water bar/seals installed at the joints. They may be metallic, rubber, or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction joint shall be provided as per clause 3.13.1 with or without water bar/seal as shown



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 38 OF 56

on the drawing. In case of water bars being used at the construction joint, fixing of the same has to be done carefully, so that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods.

Method 1: A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting. In case of walls, the above bonding agent will be mixed with water, which will be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor joint, however, after washing of retarder a solvent free two-component epoxy resin-bonding agent will be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days

Compressive strength	-	55 to 60 N/Sq.mm
Flexural strength	-	5 to 30 N/sq.mm
Tensile strength	-	15 N/Sq.mm (approx.)
Bonding strength to concrete	-	3 N/Sq.mm (approx.)
Bonding strength to steel	-	20 N/Sq.m (approx.)

The whole operation shall be done as per manufacturers specification. The contractor shall provide manufacturer's supervision at no extra cost to the owner.

Method 2: One row of threaded nozzles at regular intervals not exceeding 1.5 m centre to centre shall be placed in concrete along the construction joint during casting. Injection of cement water together with a suitable waterproof expanding grouting admixture of approved quality shall be done through the nozzles after the concrete has set to seal the voids in concrete near the construction joint in walls and slabs. The injection shall be done under pressure of approximately 2 to 4 kg/sq.cm. The nozzles shall be sealed off with suitable admixture after the injection is over. The whole operation shall be carried out as per manufacturer's specification and supervision. The cost of such manufacturer's supervision shall be borne by the contractor.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 39 OF 56

3.26.03

Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar/plaster shall conform to IS: 2645. The admixture shall not cause decrease of strength of concrete/plaster at any stage and it shall be free from chlorides and sulphates. The admixture shall not affect the setting time by more than 5%. The maximum permissible dosage of admixture will be 3% (three percent) by weight of cement, but a lower dosage will always be preferred. The product shall be stored in strong moisture proof packings. However, in case of important structures where M25 or higher grade concrete is specified, the use of melamine based, high range water reducing concrete admixture shall be used to provide a waterproof concrete, For achieving high strength concrete having cement content around 400 kg/cu.m. a melamine based super plasticizer will be preferable.

- a) In concrete: The admixtures shall be procured from reliable and reputed manufacturers and approved by the Engineer. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer. The Contractor shall have the services of the manufacturer's supervisor at no extra cost to supervise the work, if desired by the Engineer.
- b) In Plaster: The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturer's supervisor at no extra cost. On completion, the Plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

3.26.04

Structural waterproofing

- a) Nozzles spaced as required after the concrete is completed shall be drilled into surfaces to be rendered watertight. Non-shrink cement grout with waterproofing compound as per manufacturers specifications shall be injected under pressure to seal all voids. Special care shall be taken at joints by providing additional nozzles. The pressure grouting shall be done on the internal surface.
- b) External Treatment

Two layers of (1:4) plaster of 12 mm thick each with waterproofing compound as per manufacturer's specification shall be provided on outer



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 40 OF 56

surface of concrete underground structures.

3.26.05 Protective coating on Inside Surface.

Two coats of cement based two components polymer modified flexible protective and waterproofing slurry having 1 mm thick for each coat shall be applied on the walls/floor after proper surface preparation as mentioned above. The slurry shall be applied by brush.

3.26.06 Bitumen Felt: Application for Tanking

This specification shall cover laying the waterproof course on the outside and inside of the walls and bases of structures.

The materials shall conform to IS: 1322, and the workmanship to IS: 1609. The bitumen felt should be hessian base and/or fibre base as specified in Drawing. If required by the Engineer, tests as specified in relevant IS Codes shall be arranged by the Contractor without charging any extra to the Owner.

The Contractor shall execute this work in direct collaboration with one of the well-known specialized firm approved by the Engineer.

Cleaning the surface, keeping it dry, providing, necessary corner fillets and cement rendering and cutting chases, etc. shall be done as per drawings and/or instructions. If any protective brickwork on/against concrete sub-bases or walls are required, the same shall be provided. A twenty (20) years guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub-contractor jointly and severally, for this work. Free rectification of any defects noted in the work within this guarantee period will be carried out by the Contractor even if it is beyond the specified maintenance period of the contract as a whole.

3.26.07 Polyethylene Films: Application in Walls or base of structures

Waterproof treatment shall be applied as outlined and as per sequence given hereunder

- i) the concrete surface shall be made smooth with 12 mm cement plaster 1:6.
- ii) apply hot bitumen 80/100 grade (IS: 73-1961) at the rate of 1.0 Kg/Sq.m minimum
- iii) lay black polyethylene film 250-micron (IS: 2508-1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed, taking care not to puncture the film.

Alternatively, the overlaps shall be heat sealed by an electric iron having



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 41 OF 56

three parallel sealing bars. A long piece of plywood is to be placed below the polyethylene film to be heat-sealed. On the plywood a rubber gasket is to be laid to provide a cushion for better welding of the film. On the rubber padding, a cellophane tape is to be spread and on this the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another cellophane tape is to be placed to prevent the heat sealer from sticking to the LDPE film. After this, the electric iron is to be pressed on the overlap joint for sufficient time so as to allow perfect welding. The operation is to be repeated for subsequent lengths of joints. After heat-sealing, the cellophane tape is to be removed and the joints are to be tested for leaks.

- iv) Lay 100 gm brown craft paper laminated with a layer of straight run bitumen,
- v) Lay hot bitumen 80/100 grade (IS: 73-1961) at 1.0 Kg/Sq.m minimum.
- vi) Lay 250-micron polyethylene film as second layer similar to (iii)above.
- viii) Lay second layer of 100 gm. brown craft paper laminated similar to (iv) above.
- ix) Apply hot bitumen (straight run grade) to IS: 73-1961 at 1.0 Kg/Sq.m dusted with fine sand.
- x) Protecting with a layer of 75 mm plain cement concrete M-10, or a layer of brick laid in cement mortar 1:6 in case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortar as shown on the drawing.

3.27.00 Protective Coating on Concrete Surface

3.27.01 On Foundation

The outside faces of foundation of important structures will be protected from adverse effect of soil/underground water, if shown on drawing by using rubber/bitumen emulsion protective coating of approved manufacturer.

4.00.00 SAMPLING AND TESTING

4.01.00 General

The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost unless otherwise specified in this specification. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 42 OF 56

4.02.00 Cement

Representative samples will be taken from each consignment of cement received from the manufacturer/supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths as per guidelines of IS: 269. Soundness Tests may also be required to be carried out if required by the Engineer. The Contractor shall carry out the tests without any expense to BHEL. No cement from a particular consignment/batch will be used on the works unless satisfactory 3 (three) days and 7 (seven) days test results for compressive strength are known. The Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the BHEL or the Contractor. These tests are of great importance, as their results will have a bearing on the acceptance of concrete or otherwise as per the terms and conditions of the Contract.

4.03.00 Aggregates

The contractor shall carry out any or all the tests on aggregates as may be required by the Engineer in accordance with IS: 2386 PARTS-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.

4.04.00 Water

Sampling and Testing of water being used for concrete works as per IS: 3550 will be carried out by the Contractor at regular intervals and whenever directed by the Engineer. The acceptance criteria will be as per IS: 456.

4.05.00 Admixture

4.05.01 Air Entraining Agents

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cylinder cube crushing strength vis-a-vis quantity of A.E.A. used for all types of concrete will be established by the Contractor by carrying out sufficiently large number of tests. After that, at regular intervals and whenever directed by the Engineer, the Contractor will check up the actual percentages of air entrained and corresponding crushing strengths to correlate with the earlier test results.

4.05.02 Other Admixtures

Tests for establishing the various properties of any other admixtures, which may be required to be added, shall be carried out by the Contractor.

4.06.00 Concrete



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 43 OF 56

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS: 516 and IS: 1199, the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed but under special circumstances the Engineer may require other tests to be performed in accordance with IS: 516. Sampling procedure, frequency of sampling and test specimen shall conform to IS: 456. To control the consistency of concrete from every mixing plant, slump tests shall be carried out by the Contractor every two hours or as directed by the Engineer. Slumps corresponding to the test specimens shall be recorded for reference. The acceptance criteria of concrete shall be in accordance with IS: 456. Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Contractor at his own cost. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, free of charge by the Contractor, to the satisfaction of the Engineer.

5.00.00 ACCEPTANCE CRITERIA

5.01.00 Standard Deviation

Standard deviation shall be based on test results and determination of Standard deviation shall conform to IS: 456.

5.02.00 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to IS: 456.

5.03.00 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to IS: 456.

5.04.00 Load Test

Load tests of structural members as per IS:456 may be required by the Engineer, when the strength of test specimen results falls below the required strength.

If the member shows evident failure, the Contractor shall make the structure adequately strong free of cost to BHEL.

The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification. The entire cost of dismantling and replacement and restoration of the site being borne by the Contractor.

If, in the course of dismantling, any damage is done to the embedded items



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 44 OF 56

and or other adjacent structures, the same will be made good, free of charge by the Contractor to the satisfaction of the Engineer.

6.00.00 RATES AND MEASUREMENTS

6.01.00 Cast-in-situ Concrete

6.01.01 Rates

- a) The unit rates shall include the cost of labour, materials, equipment, handling, transporting, botching, mixing, placing in position, vibrating, compacting, finishing, curing, testing, etc. at all elevations. This shall include the cost of curing by regular wetting or by using curing compound.
- b) The unit rates shall include for all working conditions including at locations under water, liquid, mud, in or under foul positions and extreme weather conditions.
- c) The unit rates for exposed concrete works (including machine foundations) shall include all incidentals, rendering, smoothening with carborandum stone, finishing with a paste of cement sand mortar, curing, etc.
- d) The unit rates shall include all arrangement for maintaining stability of structure during execution.
- e) Nothing extra shall be payable for the handling/mixing of extra cement on account of any reason or pouring of second stage concrete.
- f) Nothing shall be payable to the Contractor on account of facilities and arrangement provided by him for conducting ultrasonic pulse velocity (UPV) tests or other relevant tests to ascertain grade and quality, etc. of the concrete in case the concrete quality is in doubt and contractor has to establish the quality by further tests. In case of any defects, the Contractor shall rectify the same by cement/epoxy grout at his own cost.

However, mandatory UPV test as specified in the drawings shall be carried out including arrangement of all its facilities, staging, etc. and shall be payable to the contractor as per BOQ item.

- g) The unit rates for controlling of the temperature of concrete shall include storing and mixing of ice, water, cooling of aggregate etc.
- h) The quoted rate shall include the cost of MIX design, making of all trial mixes using admixtures and mixing in concrete etc. complete.

6.01.02 Measurements



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 45 OF 56

- a) Actual volume of concrete work as executed or as per drawings issued, whichever is less shall be measured in cubic metres to the nearest two decimals.
- b) No deductions shall be made for the following:
 - i) Ends of dissimilar materials embedded inside for example, beams, posts, girders, rafters, purlins, trusses, corbels and steps upto 500 sqcm in cross section;
 - ii) Opening upto 0.1 sq.m.
 - iii) Volume occupied by reinforcement, sleeves, anchor bolts, and similar items.
 - iv) Volume occupied by pipes, conduits, sheathing, etc. not exceeding 100 sq.cm. each in cross sectional area.
- c) The concrete works of different grades; below and above ground floor finished level shall be measured separately, unless otherwise specified in the schedule of items. Accordingly rates shall be applied for concrete in foundation for concrete below ground floor finished level and concrete in superstructure for concrete above ground floor finished level.
- d) For temperature control measures, measurement shall be done in terms of quantity of concrete in cum. in concreting of which the ice have been used or cooling of aggregates has been done to keep the temperature of freshly laid concrete to less than 23°C.

6.02.00 Reinforcement

6.02.01 Rates

- a) The unit rates shall include for cover block, providing binding wire, welding, separator pieces between two or more layers of reinforcement required for keeping the steel in position, etc. at all elevations.
- b) No extra will be paid for transportation from stores, cleaning, straightening of steel, cutting, bending, binding with annealed wire, welding, tack welding, placing the reinforcement modification of already embedded reinforcement, if required, due to faulty fabrication or placement and other cost of tools and plants, materials, labours, return of unused steel to the store, etc.

c) However, lap welding of reinforcement steel if permitted shall be paid under separate item as provided in the BOQ and no deduction for labour



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 46 OF 56

and binding wire saved for not providing lap length shall be made. Similarly, splicing of reinforcement bars using mechanical couplers if permitted shall be paid under separate item as provided in the BOQ and no deduction for labour and binding wire saved for not providing lap length shall be made.

- d) No extra shall be paid for preparing and getting approved bar bending schedules (including all revisions).
- e) Generally members are straight and have straight edges. However, for bending, binding, placing of reinforcement in any curved member in length or cross section or both, no extra payment shall be made.

6.02.02 Measurements

- a) Bar or any other type of reinforcement used like hard drawn steel wire fabric etc. for reinforced concrete shall be measured by weight in tonnes. The weight shall be arrived at by multiplying the actual or theoretical length measured alongwith standard hooks, cranks, bends, authorized laps, etc. whichever is less by the sectional weights. Claims for payment for this item shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS Section weight. Nothing extra will be payable to the Contractor on account of, difference in weight, if any, due to different methods adopted for issue and measurement.
- b) Standard hooks, cranks, bends, authorised laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tonnes.

6.03.00 Formwork and Staging

6.03.01 Rates

- a) The unit rates shall be inclusive of all staging, scaffolding, making the formwork watertight, etc. for all elevations and in all types of works.
- b) No separate payment shall be made for providing fillets, for rounding or chamfering at junctions, comers, etc.
- c) The unit rates shall include the cost of labour, materials etc. and the extra time, which shall be required for the removal of shuttering/ support for satisfactory completion of work.
- d) No extra payment shall be made on account of difficulty, wastage etc. for placement/removal of formwork between the network of closely placed steel beams or for the lacing/bracing portions and ribbed slab constructions.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 47 OF 56

- e) Payment for curved shuttering shall be made for curved members/wall whose centerline radius in plan is less than 6m.
- f) If the contact surface area in pockets is less than or equal to 0.1 sq.m. in each case, payment shall be done under item for providing formwork in pockets.

6.03.02 Measurements

- a) Formwork for different classes (types) shall be measured separately as the actual surface in contact with the concrete and paid on area basis unless included in the rate for concrete. The unit of measurement shall be in sq.m.
- b) Openings upto 0.1 sq.m or boxing left for inserts etc. for facility of Contractor's work, shall be neglected as if nonexistent for the purpose of formwork measurement of surface in which the openings occur.

For suspended floor, no deduction shall be made for flange area of secondary steel beams.

- d) No measurement shall be taken for the formwork in pockets, openings, chases, blockouts, etc. in concrete, the contact surface area is less than or equal to 0.1 sq.m. in each case.
- e) For pockets, if the contact surface area is less than or equal to 0.1 sq.m. in each case, measurement shall be done under item for providing formwork in pockets.
- e) Formwork, if required, for joints shown on drawing or instructed by the Engineer, shall be paid for the 'leading side' only.

6.04.00 Embedded Parts

6.04.01 Rates

- a) The unit rate for erection of embedded steel parts, supplied by Engineer shall include transportation from Owner's store to the place of work, erection & installation including setting material in concrete, etc. complete.
- b) The unit rate for MS pipe embedments and PVC pipe embedments shall include cutting, welding, fabrication, erection, embedding, and transportation to site. Unit rate shall also include the cost of the pipes.
- c) Rate for expansion fasteners shall include cost of fasteners, installation, and fixing including cost of washers and nuts and site testing if required.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 48 OF 56

6.04.02

Measurements

- a) The measurement of the embedded steel parts fabricated and installed by the Contractor shall be based on the calculated weight of steel sections in tonne corrected to second place of decimal.
- b) Embedded steel parts supplied by Owner and installed by Contractor Measurement shall be done for the net weight of the embedments installed in tonnes correct to second place of decimal.
- c) For PVC pipes/conduits, measurements shall be in quintals correct to second place of decimal for the net weight.
- d) For mild steel pipes, measurement shall be in quintals, correct to second place of decimal, for the net weight of the steel pipe supplied, fabricated, and installed.
- e) The lugs shall be measured in Kg. correct to second place decimal for the net weight.
- f) The expansion fasteners shall be measured in number according to tension capacity.
- g) The rails shall not be treated as embedded steel part and the track shall be measured in running metres along the centre line and paid for under separate item of work as specified in schedule of items. Other related civil items associated with the laying of track shall be measured separately and paid under respective items of works.

6.05.00

Groutings

6.05.01

Rates

Rate shall include the cost of surface preparation, admixtures, and curing.

6.05.02

Measurements:

- a) Measurement shall be in cubic decimeters.
- b) Measurement for grouting shall be by volume of the block out, pockets or bolt hole upto the top surface of foundation concrete and shall be calculated from the dimensions shown on the drawings.
- c) Measurement for underpinning shall be by volume between the top surface of the foundation concrete and the underside of the base plate, the plan dimensions being as indicated on the drawings.



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 49 OF 56

d) No deduction shall be made for shims, bolts, shear keys and such other embedments.

f) Pressure injection grouting with cement based grout if required as per drawing shall be applied at appropriate spacing to cover the desired surface area and measurement shall be made for the surface area grouted in sqm as per BOQ item. However in water retaining structures, the structural grouting if required to ensure water tightness shall not be payable separately as deemed to be covered in water retaining concrete item of BOQ.

6.06.00 Joints

6.06.01 Rates

The unit rate shall include all the activities described in the schedule of items.

6.06.02 Measurements

a) Bitumen Board/Expanded polystyrene.

The measurement for bitumen board shall be based on actual finished surface area in square meters nearest to second decimal, for the specified thickness.

b) Water Stops

The measurement for water stops shall be in running metres of actual length of the joint covered, for specified thickness, width, and shapes. No separate measurement shall be made for laps/splices for cross-joints and mitered joints.

c) Metal Cover Strips

The measurement for Metal Cover Strips shall be based on actual finished surface area in square metres for the specified thickness.

d) Vibration Damping Resilient Pads

The measurement for this item shall be in square metres for the specified thickness, measured correct to the second place of decimal, of the actual finished surface area.

6.07.00 Dismantling/Demolishing Work – RCC and PCC and Chipping of Concrete



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 50 OF 56

6.07.01 Rates

The unit rates shall include the cost of all necessary propping, shoring, underpinning scaffolding, safety measures, temporary enclosures, disposal/stacking of serviceable/unserviceable materials, etc. for all types of work and for all grades of concrete.

In the case of dismantling/demolishing work, the cutting of reinforcement shall also be included in the rate.

In the case of chipping work, the cutting of reinforcement shall be paid separately.

If the serviceable material including reinforcement steel from dismantled structure is allowed to be used/taken out by bidder, suitable rebate shall be given by bidder.

6.07.02 Measurements

- a) Dismantling of PCC and RCC work shall be measured in cu.m separately. Measurement of all work, except hidden work shall be taken before execution of work and no allowance for increase in bulk shall be allowed. Specifications for deductions of voids, openings etc, shall be done on the same basis as that applied for construction work.
- b) Chipping of concrete, making holes/pockets etc. shall be measured in cubic decimeters (i.e. 0.001 cu.m.).
- c) Cutting of reinforcement in chipping work for making of pockets and openings shall be measured in sq. cm. of cross-sectional area.

6.08.00 Precast Concrete

This clause shall be read in conjunction with relevant provisions specified elsewhere for cast in-situ Concrete.

6.08.01 Rates

- a) The unit rate shall include cost of preparation of casting yard, formwork, concrete and its casting, finishing as specified, setting filling of gaps between adjacent pre-cast concrete units with concrete, or cement mortar, curing, handling, erection, grouting, welding, preparation of supporting surface, etc.

6.08.02 Measurements

The measurement of pre-cast concrete members shall be on the basis of



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 51 OF 56

volume of concrete in cubic metres nearest to second place of decimal. No deduction shall be made for volume occupied by reinforcement/inserts/sleeves and for openings up to 0.1 sq.m. The setting of element with cement mortar shall not be measured separately. The filling of concrete cement mortar between the gaps of adjacent precast units shall be considered while computing the volume of pre-cast concrete work and shall be paid for under this item itself.

7.00.00

LIST OF IS CODES AND STANDARDS FOR REFERENCE

All work under this specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not specifically covered by Indian standard Specifications, any other standard practice, as may be specified by the Engineer, shall be followed:-

IS: 73 -	Indian Standard Specification for Paving Bitumen
IS: 216 -	Indian Standard Specification for Coal Tar Pitch
IS: 383 -	Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
IS: 432 -	Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement
IS: 455 -	Indian Standard Specification for Slag Cement
IS: 456 -	Indian Standard Code of Practice for Plain and Reinforced Concrete
IS: 457 -	Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive Structures
IS: 516 -	Indian Standard Specification for Methods of Test for Strength



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 52 OF 56

of Concrete

- IS: 702 - Indian Standard specification for industrial bitumen.
- IS: 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete
- IS: 1322 - Indian Standard Specification for Bitumen Felts for Waterproofing and Damp-proofing
- IS: 1489 - Indian Standard Specification for Portland Pozzolona Cement
- IS: 1566 - Indian Standard Specification for hard drawn steel wire fabric for concrete reinforcement.
- IS: 1609 - Code of Practice for Laying Damp-proof Treatment using Bitumen Felts
- IS: 1786 - Indian Standard Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement.
- IS: 1791 - Indian Standard Specification for Batch Type Concrete Mixers.
- IS: 1838 - Indian Standard Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).
- IS: 2185 - Indian Standard Specification for Hollow Cement Concrete Blocks
- IS: 2210 - Indian Standard Specification for Design of Reinforced Concrete shell Structures and Folded Plates
- IS: 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete - Part-I to VIII
- IS: 2502 - Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
- IS: 2505 - Indian Standard Specification for Concrete Vibrators, Immersion Type
- IS: 2506 - Indian Standard Specification for Screed Board Concrete Vibrators
- IS: 2514 - Indian Standard Specification for Concrete Vibrating Tables



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 53 OF 56

IS: 2571 -	Code of practice for laying in-situ cement concrete floors.
IS: 2645 -	Integral cement water proofing compound
IS: 2722 -	Indian Standard Specification for Portable Swing Weigh Batches for Concrete (Single and Double Bucket type)
IS: 2750 -	Indian Standard Specification for steel scaffoldings.
IS: 2751 -	Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction
IS: 2770 -	Indian Standard Specification for Method of Testing Bond in Reinforced Concrete
IS: 3025 -	Indian Standard specification for Methods of Sampling and Test (Physical and Chemical) for Water used in Industry
IS: 3067 -	Code of practice for general design details and preparatory work for damp proofing and water proofing of building.
IS: 3201 -	Indian Standard Specification for Design and Construction of Precast Concrete Trusses
IS: 3370 -	Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids
IS: 3414 -	Code of practice for design and installation of joints in buildings.
IS: 3550 -	Indian Standard Specification for Method of Test for Routine Control for Water used in Industry
IS: 3558 -	Code of Practice for use of Immersion vibrators for Consolidating Concrete
IS: 3696 -	Safety Code for Scaffolding and Ladders
IS: 3812 -	Indian Standard Specification for Fly Ash for Use as Admixture for Concrete
IS: 4014 -	Code of practice for steel tubular scaffolding.
IS: 4031 -	Indian Standard Specification for Method of Tests for Hydraulic Cement
IS: 4082 -	Indian Standard Specification for Recommendation on



TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 54 OF 56

Stacking and Storage of Construction Materials at site

- IS: 4090 - Indian Standard Specification for Design of Reinforced Concrete Arches
- IS: 4634 - Indian Standard Specification for Method of Testing Performance of Batch-type Concrete Mixes
- IS: 4656 - Indian Standard Specification for Form Vibrators for Concrete
- IS: 4925 - Indian Standard Specification for Concrete Batching and Mixing Plant
- IS: 4926 - Indian Standard Specification for Ready Mixed Concrete
- IS: 4990 - Indian Standard Specification for Plywood for Concrete Shuttering work
- IS: 4991 - Indian Standard Specification for Blast Resistant Design of structure for Explosion above ground
- IS: 4995 - Indian Standard Specification for Design of Reinforced Part-I & II Reinforced Concrete Bins for the Storage of Granular and Powdery Materials
- IS: 4998 - Indian Standard Specification for Design of Reinforced Concrete Chimneys.
- IS: 5256 - Code of practice for sealing joints in concrete lining on canals.
- IS: 5512 - Indian Standard Specification for Flow Table for use in Tests of Cement and Pozzolanic materials
- IS: 5513 - Indian Standard Specification for vacate Apparatus.
- IS: 5515 - Indian Standard Specification for Compaction Factor Apparatus.
- IS: 5525 - Recommendation for detailing of reinforcement in reinforced concrete works.
- IS: 5624 - Indian Standard Specification for foundation bolts.
- IS: 5751 - Indian Standard Specification for Precast Concrete Coping Blocks.
- IS: 5816 - Indian Standard Specification for Method of Test for Splitting



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 55 OF 56

Tensile strength of Concrete Cylinders.

- IS: 5891 - Indian Standard Specification for Hand operated Concrete Mixers.
- IS: 5892 - Indian Standard Specification for transit mixer and agitators.
- IS: 6452 - Indian Standard Specification for High Alumina Cement for Structural Use
- IS: 6909 - Indian Standard Specification for Super sulphated Cement
- IS: 6923 - Indian Standard Specification for Method of Test for Performance of Screed Board Concrete Vibrators.
- IS: 6925 - Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures.
- IS: 7242 - Indian Standard Specification for Concrete Spreaders.
- IS: 7246 - Indian Standard Specification for Table Vibrators for Consolidating Concrete.
- IS: 7251 - Indian Standard Specification for Concrete Finishers.
- IS: 7293 - Safety code for working with construction machinery.
- IS: 7320 - Indian Standard Specification for Concrete Slump Test Apparatus.
- IS: 7861 - Indian Standard Specification for Recommended Practice Part-I&II for Extreme Weather Concreting.
- IS: 7969 - Safety Code for Storage and Handling of Building Materials.
- IS: 8041 - Indian Standard Specification for Rapid Hardening Portland cement.
- IS: 8112 - Indian Standard Specification for high strength Ordinary Portland Cement.
- IS: 8142 - Indian Standard Specification for Determining Setting time of concrete by Penetration Resistance.
- IS: 8989 - Safety Code for Erection of Concrete Framed Structures.



**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D2

REV.NO. 0 DATE: 13/02/2018

SHEET 56 OF 56

- IS: 9012 - Recommended method for shortcreting.
- IS: 9013 - Indian Standard Specification for Method of Making, Curing, and determining compressive Strength of Accelerated-cured Concrete Test Specimens.
- IS: 9077 - Code of Practice for Corrosion Protection of Steel Reinforcement in RB and RCC Construction.
- IS: 9103 - Indian Standard Specification for Admixtures for Concrete.
- IS: 10262 - Recommended Guidelines for Concrete Mix Design.
- IS: 13311 - Non-destructive testing of concrete.
- SP: 34 - Handbook of concrete, reinforcement and detailing.



**TECHNICAL SPECIFICATION
FOR CARPENTRY AND
JOINERY**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE: 13/02/2018

SHEET 1 OF 7

SECTION - D

SUB-SECTION – D3

CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



**TECHNICAL SPECIFICATION
FOR CARPENTRY AND
JOINERY**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE: 13/02/2018

SHEET 2 OF 7

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	5
4.00.00	I.S. CODES	6
5.00.00	RATES AND MEASUREMENTS	6



TECHNICAL SPECIFICATION FOR CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE: 13/02/2018

SHEET 3 OF 7

CARPENTRY AND JOINERY

1.00.00 SCOPE

This section covers supply, fitting and fixing of timber frames to doors and windows with M S holdfasts, flush doors, windows, shutters, partitions, wall panelling, pelmets, shelves, furniture, etc. as shown in drawings, including a prime coat of approved paint, varnish, or fixing of decorative plastic laminate where called for. This shall also include the supply and fixing of all hardware and fixtures shown in drawing or specified.

2.00.00 INSTALLATION

2.00.01 Materials

a) Timber

Unless otherwise specified, all timber shall be best quality well-seasoned CP teakwood free from large or loose knots, cracks or any other defects. All timber shall be treated with approved wood preservative before use, unless specified otherwise. The rough timber shall be approved by the Engineer before incorporating in the works and starting the carpenter's work.

b) Plywood

Plywood shall be of commercial quality or with decorative surface veneer. Unless specifically permitted otherwise, the adhesive used in plywood shall be phenol formaldehyde synthetic resin of BWP grade conforming to IS: 848.

c) Decorative Laminated Plastic Sheets

The colour, pattern, finish and texture shall be approved by the Engineer. The bulk supply shall be procured in full sheet sizes which will ensure the least number or joints in one surface.

d) Flush Doors

Flush doors shall be solid core doors with commercial or decorative faces and hardwood edges conforming to IS: 2202 (Part-1). The core for solid core doors shall be of block board or wood particle board. Manufacturer's literature and test certificates shall be submitted for the approval of the Engineer. The Contractor shall give a guarantee that the adhesive used is BWP grade phenol formaldehyde synthetic resin conforming to IS: 848. The thickness shall be as specified.



TECHNICAL SPECIFICATION FOR CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE: 13/02/2018

SHEET 4 OF 7

e) Panel Doors

Panel door shall be of teakwood shutter frame, unless otherwise noted and panels with teakwood/commercial ply/teakwood particle board. Other considerations shall be as mentioned in item (d) above.

f) Windows, Ventilators

Windows and ventilators shall be made of teakwood shutter frame, unless specified otherwise and glazing of specified thickness shall be fixed with wooden beadings.

g) Fixtures

Fixtures for doors, windows, furniture etc. shall be as shown on drawing or specified.

2.02.00 Workmanship

2.02.01 General

The work shall be done by skilled carpenters as per details shown on drawing or instructed by the Engineer.

Framing timber and other work shall be close - fitting with proper wood joinery, accurately set to required lines or levels and rigidly secured in place. The surface of frames etc., which will come in contact with masonry after fixing, shall be given two coats of approved paint before fixing. Mastic caulking shall be done after fixing external door and window frames. Special care shall be taken to match the grain of timber or plywood, which will be subsequently polished. Screwing or nailing will not be permitted to the edge of plywood and particle board. The edge of all plywood, blackboard and particle board shall be finished with teakwood lipping unless otherwise shown on drawings.

Fixing to frames and partitions shall generally be with 40 mm x 6 mm x 300 mm long M S holdfasts bifurcated at end and grouted with 1:2:4 cement concrete. The gap between masonry and external door and window frame shall be caulked with polysulphide mastic. M.S. grills or guard bars shall be provided to windows where called for in the drawings.



TECHNICAL SPECIFICATION FOR CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE: 13/02/2018

SHEET 5 OF 7

2.02.02 Finish

All carpentry work after finishing shall be sand papered smooth. A prime coat paint shall be given after inspection of the Engineer to all surfaces other than those, which shall be subsequently polished or covered with laminated plastic sheet.

2.02.03 Surface Treatment

When shown on drawings or called for, decorative ply or laminated plastic sheets shall be bonded under pressure to the surface to be finished. The adhesive used shall be of brand and brought to site in sealed containers. The rate of application and the length of time for which the pressure is to be applied shall be as per the manufacturer's instructions. The edge of sheets shall be protected by teak lipping or bevelled as shown on drawings.

3.00.00 ACCEPTANCE CRITERIA

3.00.01 Door and Window Frames

All frames shall be square and flat at the time of delivery and shall be checked for dimensions and corner angles. After fixing they shall be on a fine vertical plane. All external door and window frames shall be caulked with mastic.

3.02.00 Door and Window Shutters

All doors and window shutters shall be of proper size, shape, and design and free of warp. When fixed to frames, these shall operate smoothly without jamming and all latching or locking devices shall engage properly without undue pressure.

3.03.00 Partitions, Panelling, Pelmet, Furniture, etc.

3.03.01 General

These shall conform to drawings in all details. No unsightly nail marks etc. shall be permitted. Plywood grains shall be matched to give a uniform and pleasing appearance.

3.03.02 Partition

Shall be checked for rigidity of fixing, plumb and horizontal as well as vertical alignment.



TECHNICAL SPECIFICATION FOR CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE: 13/02/2018

SHEET 6 OF 7

3.03.03 Pelmets

Shall be checked for rigidity of fixing and adequate clearance of fixture.

3.03.04 Cupboard Shutters

Shall operate smoothly without jamming and locks, bolts and double ball catches shall engage securely. Single ball catches shall not be used.

3.03.05 Drawers

Shall operate smoothly and have backstops to prevent them from being pushed too far. Locks shall engage securely.

3.03.06 Loose Furniture

When placed on a level surface, tables tops etc. shall be horizontal and the pieces stand stably on legs or supports.

4.00.00 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 848 - Synthetic resin adhesives for plywood (Phenolic and Aminoplastic)

IS: 1003 - Timber panelled and glazed shutters.

IS: 2191 - Wooden flush door shutter (Cellular and hollow core type).

IS: 2202 - Wooden flush door shutters (solid core type).

IS: 4021 - Timber door, window, and ventilator frames.



**TECHNICAL SPECIFICATION
FOR CARPENTRY AND
JOINERY**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D3

REV.NO. 0 DATE: 13/02/2018

SHEET 7 OF 7

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall include of all activities mentioned in “Schedule of Item” for completion of the work. No separate payment shall be made for fixing, caulking, application of primer coat, polishing, providing of butt hinges, holdfasts, sliding/tower bolts, door stoppers, door closers and other fittings and fixtures.

5.02.00 Measurement

Measurement shall be done in Sqm for doors, windows, ventilators, shutters, partitions etc.

Measurement for wooden frame shall be in CuM.

Pelmets shall be measured in RM.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 1 OF 15

SECTION – D

SUB-SECTION – D4

**ROOF AND UNDERGROUND STRUCTURES WATER
PROOFING, INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 2 OF 15

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA AND GUARANTEE	13
4.00.00	I.S. CODES AND STANDARDS	14
5.00.00	RATES AND MEASUREMENTS	15



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 3 OF 15

**ROOF AND UNDERGROUND WATER PROOFING,
INSULATION AND ALLIED WORKS**

1.00.00 SCOPE

This section covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of roof and underground water-proofing, insulation and allied works for buildings and at locations covered under the scope of this package.

2.00.00 INSTALLATION

2.01.00 GRADING UNDERBED

The surface to receive the underbed shall be roughened and thoroughly cleaned with wire brush and water. Oil patches if any shall be removed with detergent. The surface shall be soaked with water and all excess water removed just before laying of the underbed.

The underbed shall not be laid under direct hot sun and shall be kept in shade immediately after laying so as to avoid quick loss of water from the mix and separation from the roof surface. The underbed shall be cured under water for at least 7 days.

The underbed shall be laid to provide an ultimate run off gradient not less than 1 in 120 and as directed by the Engineer. Upto an average thickness of 25mm the underbed shall usually be composed of cement and sand plaster. For higher thickness the underbed shall be made with cement concrete. The underbed shall be finished to receive the waterproofing treatment direct or insulation as the case may be.

2.01.01 Cement Mortar Underbed

The underbed grading plaster shall be average 25 mm thick maximum. It shall consist of cement and coarse sand in the ratio 1:4 nominal by volume. The sand and cement shall be thoroughly mixed dry and then water added. Each batch of mix shall be consumed before the initial set starts.

The plaster shall be fully compacted to the desired grade in continuous operation. The surface shall be even and reasonably smooth.

2.01.02 Cement Concrete Underbed

The underbed cement concrete shall be used where the subgrade is more than average 25 mm thick. It shall consist of cement concrete 1:2:4 nominal mix



TECHNICAL SPECIFICATION FOR ROOF AND UNDERGROUND STRUCTURES WATER PROOFING, INSULATION AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 4 OF 15

by volume with 12 mm down stone chips and coarse sand. The aggregate shall be mixed dry and minimum quantity of water shall be added to make the mix workable.

The mix shall be laid to proper grade, fully consolidated and surface shall be smooth and even.

2.02.00 INSULATION

The Tenderer shall, along with the tender, send specifications of insulating materials he proposes to use and the proposed method of laying. Before bulk supply, the contractor shall send samples of insulating material to the Engineer, and after approval of the samples, the Contractor shall procure and transport the bulk material to the site. Whenever asked by the Engineer, the Contractor shall furnish test certificates from testing laboratory on the insulating and other properties of the materials.

After laying the insulation, the surface shall be made ready as required to receive the waterproofing treatment. If any plastering is used it shall be not leaner than 1:4 cement sand by volume and not thinner than 12 mm and it shall be cured for seven days.

2.02.01 Foam Concrete

This shall be of lightweight foam concrete of average 50 mm thickness or as specified or as shown on drawings. This may be laid in situ in suitable panels or precast blocks. The insulating properties shall be such that the thermal conductivity shall not exceed 0.125 Kcl/sq.m. hr degree C. Before starting the laying of foam concrete samples shall be prepared at site and got tested for approval of the Engineer.

The foam concrete laid shall be sufficiently strong to withstand the usual workload and standard loads expected on the roof. Any damaged portion shall be removed and replaced forthwith. Approval of the Engineer shall be taken before laying the waterproofing over the insulation.

While laying the foam concrete, samples from each batch of the mix shall be kept for test if so desired by the Engineer.

2.02.02 Expanded Polystyrene Blocks

The expanded polystyrene block Insulation shall be fire retardant quality and shall have a maximum thermal conductivity of 0.026 Kcl m/sq.m h °C. It must be strong enough to withstand without any deformation under the workload and standard loads expected on the roof.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 5 OF 15

The Contractor shall lay the expanded polystyrene block as per manufacturer's approved specification. Only specifically experienced workers shall be used for this work. If the Engineer is not satisfied about the efficiency of the workers the Contractor shall secure manufacturers supervision at no extra cost to the Owner.

2.03.00 Fillets

Fillets at Junction of roofs and vertical walls shall be provided with the same insulating material as provided for the main roof insulation. The fillets shall be 150 mm x 150 mm in size unless otherwise shown on drawings or instructed by the Engineer.

Where there is no insulation over roof slab, fillets shall be cast-in-situ cement concrete (1:2:4) nominal mix volume.

2.04.00 Waterproofing Treatment

2.04.01 Bitumen Felt Treatment

Waterproofing treatment shall be laid by a specialist firm with long experience in the particular trade.

The waterproofing treatment for roofs with bitumen felts shall be done following relevant IS: 1346. Bitumen felt shall conform to IS: 1322 and Bitumen primer to IS: 3384.

The bonding materials shall consist of blown type conforming to IS: 702 or residual bitumen conforming to IS: 73 or a mixture of the two to withstand local conditions of prevailing temperature or gradient of roof surface. The Contractor shall convince the Engineer that the bonding material proposed to be used is suitable for the particular job.

The Contractor shall state the source from where he proposed to procure the materials. Samples of the self-finished felt shall be submitted in advance to the Engineer along with test certificates for his review. Test certificates for the bonding materials shall also be submitted and samples, if desired by the Engineer, shall be provided for confirmatory tests. Samples shall be submitted if instructed by the Engineer.

Minimum overlaps of 100 and 75 mm shall be given at the end and sides of strips of felt and properly bonded with bitumen. Joints in successive layers of felt shall be staggered.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 6 OF 15

Normal treatment with one layer of felt, heavy treatment with two layers of felt or Extra Heavy treatment with three layers of felt shall be indicated. Brief details of the various treatments shall be as follows:

a) Normal Treatment - Five courses

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)
- 3) Hessian base self-finished felt, type 3, grade 1.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)
- 5) 20 mm thick pressed precast concrete tiles with 15 mm, thick 1:4 cement-sand mortar underbed.

b) Heavy Treatment - Seven Courses

With Hessian base felt

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 3) Hessian base self-finished felt, type 3, grade 1.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 5) Hessian base self-finished felt, type 3, grade I.
- 6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With fibre base felt

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Not applied bitumen at the rate of 1.2 kg/sq.m (Min.)



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 7 OF 15

- 3) Fibre base self-finished felt, type 2, grade 2.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 5) Fibre base self-finished felt, type 2, grade 2.
- 6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

c) Extra Heavy Treatment – Nine courses

With fibre based felt

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)
- 3) Fibre-base self-finished felt type 2, grade 1.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m (min.)
- 5) Fibre base self-finished felt type 2, grade 1.
- 6) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)
- 7) Fibre base self-finished felt type 2, grade 1.
- 8) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)
- 9) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With Hessian base felt

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)
- 3) Hessian base self-finished felt, type 3, grade 1.



TECHNICAL SPECIFICATION FOR ROOF AND UNDERGROUND STRUCTURES WATER PROOFING, INSULATION AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 8 OF 15

- 4) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)
- 5) Hessian base self-finished felt, type 3, grade 1.
- 6) Hot applied bitumen at the rate of 1.2 kg/sqm. min.
- 7) Hessian base self-finished felt, type 3, grade 1.
- 8) Hot applied bitumen at the rate of 1.2 kg/sqm. min.
- 9) 20 mm thick pressed precast concrete tiles with 15 thick 1:4 cement: sand mortar underbed.

However, in special cases, more courses, or a combination of fibre base and hessian base felts may be asked for.

The surface to receive the waterproofing treatment must be cleaned and dried satisfactorily and the Engineer's approval taken before starting the work. If any existing waterproofing treatment is being augmented the existing top course shall be completely removed and all damaged felts or other defects repaired.

The Engineer may instruct the Contractor to lay part of the stipulated courses at the first instant to be followed later on with the balance courses. This interim finish shall be done with a course of hot applied bitumen. While doing the balance again hot bitumen shall be applied to start with after repair of all damages to the already laid course.

After completion the surface shall be cleaned taking care that felt cuttings etc. do not find their way into rainwater down comers.

2.04.02

Elastomeric Membrane

a) Material

The material shall consist of high solid content Polyurethane based cold liquid applied coatings as per ASTM C 836-89a comprising of urethane pre-polymers extended with flexible material, which cure by reaction with atmospheric moisture to give a continuous film which is rubbery and elastic or any other equivalent material permitted as per ASTM and approved by the Engineer. The material shall consist of high solid coating designed to give a high-build film. The material shall not be diluted. The coating shall have physical feature like high viscosity, 90% solids, high resistance to impact, abrasion and cracking, superior tensile strength, application limit of 70°C minimum, 300%



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 9 OF 15

elongation and forming a perfectly smooth permanently flexible seamless membrane which should have good adhesion to roof substrates (RCC, tiles, brick, and metals), having a minimum life of 10 years. It should also be resistant to acid (mild concentrated), alkali and have a very low water absorption rate (0.5%) max. at ambient temp. after 7 days.

The pack shall not be older than 9 months after the date of manufacture and packing.

b) Primer coat

It shall consist of polyurethane (P.U.) or any other equivalent material. Primer coat shall be a special blend of moisture curing urethane pre-polymers in solvent. A single coat of this primer shall be applied by brush over the prepared bed as an adhesion coat of an application rate of minimum 6 sq.m per litre.

The primer shall be allowed to dry for minimum of 2hrs. time before the successive finishing coats of P.U. liquid membrane is applied.

c) Finishing coats:

The finishing coats shall consist of two successive liquid coatings of high solids content urethane pre-polymers or equivalent material to form an elastomeric membrane. The overall dry film thickness shall be 1.5mm subject to minimum 500 gm per sq.m per coat application rate.

Each coat shall be allowed to dry for minimum 12 hours before applying the next coat. The surface should be dry and smooth before application.

The coating shall be continued up the parapets/walls for a minimum of 150mm over the finished roof surface. It shall be continued into rain water pipes by atleast 100mm.

The final coat of P.U. liquid when tacky shall be sprinkled with the sand.

For edges, expansion joints and any vulnerable points a later of polyscrim cloth /fabric to be embedded between 2 finishing coats.

d) Surface Finish:

Areas of roof treatment which are vulnerable to accidental damage shall be provided with wearing course consist of minimum 20 mm thick PCC of Grade M15 (using 12.5mm size aggregate) cast in panel of maximum size of 1.20m x 1.20m and reinforced with 0.56mm diameter galvanised chicken wire mesh



TECHNICAL SPECIFICATION FOR ROOF AND UNDERGROUND STRUCTURES WATER PROOFING, INSULATION AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 10 OF 15

and sealing of joints using sealant or elastomeric compound.

When the roof surface is subjected to foot traffic or used as a working area, a cement mortar (1:4) shall be applied over the top most layer of roofing treatment. Over this, a layer of chequered cement concrete flooring tiles conforming to IS:13801 shall be provided in place of stone grit and cement painted. The tiles shall be laid as per IS:1443.

2.04.03 Waterproofing by Epoxy Resin Based Application

Exposed surfaces of cement concrete, lime concrete or brickwork to be treated for waterproofing by the resin-based application shall be thoroughly cleaned and the epoxy resin based material to be applied as directed by the manufacturer. The material shall not have any adverse effect on the surface on which it is applied and must stick to it uniformly to make a strong durable bond. It shall not be affected by short duration fire, sun exposure, and light duty traffic. The application shall be resistant to growth of fungus and proof against saltpetre action. If desired by the Engineer, a sample shall be prepared in advance and tested for waterproofness for 48 hours under 300 mm depth of standing water. The Contractor shall arrange the demonstration by providing free the materials and labour for the application as free of cost to Owner. This item shall carry a guarantee as specified.

2.04.02 Flashing

Unless otherwise stated flashing shall be done in the same way as the waterproofing except that the last layer shall be finished with two coats of bituminous primer. The flashing shall be extended up the vertical surfaces as shown on drawing. The flashing shall end in grooves in vertical walls. The grooves shall be at least 65 mm deep and caulked with waterproof mastic cement. The minimum overlap with horizontal roofing felt shall be 100 mm.

Where specified or directed by the Engineer, metal flashing shall be provided. The materials shall be 18 Gage or 22 G G.I. sheets, as specified or as directed by the Engineer.

2.05.00 WATER-PROOFING OF UNDERGROUND STRUCTURES

Basements, ducts, pits, tunnels (excluding tanks) etc below the ground water table and in contact with soil are covered under this. Bonding material shall be blown bitumen of 65/25 grade conforming to IS: 702.

Waterproofing shall be provided on the outside of walls and top of RCC slab and shall be carried out upto 150mm above ground level. The number of layers of bitumen felt to be used for walls and floor unless otherwise shown in the drawing shall be:



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 11 OF 15

a) 2 layers - for depths up to 5m below ground level

b) 3 layers - for depths beyond 5m below ground level

2.05.01

Method of laying the bitumen felts and workmanship shall be as per IS: 1609 and IS: 3067. Water proofing work shall be taken in hand only when the sub-soil water level is at its lowest; the site shall be kept dry by adequate arrangements for pumping out water till the work has been completed.

For this purpose, drains shall be formed along the edges of the excavation but beyond the building line, with suitable collecting sumps.

In case of large excavation areas where it is necessary to dewater under the floor, additional land drains shall be formed across the excavation, to adequately drain the area.

Adequate arrangement shall be made to protect the sides of excavation from slipping while the work is in progress.

The base concrete or mud-mat shall be rendered smooth by a 20mm thick sand-cement plaster (6:1). Any sharp edges/corners, over which the waterproofing course is to be laid, shall be eased out by means of cement.

The surface must be dry before the next operation is carried out.

Water proofing/damp proofing treatment:

A) Heavy Treatment (Two layers of felt)

- i) Primer (For vertical faces only), as per I.S. 3384.
- ii) Hot applied blown bitumen at the rate of 1.2 Kg/m²
- iii) Hessian base, bitumen felt type 3 grades 2
- iv) Hot applied blown bitumen @ 1.2 Kg/m²
- v) Hessian base, bitumen felt type 3 grade 2
- vi) Hot applied blown bitumen @ 1.2 Kg/m²

B) Extra Heavy treatment (Three layers of felt)

- i) Primer (for vertical faces only) as per I.S. 3384



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 12 OF 15

- ii) Hot applied bitumen at the rate of 1.2 Kg/m²
- iii) Hessian base bitumen felt type 3 grades 2
- iv) Hot applied bitumen at the rate 1.2 Kg/m²
- v) Hessian base bitumen felt type 3 grades 2
- vi) Hot applied bitumen at the rate of 1.2 Kg/m²
- vii) Hessian base bitumen felt type 3 grades 2
- viii) Hot applied bitumen at the rate of 1.2 Kg/m²

The surface must be dry before the next operation is carried out at each stage said above.

The laying of felt over the bitumen so applied that it shall always commence on the floor, and shall be carried over to the walls only after treatment of the floor is complete. The minimum over lapping at sides and ends of strips shall be 10cm. Point for subsequent layers completely sealed by blow lamp.

A protective flooring of either brick flat in cement mortar (1:3) or 6cm thick cement concrete (M 15) or a coat of cement plaster (1:3) 4 cm thick shall be constructed over the bitumen layers to prevent damage to the latter during subsequent construction of the structural floor.

The walls shall be treated in a similar way; the bitumen felts joining at the base with the projecting felt laid over the mud-mat. The wall surface shall be made smooth where necessary with a coat of cement plaster (1:3), the felts laid as for the floor, ensuring that the surface to be treated is dry and then a protective brick wall, 12.5 cm nominal thickness shall be built in cement mortar (1:3) over the projecting mud-mat, the space between the wall and felt being grouted with cement.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 13 OF 15

3.00.00

ACCEPTANCE CRITERIA AND GUARANTEE

The surface level shall be such as to allow quick draining of rains without leaving any pool anywhere. The finishing course shall be fully secured and shall have an even density. There shall not be any bubble formation or crushed or squeezed insulation or underbed.

The contractor shall give a guarantee in writing for all works executed under this specification supplemented by a separate and unilateral guarantee from the specified agency for the roof waterproofing treatment work. The guarantee shall be for materials and workmanship as under:

For Bitumen Felt Treatment under clause no. 2.04.01: 5 years in case of normal treatment, 10 years for heavy treatment and 20 years for extra heavy treatment.

For Elastomeric Membrane under clause no. 2.04.02: 10 (ten) years.

In case guarantee is more stringent in owner specification, more stringent guarantee shall be applicable. The mode of execution of the guarantee shall be such, which shall be acceptable to the Owner.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 14 OF 15

4.00.00

I.S. CODES AND STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

- a) IS: 73 - Paving Bitumen
- b) IS: 702 - Industrial Bitumen
- c) IS: 1203 - Methods of testing tar and bitumen
- d) IS: 1322 - Bitumen felts for waterproofing and damp proofing.
- e) IS: 1346 - Code of practice for waterproofing of roofs with bitumen felts.
- f) IS: 1609 - Damp-proofing Treatment using Bitumen Felts – Code of Practice
- g) IS: 3067 - Code of practice for General design details and preparatory work for Damp-proofing and waterproofing of buildings
- h) IS: 3384 - Bitumen primer for use in waterproofing and damp proofing.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D4

REV.NO. 0 DATE: 13/02/2018

SHEET 15 OF 15

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be for complete work, including the cost of all materials and labor, as detailed in the specification unless any portion is specifically excluded in the "Schedule of Items".

No extra shall be paid for finishing around opening, sleeves, pipes, ducts, inserts, etc.

No separate payments shall be made for cleaning of surface, treating of cracks and surface preparation.

5.02.00 Measurement

The finished work shall be measured in Sqm of actual surface area for the purpose of payment.

No deduction shall be made and no extra shall be paid for openings upto 0.4 sqm.



TITLE:
**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION – D5
REV.NO. 00 DATE 13/02/2018
SHEET 1 OF 15

SECTION - D

SUB-SECTION – D5

METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:
**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001
VOLUME -
SECTION - D | SUB-SECTION – D5
REV.NO. 00 DATE 13/02/2018
SHEET 2 OF 15

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	8
4.00.00	INFORMATION TO BE SUBMITTED	9
5.00.00	I.S. CODES	10
6.00.00	RATES AND MEASUREMENTS	10
ATTACHMENT		
ANNEXURE – A	SCHEDULE OF FIXTURES	12



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 13/02/2018

SHEET 3 OF 15

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.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 13/02/2018

SHEET 4 OF 15

2.02.00 Fabrication**2.02.01 Steel Doors, Windows, Ventilators, louvers etc.****a) Door Frames**

Frames shall be fabricated from 16 gage(G) sheets. They shall, be mortised, reinforced, drilled, and tapped for hinge lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Welded construction with mitered Corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose "T" masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be installed. Frames shall be brought to site with floor ties/weather bars installed in, place.

b) Double Plate Flush Door Shutters

Door shutters shall be 45 mm thick, completely flush design and shall comprise of the outer sheets or 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm on centres.

Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally as shown on drawing by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and heads, shall have proper level on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting-stile edges bevelled or rebated. Where shown on drawing, or called for in the schedule of items, the doors shall be sound deadened by filling the inside voids with mineral wool or other suitable approved materials.

Doors shall be mortised, reinforced, drilled, and tapped in shop for hinges, locks, and bolts. They shall also be reinforced for closers, push-plates, and other surface hardware's where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown drawing, provision shall be made for fixing glazing, vision panels, louvers etc. glazing mouldings shall be of 18 G steel or extruded aluminium sections and suitable for fixing 6 mm. glass. Louvers blades shall be V or Z shaped and made out of 16 G sheets.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 13/02/2018

SHEET 5 OF 15

c) Single Sheet Door Shutters

Single sheet doors shall be made from best quality 18 G mild steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with semi tubular edge and central stiffening rail, which shall convey the lock and other fixture. The frames shall be made from best quality, 16 G mild steel sheets.

Wherever required, provisions for fixing glass panes, louvers etc. shall be made.

The manufacturing shall be done as specified in 2.02.01 (b) "Double Plate Flush Door Shutters."

d) Sliding Door

Sliding doors shall be either double plate or single plate Construction made out of 18-gauge steel sheets with adequate stiffeners. The contractor shall specify the weight of the door in his shop and submit the manufacturer's catalogue of the sliding gear he proposes to use. Where called for the Contractor shall make provision for openings to the door for monorail beams. Doors shall close positively to exclude rainwater from seeping in. When called for, sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions.

e) Door Threshold

Door threshold shall be provided. Doors without threshold shall have bottom tie of approved type.

f) Steel Windows, Sashes, and Ventilators etc.

These shall conform in all respects to IS: 1038 and IS: 1361 latest editions. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, and pivot arrangements for ventilators, etc. or as called for. All welds shall be dressed flush on all exposed and contact surfaces. Where composite unit openings are required the individual window units shall be joined together with requisite transoms and mullions. All windows shall be outside glazed, fixed with putty or metal glazing beads as specified. Where aluminium glazing beads are specified, they shall be extruded aluminium channel 9.5 mm x 9.5 mm x 1.6 mm (Jindal Section No. 2209) unless otherwise shown on drawings. Aluminium beads shall be given one coat of zinc chromate primer before fixing to windows.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 13/02/2018

SHEET 6 OF 15

2.02.02

Aluminium Door, Windows, and Frames

Extruded sections shall have a minimum 3 mm wall thickness. All sections shall be approved by the Engineer before fabrication is taken up. Doors frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating of minimum 15-micron thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent Coating shall be applied to the sections before shipment from the factory.

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce a uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.03.00

Shop Coat or Paint

The shop Paint for steel doors, windows etc. shall be best lead or zinc chromate primer paint from, approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. that will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.

Where called for, all steel doors, windows, etc. shall be hot dip galvanized to give a coating weight of 1½ - 2 oz. per sqft. One coat zinc chromate primer coat shall then be applied as shop paint.

Portions of aluminium frame, which come in contact with masonry construction shall be (before shipment from workshop) protected with a heavy coat of alkali resistant paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer.

2.04.00

Handling & Storage of Fabricated Material

All metal doors, windows, etc. shall be packed and crated properly before dispatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 13/02/2018

SHEET 7 OF 15

When taking delivery of items supplied by Owner, the Contractor shall satisfy himself that the items supplied are up to the specified standard. Any defect detected shall promptly be brought to the notice of the Engineer.

All metal doors, windows etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.

2.05.00

Assembly & Erection at Site

In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to IS: 1081. The Contractor shall assemble and install all steel doors, windows, sashes, fixed metal louvers, etc. including transoms and mullions for composite units in respective places, keening proper "Lines and levels", and in approved workmanlike manner, to give trouble free and leak-proof installations. Installation shall be done according to instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Contractor shall take all precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Contractor and made good again as per original, after installation, without any extra charge.

After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good the same quality of paint used in shop coat.

All coupling mullions, transoms, frames, etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The Contractor shall bring to the site the cement in original sealed containers of manufacturer and shall apply it as per the instruction. For all frames supplied by either the owner or the Contractor, mastic shall be supplied by the Contractor and caulking done properly as per drawings, specifications and as per instructions of the Engineer.

Door shutters, partitions hardware fixtures etc. shall be fixed only after major equipments have been installed in rooms.

Wherever required, nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one meters from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 13/02/2018

SHEET 8 OF 15

2.06.0 Fire proof Door

Fire proof doors shall be provided at all fire exit points as specified and also to restrict the spread of fire within buildings whether from internal fire or from external fire. The construction details of door shall conform to the requirements stipulated in IS:3614 (Part-1). Doors shall comply with the testing requirement mentioned in IS:3614 (Part-2). The doors shall be approved by Tariff Advisory Committee and shall have minimum 2 hrs. fire rating.

Metal covered (on both sides) Doors having insulating core filled up with mineral wool shall be used at all fire exit points and shall open outside.

All necessary accessories and hardware shall also be supplied along with doors. Fire proof door shall be provided with zinc silicate primer (minimum DFT 75 micron) after blast cleaning the surface to near white metal surface and shall be finished painted with epoxy based painting.

3.00.00 ACCEPTANCE CRITERIA

3.01.00 For fabricated Items

- a) Overall dimensions shall be within ± 1.5 mm of the size shown on drawings.
- b) Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ± 1.5 mm from the axis of the member.
- c) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm for double leaf doors; the gap at the meeting stiles shall not be more than 1.5 mm.
- d) Door leaves shall be undercut where shown on drawings.
- e) Doors, windows, frames, etc. shall be on a true plane, free from warp or buckle.
- f) All welds shall be dressed flush on exposed and contact surfaces.
- g) Correctness of location and smoothness of operations of all shop installed hardware and fixtures
- h) Provision for hardware and fixtures to be installed at site.
- i) Glazing beads shall be cut with mitered corners.
- j) Glazing clips, fixing devices etc. shall be supplied in adequate numbers.



TITLE:
**TECHNICAL SPECIFICATION
 FOR METAL DOORS, WINDOWS,
 VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001			
VOLUME -			
SECTION - D		SUB-SECTION – D5	
REV.NO.	00	DATE	13/02/2018
SHEET	9	OF	15

- 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.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 13/02/2018

SHEET 10 OF 15

- 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

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



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 13/02/2018

SHEET 11 OF 15

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

Rates shall be applicable of all elevation. Rates shall include preparation of working drawings (if required), supply of material, fixtures, gaskets, erection of unit, caulking and jamming of frames, including cutting/drilling/welding, grouting, grinding, making good of the structure for installing the unit etc. complete as per "Schedule of Items".

Rates shall also include cost of surface preparation, application of primer, enamel painting or anodizing as applicable.

Rate for fire proof door is inclusive of providing insulation core, primer, shop painting (epoxy based), all hardware as specified in Schedule of items.

6.02.00 Measurement

Supply and installation of doors, windows, and ventilators shall be measured in Sqm or Kg as per BOQ item. If measured in sqm, it shall be for net outer to outer (excluding frame) area of doors, windows, and ventilators of each type used as described in "Schedule of Items". Frame for steel or aluminum shall be measured in Kgs. Wooden frames shall be measured in Cum. Measurement for aluminum partition frames shall be in Kg. Paneling and glazing shall be paid separately if not covered in BOQ item description.

Measurement for fire proof door shall be in Sqm in net area outer to outer of the door.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 13/02/2018

SHEET 12 OF 15

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.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 13/02/2018

SHEET 13 OF 15

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



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 13/02/2018

SHEET 14 OF 15

ANNEXURE-A

iii) 2 point handles - 1 No. per leaf

b) Top Hung Ventilators (Projecting Out)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Adjustable sliding fabrication assemblies - 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.



TITLE:

**TECHNICAL SPECIFICATION
FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D5

REV.NO. 00 DATE 13/02/2018

SHEET 15 OF 15

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 assemblies - 2 Nos. per leaf
- iii) 2 Point handles - 1 No. per leaf

c) Bottom Hung Ventilation & (Projecting In)

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) Concealed side arms for opening adjustment - 2 Nos. per leaf
- iii) Spring Catch - 1 No. per leaf



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D

SUB-SECTION – D6

REV.NO. 00

DATE 13/02/2018

SHEET

1

OF

5

SECTION - D

SUB-SECTION – D6

GLASS AND GLAZING

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D

SUB-SECTION – D6

REV.NO. 00

DATE 13/02/2018

SHEET 2 OF 5

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	4
4.00.00	I.S. CODES	4
5.00.00	RATES	5



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D6

REV.NO. 00 DATE 13/02/2018

SHEET 3 OF 5

GLASS AND GLAZING

1.00.00 SCOPE

This section covers supplying and fixing of all glass and glazing including all clips, putty, mastic cement etc. wherever required as per specifications.

2.00.00 INSTALLATION

2.01.00 General

The Contractor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvers, miscellaneous glazing and partitions, from approved manufacturer like Hindustan Pilkinton or equivalent, having uniform refractive index and free from flaws, specks, and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site.

Materials:

- a) Glare reducing or heat absorbing glass shall be "Calorex" of Hindustan Pilkinton or approved equivalent and special care shall be taken to grind smooth and round off the edges before fixing.
- b) Clear glass shall be flat draw sheet glass and shall be at least 4 mm thick. Sheet glass for doors shall be minimum 5.5 mm thick.
- c) Wired glass shall be thick- rolled glass with centrally embedded 42g wire mesh of Georgian type. This may be of clear or coloured glass, as required.
- d) Obscure glasses shall have a cast surface in one side.
- e) Coloured and figured glass shall be as per approved sample.
- f) In general, the putty shall conform to IS: 400 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing.
- g) Neoprene gaskets with snap-fit glazing beads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leak proof installation.



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D6

REV.NO. 00 DATE 13/02/2018

SHEET 4 OF 5

2.03.00 Glazing, Setting, and Finish

All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the Contractor.

All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant I.S. Codes, four glazing chips shall be provided per glass pane, except for large panes 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 mouldings or gasket are specified, putty, mastic cement etc. shall be smoothly finished to the even line and figured glass shall be set with smooth side out.

Where owner will supply glass, the Contractor shall cut it to size and fix them in the same as specified above.

The Contractor shall supply necessary glazing clips, putty, mastic cement etc.

After completion of glazing, the Contractor shall remove all dirt stains, excess putty etc. clean glass panes and leave the work in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones at the contractor's own cost.

3.00.00 ACCEPTANCE CRITERIA

- a) All installation shall be free from cracked, broken, or damaged glass. Edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped, cracked, or underground edges.
- b) Glazing shall be carefully done to avoid direct contact with metal frames.
- c) All glass shall be embedded in mastic or fixed by neoprene gaskets to give a leak proof installation.
- d) At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer.



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D6

REV.NO. 00 DATE 13/02/2018

SHEET 5 OF 5

4.00.00 I.S. CODES

Following are some of the important I.S. Codes relevant to this Section:

IS: 3548 - Code of practice for glazing in building.

IS: 1081 - Code of practice' for fixing and glazing metal doors, windows ventilators.

5.00.00 RATES

Rates of glass and glazing if not included in respective items for supply and installation of window, ventilator, and partitions shall be paid separately as per BOQ items provided. No separate payment shall be made for glazing clips, mastic cement, putty, screws; rails, etc. nor for drilling holes in frames for inserting glazing clips.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROLLING STEEL SHUTTERS AND
GRILLS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D

SUB-SECTION - D7

REV.NO. 00

DATE 13/02/2018

SHEET 1 OF 5

SECTION - D

SUB-SECTION – D7

ROLLING STEEL SHUTTERS AND GRILLS

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
ROLLING STEEL SHUTTERS AND
GRILLS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D

SUB-SECTION - D7

REV.NO. 00

DATE 13/02/2018

SHEET 2 OF 5

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA & GUARANTEE	5
4.00.00	I.S. CODES	5
5.00.00	RATES AND MEASUREMENTS	5



TITLE:

**TECHNICAL SPECIFICATION FOR
ROLLING STEEL SHUTTERS AND
GRILLS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D7

REV.NO. 00 DATE 13/02/2018

SHEET 3 OF 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.

 Maharatna Company	TITLE:	SPECIFICATION NO. PE-TS-635-600-C001	
	TECHNICAL SPECIFICATION FOR ROLLING STEEL SHUTTERS AND GRILLS	VOLUME -	
		SECTION - D	SUB-SECTION – D7
		REV.NO. 00	DATE 13/02/2018
		SHEET 4	OF 5
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			

 Maharatna Company	TITLE:	SPECIFICATION NO. PE-TS-635-600-C001	
	TECHNICAL SPECIFICATION FOR ROLLING STEEL SHUTTERS AND GRILLS	VOLUME -	
		SECTION - D	SUB-SECTION – D7
		REV.NO. 00	DATE 13/02/2018
		SHEET 5	OF 5
	and all abrasion to shop coat shall be touched up. All electrical work shall be in strict accordance with the latest Indian Electricity Rules.		
3.00.00	ACCEPTANCE CRITERIA AND GUARANTEE		
3.01.00	Shop Inspection		
	After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings.		
3.02.00	Field Inspection		
	After installing the shutters, the Contractor shall test the performance of the shutter in the presence of the Engineer. The doors shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault free performance.		
3.03.00	Guarantee		
	The Contractor shall give one year's guarantee for the successful operation of the shutters. This shall be supported by a separate and unilateral guarantee from the manufacturer of the shutters.		
4.00.00	I.S. CODE		
	IS: 6248 - Metal rolling shutters and rolling grills.		
5.00.00	RATES AND MEASUREMENT		
5.01.00	Rates		
	Rates for rolling shutters and grill shall include the cost of the locks, guide channels, cost of drive as specified. In case of electrically operated rolling shutters, the rate shall also include the mounting of controls, wire and wiring from the nearest junction box, conduit and other electrical connections and cost of electric motor.		
5.02.00	Measurement		
	Supply and installation of rolling shutter and grill shall be measured in Sqm in net outer to outer (including frame) area of each type used as described in “Schedule of Items”.		



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION – D8

REV.NO. 00 DATE 13/02/2018

SHEET 1 OF 9

SECTION - D

SUB-SECTION – D8

MISCELLANEOUS METAL

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION – D8

REV.NO. 00 DATE 13/02/2018

SHEET 2 OF 9

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	7
4.00.00	IS CODES	8
5.00.00	RATES AND MEASUREMENTS	8



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D8

REV.NO. 00 DATE 13/02/2018

SHEET 3 OF 9

MISCELLANEOUS METAL

1.00.00 SCOPE

This section covers supply, fabrication and erection of miscellaneous metal items of light nature in gates, balcony and stair hand rails, structural works, ladders, hangers, masonry anchors, anchor bolts, fasteners, chain link fencing, barbed wire fencing etc. as specified or shown on drawing or as instructed by the Engineer. The above items shall be of fabricated or cast of mild steel, aluminium, brass, cast iron, M.S.& galvanized M.S. sheets, aluminium sheets, expanded metal, wire mesh as shown on drawings or specified.

2.00.00 INSTALLATION

2.01.00 Fabrication/casting

2.01.01 General

All work shall be done according to approved shop drawings. All workmanship shall be equal to the best practice in modern structural or foundry shop.

2.01.02 Shop Connections

- a) All shop connections shall be riveted or welded except when noted otherwise on drawings.
- b) Welding of steel shall be done in accordance with IS: 816.
- c) Welding of aluminium shall be done accordance with IS: 2812, "Arc welding of Aluminium and Alloys." Special care shall be taken to grind smooth all welded surface that shall remain exposed to view. Welds shall be electrically continuous if so required by the Engineer.

2.01.03 Shop Coat

Before leaving the shop, all metal work shall be thoroughly cleaned by effective means of all loose mill scale, rust and foreign matter. Except where encased in concrete, all steelwork shall be given one coat of approved metal protective paint, applied by brush thoroughly and evenly, well worked into joints and other open spaces. All paint shall be applied to dry surfaces. When specified steel work shall be galvanised or painted with a coat of zinc chromate primer. Aluminium surfaces, which shall come in contact with masonry, shall be given one coat of bituminous paint.



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D8

REV.NO. 00 DATE 13/02/2018

SHEET 4 OF 9

2.02.00 Erection

2.02.01 Bracing

The Contractor shall provide all necessary temporary guys and braces to ensure alignment and stability of the members and to take care of all loads to which the structure may be subjected, including erection of equipment and operation of the same.

2.02.02 Temporary Bolting-Up

As erection proceeds the Contractor shall plum up and level all members and shall securely bolt up to take care of all dead load, wind load and erection stresses. Wherever erection equipment or other loads are carried by members during erection, proper provision shall be made to take care of the stresses resulting from the same.

2.02.03 Turned Bolt

For field connections where bolting is specified, holes for the turned bolts may be reamed in the field, if required. All drilling or reaming for turned bolts shall be done after the parts to be connected are assembled.

2.02.04 Welding

Where specified on drawings, welding shall be done in accordance with IS: 816 for steel and IS: 2812 for Aluminium & Alloys.

2.02.05 Cutting and Fitting

No cutting of sections, flanges, webs of angles shall be done without the approval of the Engineer. Where indicated on the drawings holes, cuttings, etc. shall be provided as required for installation, to the work by the other Contractors. No additional holes or cuttings, then those shown on drawings, shall be made without the approval of the Engineer.

2.02.06 Drifting

Correction minor misfits and a reasonable amount of reading and cutting of excess stock from rivets may be permitted. For this, light drifting may be allowed to draw holes together. Twist drills shall be used to enlarge as necessary to make connections, reaming that weakness the members or make it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION – D8

REV.NO. 00 DATE 13/02/2018

SHEET 5 OF 9

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins or a moderate amount of reaming and slight chipping and cutting shall immediately be called to the attention of the Engineer-and approval of the method of correction obtained. The use of cutting torches to enlarge or alter rivet holes shall not be permitted.

2.02.07 Spot Painting

All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials and used for the shop paint or equivalent.

2.02.08 Good

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.

2.02.09 Grouting

All bearing plates, loose, lintels and beams, etc. shall be set to proper grade and level by the Contractor and the Engineer's approval obtained before proceeding with the grouting. Grouting shall be done in 1:1½:3 concrete with 6 mm down stone chips or as specified in schedule of items.

2.02.10 Anchor Fasteners

The anchor fasteners shall be of two type viz. light duty for carrying tensile load upto 0.5MT per fasteners and heavy duty for carrying tensile load of 0.5MT to 5.0MT per fasteners. These anchor fasteners shall be fixed into concrete. The Contractor shall submit the Manufacture's literature showing the average pull out and average shear value for anchor of various sizes. Anchors shall be fixed in position strictly as per the manufacturer's instructions and as approved by the Engineer.

Heavy Duty Anchor Fasteners

The safe tensile load carrying capacity of the anchors shall be arrived by providing the minimum factor of capacity of 2.5 for the characteristic load of the anchor. Minimum size of anchor shall be M8 (8mm). All anchors shall be from the approved manufacturers like HILTI or equivalent.

- a) Anchor fasteners shall be supplied and fixed in position by the contractor. Anchor fasteners can be of mechanical bonding or chemical bonding.
- b) Capacity of the anchor shall be established after considering the effect of concrete grade, embedment depth, concrete thickness, anchor spacing and edge distance from the concrete edge.



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D8

REV.NO. 00 DATE 13/02/2018

SHEET 6 OF 9

- c) The selection for the particular type of bonding for the anchors shall be made after considering the concrete grade, available embedment depth, load to be transferred, space available for installing anchors.
- d) The mechanical bonding anchor are torque controlled anchors made from carbon steel of grade 8.8 as per IS:1367 part 3. Anchors in bolt as well as nut version are acceptable. The bolt version anchors consist of bolt washer, sleeves, plastic section, expansion sleeves and a cone. Nuts version anchor consists of nuts, threaded rod, washer, sleeves, plastic section, expansion sleeves and a cone. All steel component of anchor shall be electro galvanised to minimum 5 micron coating thickness. The plastic section shall be of polyacetal Derlin 100 or equivalent.
- e) Chemical bonding anchor shall consist of foil capsule and threaded rod. The foil capsule shall contain the resin and hardener. The threaded rod shall have chiselled tip. The behaviour of anchors under fire shall conform the heating curves as per ISO:834. Anchors of size M8 to M24 shall conform to grade 5.8 and anchors of size M27 to M39 shall conform to grade 8.8 as per IS:1367 part 3. All steel components of the anchors shall be electro-galvanised to minimum 5-micron thickness.

Light Duty Anchors

This anchor shall comprise of stud, nut, washers, expansion sleeve. The one end of the stud shall have thread and the other end shall have cold formed conical head. All steel components of the anchors shall be electro-galvanised to minimum 5-micron thickness. The expansion sleeve shall preferably be of stainless steel of SS316. The anchors shall conform to minimum grade 5.8 as per IS:1367 part 3.

2.02.11 Pipe Joints

MS pipes or GI pipes shall be joined by threaded sockets or by welding. Cast iron pipes shall be socket and spigot joined and caulked with hemp and molten head.

2.03.0 FENCING

2.03.01 Chain Link Fencing

The material requirement shall conform to IS: 2721 latest edition. The chain link fencing shall be woven from 3.15mm dia. wire with mesh size of 50mm. The mesh wire shall not vary from specified dia. by more than ± 0.05 mm. all steel wire shall be hot dipped galvanised wire. The Dia. shall be measured over the galvanised coating. The line wire shall be 4.0mm dia. mild steel. The stirrup wires for securing the line wire to the intermediate post (RCC/structural steel) shall be 2.5 mm diameter mild steel. The tying wire for securing the chain link fencing to the line wire shall be 1.6mm diameter mild



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D8

REV.NO. 00 DATE 13/02/2018

SHEET 7 OF 9

steel. Hair pin chain staples for fastening down the bottom of galvanised chain line fencing to the concrete sill shall be 3.15mm wire. The ends shall be bent outwards for securing anchorage.

Cleat for eye bolts shall be of uniform size and shall consist of mild steel angle of 75 x 50 x 8 mm. The eye bolts strainer shall consist of bolt with welded eye sufficiently threaded and fitted with a nut and washer. Two-way eye bolt strainer shall have suitable ring nuts fitted after the wires have been strained on one side. Stretcher bar shall consist of mild steel flats 25 x 4.75 mm. They shall be secured to the cleats by steel bolts.

The chain link fencing shall be strained between each pair of straining posts and secured to each straining posts by means of a stretcher bar. One of top line wire shall be threaded through appropriate adjacent row of mesh, care being taken that no meshes in the row are bypassed by the line wire except where deviation is necessary at the straining posts. The second top line wire shall be strained in front of the fencing. The fencing shall be attached to the top and bottom line wire by wire ties spaced at 150mm apart and to the other middle line wire by wire ties spaced at 450mm apart.

The bottom of fencing shall be treated as follows:

Continuous concrete sill 125mm wide x 225mm high for full length between posts shall be cast with the top 25mm above GL and 25mm below the chain link fencing. Hair pin staples shall be threaded through the bottom row of mesh at 750mm c/c and set in the sill to a depth of 150mm.

2.03.02 Barbed Wire Fencing

The barbed wire shall be conforming to IS:278 latest editions. The barbed wire shall be galvanised and galvanising shall conform to the requirement laid down for 'light-coated wire' of IS:4826 and it shall be smooth and relatively free of lumps etc. Wire with excessive roughness blisters, salammoniac spots shall be rejected. The barbed wire shall be made from two-line wire and two-point wire of 2.5 mm thickness each. The barbs shall have four point and shall be formed by twisting two point wires, each two turns, tightly around both or one-line wire (Type A - around both line wire, Type B - around one-line wire) making altogether four complete turns. The barbs shall be so finished that four points are set and located or locked as far as possible at right angle to each other. The barbs shall have a length of not less than 13mm and not more than 18mm. The distance between two barbs shall be 75±12mm.

Straining posts shall be provided at all ends and corners of fences or at changes in direction or acute variation in level and at intervals not exceeding 66 M on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3.0m. Struts shall be fitted to all straining posts behind the chain link fabric in the direction of line of fence. There shall be four



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D8

REV.NO. 00 DATE 13/02/2018

SHEET 8 OF 9

evenly spaced row of line wire in all. The top line wire shall be doubled, making five-line wire in all. The bottom wire shall be closed to the ground. Each line wire shall be strained tightly by means of eyebolts strainers or winders at each straining points. Each line wire shall be secured to each intermediate post by a wire stirrup passed through a hold in the post and secured to the line wire by three complete turns on each sides of the post. The barbed wire shall be fitted with one dropper at the centre of each bay, secured to the wire so that they could not be bunched together. Droppers for barbed wire shall be of mild steel of not less than 25 x 4.75 mm thick with 38 x 4.85 mm half round staples for fastening the barbed wire to them. Bracing for the rows of barbed wire shall be approved by the Engineer.

3.00.00 ACCEPTANCE CRITERIA

- a) All items shall be correct shape, size, weight etc. shown on drawings and schedule of items.
- b) For installed items, the tolerances shall be as follows
 - i) Permissible deviation from, straightness – 1 in 1000.
 - ii) Seats, stiffener connections etc. shall be as per approved drawings and shall not interfere with architectural clearances.
- c) All castings shall be free from blowholes, cracks, and other blemishes.
- d) All MS wire fencing shall be in true vertical plain, and shall not bulge.

4.00.00 IS CODES

- IS:278 Specification for Galvanized Steel Barbed wire for fencing.
- IS:816 Code of practice for use of Metal Arc welding for general construction in mild steel.
- IS:1367 Industrial Fasteners – Threaded steel fasteners - Technical supply condition.
- IS:2721 Specification for Galvanized Steel Chain Link fence fabric.
- IS:2812 Arc welding of Aluminum and Alloy



TITLE:
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL SIDING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D8

REV.NO. 00 DATE 13/02/2018

SHEET 9 OF 9

5.00.00 RATES AND MEASUREMENTS

5.01.0 Rates

Rates shall include supply, fabrication and installation for misc. metals works as required for completion of works like gates, fencing, handrails, ladders, hangers, anchors etc., unless otherwise specified in Schedule of Items.

Rate for fencing shall also include excavation, concreting and supply, erection & fabrication of post (post made of either structural steel or reinforced cement concrete), unless any specific item is excluded.

5.02.0 Measurements

Measurement for MS gates shall be in MT.

Measurement for galvanised MS wire fencing shall be in Sqm.

Measurement for Anchors shall be in nos. for the type as specified in schedule of items.

Measurement of other misc. metals shall be done in MT unless otherwise specified in schedule of items.



**TECHNICAL SPECIFICATION FOR
MASONRY AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME - `

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 13/02/2018

SHEET 1 OF 12

SECTION - D

SUB-SECTION – D9

MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME - `

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 13/02/2018

SHEET 2 OF 12

C O N T E N T

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	SCOPE	3
2.00.00	MATERIALS	3
3.00.00	INSTALLATION	6
4.00.00	I.S. CODES	10
5.00.00	RATES AND MEASUREMENTS	11



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME - `

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 13/02/2018

SHEET 3 OF 12

MASONRY AND ALLIED WORKS

1.00.00 SCOPE

This section covers furnishing, installation including handling, transporting, batching, mixing, laying scaffolding, centering, shuttering, finishing, curing, protection, maintenance and repair of common building materials till handing over of masonry and allied works for use in structures and locations covered under the scope of this package.

2.00.00 MATERIALS

a) Brick

Bricks for general masonry work shall be of class designation 7.5 of nominal dimensions as per standard specification under IS: 1077, well burnt, of uniform size, shape and colour, free from cracks, flaws or modules of free lime and emit clear ringing sound when struck. Fractured surface shall show uniform texture free from grits, lumps holes etc. Water absorption after 24 hours' immersion shall not exceed 20% by weight for bricks. Dimensional tolerance shall not exceed 8% of the size shown in drawings for bricks. All bricks shall have rectangular faces and sharp straight edges. The bricks shall show no efflorescence after soaking in water and drying in shade.

Each brick shall have the manufacturer's identification marks clearly marked on the frog. Representative samples shall be submitted and approved samples shall be retained by the Engineer for further comparisons and reference. Any brick not found up to the specification shall be removed immediately from site at the Contractor's own cost.

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

b) Stone

All stones shall be obtained from approved quarries, hard, tough, durable compact grained, uniform in texture and colour and free from decay, flaws, veins, cracks and sand holes. The surface of a freshly broken stone shall be bright, clean, and sharp and shall show uniformity of texture, without loose grains and free from any dull, chalky, or earthly appearance. Stone showing mottled colours shall not be used for face work. A stone shall not absorb more than 5 per cent of its weight of water after 24 hours'



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME - `

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 13/02/2018

SHEET 4 OF 12

immersion. The type of stone shall be as specified on drawings and/or instructed by the Engineer. Samples shall be submitted by the Contractor and approved samples shall be retained by the Engineer for comparison of bulk supply.

c) Cement

Cement used shall be Ordinarily Portland Cement or Portland Slag Cement or Portland Pozzolana Cement conforming to IS Codes and shall be fresh when delivered. In special cases, Rapid Hardening Portland Cement, Low Heat Cement etc. may be permitted or directed to be used by the Engineer. The Contractor shall submit the manufacturer's certificate for each consignment of cement procured to the Engineer. If at any time, the Engineer feels that the cement being used by the Contractor is not up to specification, he may stop the work and send the samples of the cement to a testing laboratory for standard tests and all expenses incurred thus shall be borne by the Contractor. The Contractor shall also have no claim for this type of suspension of work.

The cement shall be stored above the ground level in perfectly dry and watertight sheds. The bags shall be stacked in a manner so as to facilitate removal or first in first out basis. Any material considered defective by the Engineer shall not be used by the Contractor and shall be removed from the site immediately.

d) Coarse Aggregate

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

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

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

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



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME - `

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 13/02/2018

SHEET 5 OF 12

Aggregates shall be stored on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass, or any other injurious substances at any stage.

Aggregate of different size shall be kept in separate stacks. If so desired by the Engineer aggregate from different sources shall be stacked separately with proper care to prevent intermixing.

e) Sand

Sand shall be hard, durable, clean, and free from adherent coatings or organic matter and shall not contain clay balls or pellets. The sand shall be free from impurities such as iron pyrites, alkalis, salts, coal, mica, shale or other laminated materials in such forms or quantities as to affect adversely the hardening, strength, durability or appearance of mortar, plaster or concrete or to cause corrosion to any metal in contact with such mortar, plaster or concrete. All sand shall be properly graded and shall be as per relevant IS Code. Sand for concrete shall conform to IS: 383.

f) Water

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

g) Reinforcement

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust, oil and grease or other coatings, which may impair proper bond. Structural steel shall conform to IS: 2062. Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement shall conform to IS: 432. Cold twisted steel bars shall conform to IS: 1786. Hand drawn steel wire fabric shall conform to IS: 1566. Hexagonal wire netting shall conform to IS: 3150. All steel bars including and above 10 mm diameter shall be of tested quality. All wire netting shall be galvanized.

Reinforcement bars shall be stored off the ground and under cover if so desired by the Engineer. If necessary, a coat of cement wash shall be given to the bars to guard against rusting.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME - `

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 13/02/2018

SHEET 6 OF 12

3.00.00 INSTALLATION

3:01.00 Soling

3.01.01 Brick Soling

The ground shall be dressed, consolidated by ramming, or by light rolling and a 12 mm thick cushion of sand laid. On the sand cushion the bricks shall be laid with fine joints and placed firmly in position by hammering with wooden mallet. The surface shall be free from undulations. The 'frog' side shall be on the underside. The joints shall be broken the in all direction and bricks cut as required. The pattern of laying and number of layers shall be as per Schedule of item. Orientation shall be as desired by the Engineer. After laying of each layer of bricks sand shall be spread over and worked into the joints to pack the bricks tight.

3.01.02 Stone Soling

The stones for soling shall be selected on the basis of thickness of soling specified in the Schedule of Items. The larger stones shall be laid and the gaps filled by smaller stones. The interstices shall then be firmly packed with sand by flooding with water.

3.02.00 Brick-on-Edge

Excavation shall be done close to the brick dimensions and in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be acceptable to the Engineer.

3.03.00 Masonry

3.03.01 General

All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings.

3.03.02 Cement Mortar

Cement mortar shall be prepared with materials specified in clause 2.00.00. Sand for masonry mortar shall conform to IS: 2116. Cement and sand in the specified proportion shall be mixed dry thoroughly and minimum water added to attain required workability.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME - `

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 13/02/2018

SHEET 7 OF 12

Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with fresh mortar if permitted by the Engineer who may direct addition of additional cement without any extra payment. No mortar, which has stood for more than half an hour, shall be used.

3.03.03 Brick Masonry

Bricks shall be soaked by submergence in clean water for at least two hours in approved vats before use. Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing.

Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickworks two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

3.03.04 Exposed Brickwork

Brickwork in superstructures, which is not covered by plaster, shall be as shown on drawing and executed by especially skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule, and string. All brickwork shall be cleaned at the end of days' work. If face bricks are specified, the brickwork shall be in composite bricks, with face bricks on the exposed face and balance in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean, and pointed as specified. Where face bricks are used carborundum stone shall be used for rubbing down.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME - `

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 13/02/2018

SHEET 8 OF 12

3.03.05 Reinforced Brickworks

Reinforcements shall be as specified. All reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S. bars are used as reinforcement, these shall be lapped with dowels if left in R.C. columns or welded to steel stanchions.

3.03.06 Stone Masonry

Stones shall be thoroughly soaked before laying. Stones shall be laid on their natural quarry beds. Individual stones shall be fitted with mallet and properly wedged to reduce thickness of mortar joints. Thickness of joint shall be not less than 8 mm and not greater than 25 mm. At least two stones shall run the full width of the wall for every square meter of surface area.

3.03.07 Exposed Stone work

Stonework, which is to be kept exposed, shall be as shown on approved drawing. It shall be executed by especially skilled mason. Stones used for exposed face shall be specially selected. All exposed stone faces shall be kept clean and free from mortar and pointed up neatly as the work proceeds in a manner called for in the drawings or instructions. A sample wall, 10 Sq.M. area shall be built and approved by the Engineer and all works shall match with this sample.

3.03.08 Composite Masonry

Where stonework facing with brick masonry backing is specified the bond between them shall be achieved by bond stones of dimensions and frequency as desired by the Engineer.

3.03.09 Expansion & Separation Joints

Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings and specified. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard waterproof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME - `

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 13/02/2018

SHEET 9 OF 12

3.03.10 Mouldings, Cornices, Drip Course

These shall be made as shown in drawings. Bricks or stone shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with Carborundum stone.

3.03.11 Curing

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days' work top surface of masonry shall be kept wet by ponding.

3.03.12 Embedding of fixtures

All fixtures shall generally be embedded in mortar and masonry units shall be cut as required.

3.03.13 Encasing of Structural Steel

This shall be done by building masonry work round flanges, webs etc., and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh when shown on drawings or instructed by the Engineer. The minimum lap in chicken wire mesh shall be 50 mm.

3.04.00 Damp Proof Course (DPC)

Unless otherwise specified Damp-proof course shall be 40 mm thick 'artificial stone' in proportion 1:1½:3 cement sand stone-chips (10 mm down) with admixture of a waterproofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double Chequered and cured by ponding for seven days.

3.05.00 Damp Proof Membrane

Damp proof treatment using fibre or hessian base bitumen felt shall be 6, 8 or 10 course treatment as specified in IS: 1609. The number of courses shall be as shown as drawings or as specified. Sequence of work shall be as directed by the Engineer. Extreme care shall be taken to prevent damage to felt during and after laying. The Contractor shall be obliged, at his own expense, to rectify any leakage appearing within 5 years of installation by removing and renewing the coats at the point of leakage.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME - `

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 13/02/2018

SHEET 10 OF 12

Where shown on drawing, damp proof membrane with one-layer bitumen paper or one layer alkathene sheet shall be laid with minimum 150 mm lap under slabs on grade.

3.06.00

Plinth Protection

Plinth of buildings shall be protected with brick-on-edge paving of minimum 750mm width unless otherwise shown on the drawings. The treatment shall consist of laying bricks in cement mortar 1:6 (1 cement: 6 sand) over a 75mm thick bed of dry graded brick aggregate, 40mm nominal size, grouted with sand. The top shall be finished with 1:2 cement mortar pointing (1 cement: 2 sand). Plinth protection shall be laid with a minimum outward slope of 1 in 50. The brick aggregate shall be well graded, broken from well burnt or slightly over burnt and dense brickbats. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt or any other foreign matter.

The ground shall first be prepared to the required slope around the building. The high portions of the ground should be cut down; hollows and depressions filled up to the required level from the excavated earth and rammed so as to give uniform outward slope. The bed shall be watered and rammed with heavy iron square rammers. Surplus earth, if any, shall be disposed off beyond a lead of 50m or as directed by the Engineer.

Over this, 75mm thick bed of aggregate of 40mm nominal size, shall be laid with a minimum outward slope of 1 in 50. Aggregates shall be carefully laid and packed, bigger sized being placed at the bottom. The brick aggregates shall be consolidated dry with heavy iron rammers.

The aggregates shall then be grouted evenly with sand at the rate of 0.6 cubic metre per square metre area, adequately watered to ensure filling of voids by sand and again rammed with heavy iron rammers. The finished surface shall give uniform appearance. After the subgrade has been compacted thoroughly, brick flooring with bricks of specified strength in cement mortar 1:6 (1 cement: 6 sand) shall be laid.

The bricks shall be laid on edge in Diagonal/Herring Bone Bond or other pattern as specified or as directed by the Engineer. Bricks shall be laid on 12mm thick mortar bed and each brick shall be properly bedded and set home by gentle tapping with handle of trowel or wooden mallet. Its inside face shall be buttered with mortar before the next brick is laid and pressed against it. On completion of the portion of flooring, the vertical joints shall be fully filled from the top with mortar. The surface shall present a true plain surface with the required slope.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME - `

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 13/02/2018

SHEET 11 OF 12

The pointing shall be done in cement mortar 1:2 (1 cement: 2 sand). The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the bricks so as give a smooth appearance. The edges shall be neatly trimmed with a trowel and a straight edge. The mortar shall not spread over surface of the masonry.

Brick flooring & pointing shall be kept wet for a minimum period of seven days. These shall be protected from rain by suitable covering when the mortar is green.

4.00.00

I.S. CODES

Some of the important relevant codes for this section are:

IS: 1127: Recommendations for dimensions and workmanship of natural building stones for masonry work.

IS: 1597: Code of Practice for Construction of stone Masonry.

IS: 1609: Code of Practice for laying Damp proof treatment using bitumen felts.

IS: 2212: Code of Practice for Brickwork.

IS: 2250: Code of Practice for preparation and use of masonry Mortar.

IS: 5134: Bitumen Impregnated Paper & Board.

5.00.00

RATES AND MEASUREMENTS

5.01.00

Rates

Unit rate for masonry work shall include the following:

- Raking out joints for plastering or pointing or finishing the joint flush as the work proceeds.
- Preparing top sand sides of existing wall for joining old with new work.
- Providing, dismantling and removing the scaffolding.

Unit rate for DPC shall be inclusive of formwork and bitumen painting.



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME - `

SECTION - D SUB SECTION - D9

REV.NO. 0 DATE: 13/02/2018

SHEET 12 OF 12

5.02.00

Measurement

Brickwork in wall of half brick thickness shall be measured separately in Sqm stating the wall thickness and more than half brick thickness shall be measured by volume. Plaster thickness shall not be considered for computation of volume.

Masonry work in sub structure and super structure shall be measured separately, unless otherwise specified in the Schedule of items.

No deductions shall be made and no extra payment shall be made for following:

- a) Opening upto 0.1 Sqm each in area. In calculating the area of the opening lintels or sills shall be included along with the size of the opening.
- b) Drainage holes and recesses for cement blocks to embed holdfasts for doors, windows etc.
- c) Pipe and fixtures upto 300mm dia. and nothing extra shall be paid for the mortar used for fixing.
- d) Ends of dissimilar materials (i.e. joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc.); up to 0.1 sqm in section;
- e) Chases of section not exceeding 50 cm in girth;
- f) Iron fixtures, such as wall ties and hold fasts for doors and windows;
- g) Cement concrete blocks as for hold fasts and holding down bolts;
- h) Wall plates, bed plaros, and bearing of slabs, CHAJJAS and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall;

Reinforcement in masonry work shall be paid separately under respective items.

Damp proof course shall be measured in Sqm. No deduction shall be made and no extra shall be paid for opening upto 0.1 Sqm in area.

Plinth protection shall be measured under respective item of works executed required for completion of the work as specified.



**TECHNICAL SPECIFICATION FOR
FINISH TO MASONRY AND CONCRETE**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 13/02/2018

SHEET 1 OF 9

SECTION - D

SUB-SECTION – D10

FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 13/02/2018

SHEET 2 OF 9

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	8
4.00.00	I.S. CODE	8
5.00.0	RATES AND MEASUREMENTS	9



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 13/02/2018

SHEET 3 OF 9

FINISH TO MASONRY AND CONCRETE

1.00.00 SCOPE

This Section covers finishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment.

Before commencing finishing items, the Contractor shall obtain the approval of the Engineer regarding the scheduling of work to minimize damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.00.01 INSTALLATION

2.01.00 Preparation of Surface

All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be rushed down with stiff wire brush to remove all loose dust from joints and thoroughly, washed with water. All laitance shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as to the acceptability of the base.



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 13/02/2018

SHEET 4 OF 9

2.02.00 PLASTERING

2.02.01 Mortar

Mortar for plastering shall be as specified.

For sand cement plaster, sand and cement in the specified proportion shall be

mixed dry, on a watertight platform and minimum water added to achieve working consistency. The sand for plaster shall conform to IS: 1542.

No plaster, which has stood for more than half an hour, shall be used; plaster that shows tendency to become dry before this time shall have water added to it.

2.02.02 Application of Plaster

Plaster, when more than 12 mm thick, shall be applied in two coats a base coat followed by the finishing coat. Thickness of the base coat shall be sufficient to fill up all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The lower coat shall be thicker than the upper coat; the overall thickness of the coats shall not be less than the minimum thickness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'.

To ensure even thickness and true surface, patches of plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster, shall be fixed vertically about 2000 mm to 3000 mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the Contractor shall, without any extra cost to the Owner, make up any irregularity in the brickwork with plaster.

All vertical edges of brick pillars, doorjambs etc. shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 13/02/2018

SHEET 5 OF 9

2.02.03

Finish

Generally, the standard finish shall be used unless otherwise Shown on drawing or directed by the engineer. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the engineer regarding the texture, color and finish.

a) Standard Finish

Wherever punning is indicated, the interior plaster shall be finished rough; otherwise the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.

b) Neat Cement Finish

Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1) kg. per Sq.M. and rubbed smooth with a trowel.

c) Coloured Plaster Finish

This shall be done in the same way as specified in Clause 2.02.02 but using Coloured cement in place of ordinary cement. When coloured plastering is specified in more than one coat, the topcoat only shall be made with coloured cement.

Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement at site, as approved by the Engineer. The pigments to be mixed with cement shall conform to Appendix-A of IS: 2114 latest editions.

Samples of colouring material shall be submitted to the engineer for approval and material procured, shall conform in all respects to the approved samples, which shall remain with the Engineer. All coloured cement and/or pigments shall be stored in an approved manner in order to prevent deteriorations.

d) Pebble-dash Finish

Mortar of required thickness consisting of 1-part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering Clause 2.02.02. While the mortar is still plastic small pebbles or crushed stone of size generally from 10mm to 20mm as approved by the



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 13/02/2018

SHEET 6 OF 9

Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float or the flat end of oil a trowel, in order to ensure satisfactory bond between the dashing and the mortar.

e) Rough-cast Finish

A wet plastic mix of 3 parts coloured cement 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 as approved by the Engineer) shall be thrown on to the wall by means of a plaster's trowel and left in the rough condition.

f) Scraped Finish

Ordinary plaster as described under Clause 2.02.02 after being leveled and allowed to stiffen for a few hours, shall be scraped with a steel straight edge to remove the surface skin. The pattern shall be as approved by the Engineer.

g) Textured Finish

Mortar consisting of 1-part cement and 3 parts sand by volume shall be applied in a manner as specified under "Plastering" Clause 2.2.2 Ornamental treatments in the form of horizontal or vertical rib texture fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.

h) Sand Faced Plaster

The plaster shall be applied in 2 coats. The first coat or the scratch coat should be approximately 14mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows, etc. The scratch coat shall be dashed on the prepared surface with heavy pressure, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the finishing coat. The mortar proportion for this scratch coat shall be as specified in the respective item or work. The scratch coat shall be cured for at least 7 days & then allowed to dry. The second coat shall be 6mm thick and it shall not be applied until at least 10 days have elapsed after the application of scratch coat. Before application of the second coat, the scratch coat shall be evenly damped. This coat shall be applied from top to bottom in one operation & without joints; finish shall be straight, true, & even. The mortar of this coat shall be as specified under the respective item of work. White sand for finish shall be used for the second coat & for finishing work. Sand for finish shall be of even coarse size & shall be dashed on the surface & sponged.



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 13/02/2018

SHEET 7 OF 9

2.02.04 Curing

All plastered surfaces after laying shall be watered, for a minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried thoroughly, before applying the next coat.

2.03.00 Pointing to masonry

All Joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1-part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finishes with suitably tools to shape as shown on the drawings. Any surplus mortar shall be scalped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.04.00 Plaster with Metal Lath

The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection.

The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two-layers. The mortar for plastering shall consist of 1-part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.02.01. The application, finish etc. shall be as specified under relevant clause above. Where called for a 2 mm Plaster of Paris punting shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.

2.05.00 Lime Punning

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 13/02/2018

SHEET 8 OF 9

lime punning. The punning shall be applied by skilled workman and given a smooth and even finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

2.06.00 Plaster of Paris Punning

Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq.M. areas and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

2.07.00 Stone Facing

Stone facing where specified shall be done as shown on design drawings and approved shop drawings. The stone shall be as specified on drawings. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of shop drawings for the Engineer's approval before commencing the work.

The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable non-corrodible anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanized (weight of zinc coating shall not be less than 700 gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1-part cement and 3 parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer.

The completed surface shall be neat, or uniform texture and acceptable to the Engineer.

Where pointing is specified on drawings it shall be done by mortar as specified on drawings.



TECHNICAL SPECIFICATION FOR FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB SECTION - D10

REV.NO. 0 DATE: 13/02/2018

SHEET 9 OF 9

3.00.00 ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply with the Specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawings.

4.00.00 I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 1661: Code practice for cement and cement-lime plaster finish on wall & ceilings.

IS: 4101: code of practice for external facings and veneers.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall also include providing, dismantling and removing of scaffolding, surface preparation, curing and all type of surface, shapes/ profiles and at all elevations.

5.02.00 Measurement

All plastering shall be measured net (on surface area on which it is applied) in Sqm. Plaster work shall be classified according to the type used and shall be measured separately. Plaster on ceiling and walls shall be measured separately. Soffits of stairs shall be measured as plastering on ceiling.

No deduction shall be made for opening not exceeding 0.5 Sqm and for ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sills of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION – D11

REV.NO. 00 DATE 13/02/2018

SHEET 1 OF 13

SECTION - D

SUB-SECTION – D11

PAINTING, WHITEWASHING, POLISHING

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION – D11

REV.NO. 00 DATE 13/02/2018

SHEET 2 OF 13

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA AND TESTING	10
4.00.00	I.S. CODES AND STANDARDS	11
5.00.00	RATES AND MEASUREMENTS	12



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 13/02/2018

SHEET 3 OF 13

PAINTING, WHITE WASHING, POLISHING, ETC.

1.00.00 SCOPE

This section covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster of Paris, false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items.

Copper, bronze, chromium plate, Nickel, stainless steel and aluminium shall generally not be painted or finished except if otherwise specified.

Before commencing painting, the Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage; disfiguration or staining to work of other trades or other installations.

2.00.00 INSTALLATION

2.00.01 Materials

Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint of one shade is obtained from the same manufacturing batch. Each and every supply of primer, finish paint etc. shall be accompanied by manufacturer's test certificate. All paint shall be subject to analysis from random samples taken at site from painter's bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finished coats to be applied.

All unspecified materials such as shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 13/02/2018

SHEET 4 OF 13

a) White Wash/Colour Wash

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the engineer, and shall conform to IS: 712 latest editions. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 litres of white wash water and a little of indigo or synthetic ultramarine blue shall be added to the lime. Mineral colour not affected by lime shall be added to white wash to get the required tint/shade approved by the Engineer.

b) Dry distemper

Shall be made from suitable pigments, extenders, lime proof tinters, water-soluble binders etc. and shall conform to IS: 427. 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.

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.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 13/02/2018

SHEET 5 OF 13

f) Synthetic Enamel Paint

Shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to give a smooth, hard, durable and glossy finish to all exterior and resist interior surfaces. White and pastel shades shall not be yellowing and darkening with aging. The paint shall conform to IS: 2932 and IS: 2933.

g) Aluminium Paint

Shall be in two pack containers and shall resist weathering. The paint shall conform to IS: 2339.

h) Varnishing

Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age.

i) French Polish

Shall be made from best quality shellac, denatured spirit and other suitable alcohol soluble ingredients and made by a well-known approved manufacturer. The material shall conform to IS: 348.

French polish shall not be used on bare wood it shall only be used as finishing coat on wood after the woods pre-treated with a liquid wood filler conforming to IS: 345 is applied and rubbed out.

j) Bitumen paint (black bituminous anti-corrosive paint)

Bitumen based anti-corrosive paint conforming to IS: 158 shall be used.

2.00.02

Storage

The Contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement, & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent fire.

2.01.00

Preparation of surface

Before starting the work, the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 13/02/2018

SHEET 6 OF 13

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 scrapers, sand paper, emery cloth, emery papers, or by mechanical power tools etc. or as directed by Engineer. For exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanized iron surfaces shall be pre-treated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat. The actual painting work should be commenced only after obtaining clearance from the Engineer regarding proper cleaning of the surface.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 13/02/2018

SHEET 7 OF 13

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.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 13/02/2018

SHEET 8 OF 13

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.



TITLE:
TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 13/02/2018

SHEET 9 OF 13

2.02.06 Acrylic Emulsion Paint

Paint shall be applied after providing one coat of cement primer solvent of approved quality and primer shall be conforming to IS: 109. Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be done strictly as per manufacturer's specification.

2.02.07 Synthetic Enamel Paint

Shall be applied on properly primed surface. Sub sequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats.

2.02.08 Aluminium Paint

The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction. When more than one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry.

2.02.09 Clear Synthetic Varnish

The Varnish shall be applied on wood surface after (a) filling, (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted.

For the finishing coats of varnish, the surface shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surface as well as from the neighbourhood. Damp atmosphere and draughts shall be avoided, and exposure to extreme heat or cold & dampness shall not be allowed.

The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on white the next section is being laid on excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has begun to set shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh.

The varnish shall be minimum of two coats, with the first coat being a flattening 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



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 13/02/2018

SHEET 10 OF 13

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.



TITLE:
**TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION – D11

REV.NO. 00 DATE 13/02/2018

SHEET 11 OF 13

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.



TITLE:
TECHNICAL SPECIFICATION FOR
PAINTING, WHITEWASHING,
POLISHING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 13/02/2018

SHEET 12 OF 13

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 be 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 Code of Practice for painting of ferrous metal in buildings.
(I & II)



TITLE:
**TECHNICAL SPECIFICATION FOR
 PAINTING, WHITEWASHING,
 POLISHING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D SUB-SECTION - D11

REV.NO. 00 DATE 13/02/2018

SHEET 13 OF 13

IS: 2338 Code of Practice for finishing of wood and
(I & II) wood based materials.

IS: 2339 Specification for Aluminium, Paints for general purposes in
dual containers.

IS: 2395 Code of Practice for painting concrete, masonry, and Plaster
surface.

IS: 2932 Specification for enamel, exterior type-1.

IS: 5410 Specification for cement paint, colour as required.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be unit rates for complete items described in the “Schedule of
Items”.

Rate shall include cleaning, preparation of surface, supply and application of
primer, painting and providing all protection and scaffolding required at site.

5.02.00 Measurements

Painting over the concrete/masonry/wooden surface shall be measured net (on
the surface area on which it is applied) in Sqm.

No deduction shall be made for opening not exceeding 0.5 Sqm and ends of
beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sill
of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not
exceeding 3.0 Sqm each and no addition shall be made for reveals, jams,
soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for
opening but jams, soffits, and reveals shall be measured and paid for.

Corrugated surfaces shall be measured flat and measured area shall be
increased by 15%.

Painting of structural steel works shall be measured in M.T. of fabricated steel
(as per section D-17 clause 6.02.00 i.e. Mode of measurement of technical
specification for fabrication of structural steel works) unless specified
otherwise.



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 13/02/2018

SHEET 1 OF 22

SECTION - D

SUB-SECTION – D12

FLOOR FINISH AND ALLIED WORKS

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 13/02/2018

SHEET 2 OF 22

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	4
3.00.00	ACCEPTANCE CRITERIA	20
4.00.00	I.S. CODES	21
5.00.00	RATES AND MEASUREMENTS	21



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 13/02/2018

SHEET 3 OF 22

FLOOR FINISH AND ALLIED WORKS

1.00.0 SCOPE

This section covers furnishing, installation, finishing, curing, testing, protection, maintenance till handing over various types of floor finishes, and allied items of work as listed below

a) In Situ Finishes

- i) Integral finish to concrete base
- ii) Terrazzo finish
- iii) Granolithic finishes
- iv) Patent Stone
- v) Metallic Hardener like “Ironte”/Hardonate Finish
- vi) Mastic Asphalt finishes
- vii) Chemical Resistant finish

b) Tiled Finishes

- i) Terrazzo tile
- ii) Chequered tile
- iii) Glazed tile
- iv) Tesse rae (Mosaic etc.)
- v) Chemical Resistant
- vi) Rubber, Vinyl etc.
- vii) Stone Slab including Kota Stone.

For all types of flooring, skirting, dado and similar locations, the base to receive the finish shall be adequately roughened by chipping, raking out joints and cleaning thoroughly all dirt, grease etc. with water and hard brush and



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 5 OF 22

detergent if required, unless otherwise directed by the manufacturer of any special finishing materials or specifically indicated in this specification.

To prevent of water from the finishing treatment the base shall be thoroughly soaked with water and all excess water mopped up.

The surface shall be bone dry where adhesives are used for fixing the finishes.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as per the acceptability of the surface.

2.01.00 In Situ Finishes

2.01.01 Integral Finish to Concrete Base

While the surface of the concrete laid as per specification for 'Cement Concrete' has been fully compacted and levelled but the concrete is still 'green' thick slurry, made with neat cement shall be applied evenly and worked in with iron floats. When the slurry starts to set it shall be pressed with iron floats to have a firm compact smooth surface without trowel mark or undulations. This finish shall be as thin as possible by using 2.2 kg. of cement per Sq.M. of area.

The surface shall be kept in shade for 24 hours and then cured for at least 7 days continuously by flooding with water. The surface shall not be subjected to any load or abrasion till 21 days after lying.

As desired by the Engineer the surface, while still 'green' shall be indented by pressing strings, the marking shall be of even depth, in straight lines and the panels shall be of uniform and symmetrical patterns.

2.01.02 Terrazzo Finish in Situ

It shall consist of an underbed and a topping laid over an already laid and matured concrete base.

a) Thickness

Unless otherwise specified the total thickness of the 'finish shall be minimum 40 mm for horizontal and 25 mm for vertical surface of which the topping shall be not less than 10 mm. While the topping shall be of uniform thickness the underbed may vary in thickness to provide necessary slopes. The vertical surface shall project out 6 mm from the adjacent plaster or other finish. Necessary cutting into the surface receiving the finish shall be done to achieve the specified thickness. All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 6 OF 22

b) Mix

i) Underbed

The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 parts cement, 1½ parts sand and 3 parts stone chips by volume. For vertical surfaces the mix shall consist of 1-part cement to 3 parts sand by volume. The sand shall be coarse. The stone chips shall be 10 mm down well graded. Only sufficient water to be added to give a workable consistency.

ii) Topping

The mix for the topping shall be composed of cement, colour Pigment, marble dust and marble chips. Proportions of the ingredients shall be such as to produce the terrazzo of colour texture and pattern approved by the Engineer. The cement shall be white or gray or a mixture of the two to which pigment shall be added to achieve the desired colour. To 3 parts of this mixture 1-part marble powder by volume shall be added and thoroughly mixed dry. To 1 part of this mix 1 to 1½ parts of marble chips by volume shall be added and thoroughly mixed dry again.

The pigment must be stable and nonfading. It must be very finely ground. The marble powder shall be from White marble and shall be finer than IS Sieve No.: 30. The size of marble chips shall be between 1 mm to 20 mm. Sufficient quantity to cover each visible area shall be prepared in one lot to ensure uniform colour. Water to make it just workable shall be added to a quantity that can be used up immediately before it starts to set.

c) Laying

The underbed shall be laid in panels. The panels shall not be more than 5 Sq.M. in area of which no side shall be more than 2.5 M. long. For exposed locations the maximum area of a panel shall be 2.0 Sq.M. The panel shall be laid in alternate bays or chequered board pattern. No panel shall be cast in contact with another already laid until the latter has contracted to the full extent.

Dividing strips made of aluminium or glass shall be used for forming the panels. The strips shall exactly match the total depth of underbed plus topping.

After laying, the underbed shall be levelled compacted and brought to proper grade with a screed or float. The topping shall be laid after about 24 hours while the underbed is still somewhat “green” but firm enough to receive the



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 7 OF 22

topping. A slurry of the mixture of cement and pigment already made shall be spread evenly and brushed in just before laying the topping. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the underbed. The surface of the topping shall be trowelled over, pressed and brought to a smooth dense surface showing a minimum 75% area covered by marble chips in an even pattern of distribution.

d) Curing

The surface shall be left for curing for about 12 to 18 hours and then cured by allowing water to stand on the surface or by covering with wet sack for four days.

e) Grinding and Polish

When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (no.80) grit blocks, till the marble chips are exposed and the surface is smooth. Then the surface shall be thoroughly washed and cleaned. A grout with already prepared mixture of cement and pigment shall be applied to fill up all pinholes. The surface shall be cured for 7 days by keeping it moist and then ground with fine grit blocks (no.: 120). It shall again be cleaned with water, the slurry applied again to fill up any pinholes that might have appeared and allowed to be cured again for 5 days. Finally, the surface is ground a third time with very fine grit blocks (no.: 320) to get smooth surface without any pinhole. A suitable machine shall do the grinding. Where grinding machine cannot be used hand grinding may be allowed when the first rubbing shall be with carborundum stone of coarse grade (no.:60), second rubbing with medium grade (no.: 80) and final rubbing and polishing with fine grade (no.: 120). The surface shall be cleaned with water, dried, and covered with soil free, clean sawdust if directed by the Engineer. The final polishing shall be postponed till before handing over if desired by the Engineer. Just before handing over the surface shall be dusted with oxalic acid at the rate of 0.33 gm. per. Sq.M., water sprinkled on to it and finished by buffing with felt or hessian bobs. The floor shall be cleaned with soft moist rag and dried. However, all excess wax polish to be wiped off and the surface to be left glossy, but not slippery.

2.01.03

Granolithic Finish

Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete.



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 8 OF 22

a) Thickness

The finish shall be average 20 mm and minimum 12 mm thick, unless specified otherwise.

b) Mix

The mix shall consist of 1-part cement, 1-part coarse sand, 2 parts coarse aggregate by volume. The coarse aggregate shall be very hard like granite and well graded between 6 mm and 12 mm. Minimum quantity of water to get workability shall be added.

c) Laying of Monolithic Topping

The concrete base shall be laid as per specification "Cement Concrete" and levelled upto the required grade. The form shall remain sufficiently protruding to take the finish.

Within about 3 hours of laying the base while it is still fully -green- the topping shall be laid evenly to proper thickness and grade. If considered necessary, the surface of the base shall be roughened by wire brushing. Unless manual operation is permitted by the Engineer, mechanical vibrators of suitable design shall be used to press the topping firmly and work vigorously and quickly secure full bond with concrete base.

The laitance brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then be lightly trowelled to remove all marks. When sufficiently set, hand trowelling shall be done to secure a smooth surface without disturbing the stone chips.

For large areas the laying shall be in panels of maximum 25 Sq.M. area. The panels shall be laid in chequered board pattern.

d) Laying of Topping Separately on Hardened Base

The base concrete shall be prepared as stated in clause 2.00.03 and a slurry of neat cement applied just prior to laying the granolithic concrete mix (1:1:2). The method of compaction etc. shall be same as for monolithic topping.

Curing

Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface has hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or ponding of water on the surface. The floor shall not be exposed to heavy traffic during this period.



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 9 OF 22

f) Grinding

If grinding is specified, it shall start only after the finish has fully set. Clause 2.01.02 (e) shall be followed. However, the Engineer shall decide upon the ultimate polish required.

g) Finishing

Where specified, sodium, silicate or magnesium or zinc silico fluoride treatment shall be done. The number of coats to be applied shall be as per approved drawings or as instructed. The concentration and method of application of the solutions shall be as specified in IS: 5491.

2.01.04 Patent Stone

It shall consist of an underbed and a topping laid on an already laid and matured concrete base.

a) Thickness

The patent stone finish shall have thickness as stipulated under clause 2.01.02 (a) except that the topping shall be 12 mm thick.

b) Mix

i) Underbed

The mix shall be as stipulated under clause 2.01.02 (b).

ii) Topping

The mix for the topping shall consist of 1-part cement and 2-part stone aggregate 6mm nominal size by volume.

c) Laying

The Patent Stone finish including the underbed shall be laid in alternate bays or in Chequered board pattern. No panel shall be cast in contact with another already laid till the contraction of the latter has already taken place.

The maximum area of each panel shall be 3 Sq.M. of which no side shall be more than 2 M. long.

A cement grout shall be applied and worked into the surface to receive the finish; the underbed then laid, compacted, and leveled to proper grade with



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 10 OF 22

a screed or float. The topping shall be applied evenly on the underbed while it is not fully set but firm enough and rolled and pressed to get full bond. The topping shall be trowelled to a dense finish to the satisfaction of the Engineer. All trowel marks shall be mopped out with a soft cloth to give a clean smooth surface.

After the surface is sufficiently set, the finished floor shall be kept moist for 7 days for curing. If desired the finish shall be polished as directed by the Engineer.

2.01.05 Metallic Hardener Like 'Ironite'/'Hardonate' Finish

This will consist of a topping (incorporating iron particles) to bond with concrete base while the latter is 'green'.

a) Thickness

Unless otherwise specified the metallic hardener finish shall be of 12 mm depth.

b) Material

The hardening compound shall be uniformly graded iron particles free from non-ferrous metal impurities, oil, grease, sand soluble alkaline compounds or other injurious materials when desired by the engineer, actual samples shall be tested.

c) Mix

Proportion of the metallic hardener shall be as specified or as indicated by the manufacturer. However, in absence of any such direction 1 part metallic hardener shall be mixed dry, with 4 parts cement, by weight. To this mixture 6 mm nominal size stone chips shall be added in proportion of 1-part cement (mixed with hardener) to 2 parts of stone chips by volume and uniformly mixed. Minimum quantity of water shall be added to make it workable.

d) Laying

The concrete floor shall be laid as per specification 'Cement Concrete' and levelled upto required grade. The forms, if any, shall remain sufficiently projecting to make the finish. The surface shall be roughened by wire brash as soon as possible.



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 11 OF 22

The finish shall be laid while the concrete underbed is still very 'green' within about 3 hours of laying of the latter. The finish shall be of uniform thickness and even dense surface without trowel marks, pin holes etc. This topping layer shall be pressed firmly and worked vigorously and quickly to secure full bond with the concrete base. Just when the initial set starts the surface shall be finished smoothed with steel trowel.

The finished floor shall be cured for 7 days by keeping it wet.

2.01.06 Mastic Asphalt Finish

This is a one-layer treatment on concrete or brick base.

a) Thickness

The thickness shall be as specified in the drawing.

b) Materials

Bitumen shall be industrial Bitumen of the grade 90/15 and 75/15 conforming to IS: 702.

Mineral filler shall be dry stone dust passing through 75 micron IS Sieve.

Fine aggregate shall be crushed and graded natural limestone or other hard work.

Coarse aggregate shall be crushed siliceous stone or other approved aggregate 6 mm stone chips shall be used for finish upto 20 mm thick & 10 mm chips for thicker finish.

c) Composition

Bitumen mastic shall conform IS: 1195 and shall be either brought to site in blocks weighing about 25 Kg or prepared at site. If brought in blocks, these shall be remelted in mechanically agitated mastic cookers and coarse aggregate, preferably preheated fed in successive portions until the complete change is thoroughly, incorporated. At no stage during the remelting and mixing process, shall the temperature exceed 205°C.

d) Laying

The hot mastic shall be laid on dry base surface cleaned thoroughly by wire brushing and sweeping. The mastic shall be levelled and when cooled to some extent shall be finished with a wooden float with addition of small



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 12 OF 22

quantity of fine sand if required. No load shall be allowed till the finish has cooled to normal temperature.

The mastic shall be laid in suitable panels of about 1.5 Sq.M. in area each formed by formers. Succeeding panels shall be laid overlapping the finish panel so as to melt its edges and form a continuous finish without joint.

2.01.07 Chemical Resistant in Situ Finish

Chemical resistant in situ finish shall be as epoxy resin with suitable filler material over a primer. The minimum thickness shall be 6 mm. About its performance the Engineer shall have to be fully satisfied by test results and examination of similar treatment already in existence. The contractor shall get it done by a specialized Manufacturer and get guarantee of performance from the organization and pass it on to the Owner in addition to his own guarantee.

2.02.00 Tiled Finish

These shall include finish tiles, stone slabs, and similar manufactured or natural items over already laid and matured base of concrete or masonry by means of an underbed or an adhesive layer.

2.02.01 Terrazzo Tile Finish

The finish will consist of manufacture terrazzo and an underbed.

a) Thickness

The total thickness including the underbed shall be minimum 40 mm for floors 30 mm for walls unless otherwise specified.

The skirting, dado and similar vertical surfaces shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the tiled finish, to accommodate the specified thickness shall be done.

b) Tiles: Terrazzo

The tiles shall, unless specifically permitted in special cases be machine made under quality control in a shop. The tile shall be pressed hydraulically to a minimum of 140 Kg. per Sq.cm.

Each tile shall bear on its back permanent and legible trademark of the manufacturer. All angles of the tiles shall be right angles all arises sharp and true, colour and texture of the wearing face uniform throughout. Maximum tolerance allowance length and breadth shall be ± 1 mm and the

**TITLE:****TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 13 OF 22

thickness ± 3 mm. Face of the tile shall be plane, free from pinholes and other blemishes.

The tiles shall be composed of a backing and topping. The topping shall be of uniform thickness not less than 10 mm.

The total thickness including the topping shall be as specified but not less than 20 mm in any case.

The backing shall be composed of 1 part ordinary gray cement and 3 parts of stone chips by weight mixed with water.

The topping shall be as specified under clause 2.01.02 (b).

The tile shall be cured at the shop for at least 14 days before delivery to the site. First grinding shall be given to the tiles at the shop before delivery. Tiles shall be packed properly to prevent damage during transit and storage. The tiles must be carefully stored to prevent staining by damp, rust, oil, and grease or other chemicals.

Tiles made in each batch shall be kept and used separately so that colour of each area of the floor may remain uniform.

The manufacturer shall supply along with the tiles the grout mix containing cement and pigment in exact proportions as used in topping of the tiles. The containers for the grout mix shall be suitably marked to relate it to the particular type and batch of tiles.

c) **Mix: Underbed**

The underbed for floor and similar horizontal surfaces shall be 1-part lime putty: 1 part surkhi: 2 parts coarse sand by weight mixed with sufficient water to form a stiff workable mass. For skirting and dado and all vertical surfaces it shall be about 12 mm thick and composed of 1-part cement and 3 parts coarse sand by weight.

d) **Laying**

The underbed mortar shall be evenly spread and brought to proper grade and consolidated to a smooth surface. The surface shall be roughened for better bond. Before the underbed had time to set and while it is still fairly moist but firm, cement shall be hand dusted over it or a cement slurry applied and the tiles shall immediately be placed upon and firmly pressed by wooden mallet on to the underbed until it achieves the desired level. The tiles shall be kept soaked for about 10 minutes just before laying. The



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 14 OF 22

joints between tiles shall be as close as possible and not more than 1.5 mm wide.

Special care shall be taken to check the level of the surface and the lines of the joints frequently so that they are perfect.

When tiles are required to be cut to match the dimensions these shall be sawn and edges rubbed smooth. The location of cut tiles shall be planned in advance and approval of the Engineer taken.

At the junction of horizontal surface with vertical surface the tiles on the former shall enter at least 12 mm under the latter.

After fixing, the floor shall be kept moist and allowed to mature undisturbed for 7 days. Heavy traffic shall not be allowed.

If desired dividing strips as specified under Clause 2.01.02(c) may be used for dividing the work into suitable panels.

e) Grinding and Polishing

Procedure shall be same as Clause 2.01.02(e). Grinding shall not commence earlier than 14 days after laying of tiles.

2.02.02 Chequered Tile Finish

The finish shall consist of manufactured gray or coloured cement tiles or terrazzo tiles with chequered face and an underbed laid over concrete or brick surface.

a) Thickness

Thickness shall be same as in clause 2.02.01 (a).

b) Tiles: Chequered

The tiles shall have chequers not less than 2.5 cm. c/c and not more than 5 cm. c/c. Depth of grooves shall be not less than 5 mm. The grooves shall be uniform and straight.

The tiles shall conform to clause 2.02.01 (b) except that these may have the topping in terrazzo or plain gray cement or colour pigment added to cement.

c) Under-bed

As per clause 2.02.01 (c).



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 15 OF 22

- d) Laying
As per clause 2.02.01 (d).

- e) Grinding and Polishing

As per clause 2.02.01 (e) except that the tiles shall be ground and polished by hand and after laying taking special care in polishing the grooves properly and uniformly.

2.02.03 Glazed Tiles Finish

This finish shall be composed of glazed earthenware tiles with an underbed laid over a concrete or masonry base.

- a) Thickness

The total thickness shall be between 20mm and 25mm including the underbed.

The tile finish on vertical surface shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the finish, to accommodate the specified thickness shall be done.

- b) Tiles: Glazed

The tiles shall be of earthenware, covered with glaze white or coloured, plain or with designs, of 150 mm x 150 mm nominal sizes and 5.5 mm to 6 mm on thick unless otherwise specified. The tolerance shall be ± 1.5 mm for length and breadth and ± 0.5 mm for thickness specials like internal and external angles; beads, covers, cornices, corner pieces etc. shall match. The top surface of the tiles shall be glazed with a gloss or matt, unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures, dense and homogeneous. The tiles shall be strong and free from flaws like cracks, craze, specks, crawling, etc. and other imperfections. The edge and the underside of the tiles shall be completely free from glaze and the underside shall have ribs or indentations for better anchorage with the fixing mortar.

The coloured tiles, when supplied, shall preferably come from one batch to avoid difference in colour.



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 16 OF 22

c) Mix: Underbed

The mix for the underbed shall consist of 1-part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified.

c) Laying

Same as clause 2.02.01 (d).

e) Finishing

The joints shall be cleaned and flush pointed with white cement and cured for 7 days by keeping it wet. The surface shall be cleaned with soap or suitable detergent, washed fully, and wiped with soft cloth to prevent scratching before handing over.

2.02.04 Tesserae Finish (Mosaic etc.)

This finish consists of manufactured vitreous, glass, ceramic or similar hard small pieces set in an underbed over a concrete or masonry surface, already laid.

a) Thickness

The total thickness including the underbed shall be between 16 mm & 25 mm.

b) Tesserae Finish

These shall usually be 6 mm thick small piece of ceramic vitreous china, tinted glass, or similar hard wearing, strong, and durable material in desired shapes and sizes and patterns.

The supply shall come in the desired pattern in full or sections conveniently for handling, stuck to pieces of strong thick paper on the surface to be exposed. The gum used for this purpose must be water soluble and non-staining. The sections shall be properly marked to avoid mistakes and master drawing shall be available at the site for guidance.

c) Mix: Underbed

Same as clause 2.02.03 (c)

d) Laying

The specification for laying if given by the manufacturer of the item shall be followed provided it is approved by the Engineer. Otherwise clause 2.02.03 (d) shall generally be followed. However, instead of gray cement the slurry shall be made with white cement to fix the panels. The paper-



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 17 OF 22

mounted patterns in sections shall be carefully placed and pressed in position true to lines and levels. Earliest possible the paper shall be peeled off and surface examined and cleaned, joints flush pointed with white cement and cured for 7 days by keeping it wet.

2.02.05 Chemical Resistant Tiled Finish

This shall include all varieties of special tiles used for specific chemical resistance function and an underbed over already laid concrete or masonry.

a) Tiles

The chemical resistant tiles shall be of the best indigenous Manufacture unless otherwise specified and shall be resistant to the chemical (both acid and alkali). The tiles shall have straight edges, uniform thickness, plain surface, uniform nonfading colour, and textures.

Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have at least compression strength of 700 Kg/cm². The surface shall be abrasion resistant and durable.

b) Laying

The mortar used for setting or for underbed these tiles shall be durable, strong and chemical resistant epoxy mortar. The grout, which shall be to the full depth of tile, shall have equal chemical resistant properties. Joints shall be pointed if so desired. The setting and fixing shall be according to the manufacturer's specification approved by the Engineer.

2.02.06 Rubber, Vinyl, or Vinyl Asbestos Tiles Finish

This shall include various types of tiles manufactured from rubber, vinyl etc. set with an adhesive on concrete or masonry base. An underbed may be required to secure desirable surface and grade.

a) Thickness

The thickness of the tiles shall be as incorporated in drawing.

b) Tiles

Unless otherwise desired the tiles shall be squares of approved dimensions. The tolerance in dimensions shall be ± 1.5 mm.

**TITLE:****TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 18 OF 22

The face of the tiles shall be free from porosity, blisters, cracks, embedded foreign matters or either physical defects which affect appearance or serviceability. All edges shall be cut true and square. The colour shall be nonfading and uniform in appearance, insoluble in water and resistant to alkalies, cleaning agents and usual floor polishes.

Each tile shall be marked on the back legibly and indelibly with manufacturer's trademark, the thickness, sizes, batch number, and date of manufacturer.

Tiles shall be delivered securely packed and stored in clean, dry well ventilated place at a temperature near about to that the tiles shall be called upon to stand ultimately.

Adhesive to be used for sticking the tiles shall be approved by the tile manufacturer. The adhesive shall have a short drying time and long life in addition to toughness.

c) Mix: Underbed

The underbed where required to make up the specified thickness or to give the required grade or to get the right type of surface shall be composed of 1 part like putty:1-part cement: 3 parts coarse sand mixed with just sufficient water to make it workable.

d) Laying

The tiles shall be kept in the room to be tiled for at least 24 hours to bring them to the same temperature as the room. For air-conditioned space, the air-conditioning shall be completed before tiling is taken up.

The surface to receive this finish shall be firm even textured but not too smooth, without undulations and other deficiencies. If an underbed is laid the same shall be cured for at least 7 days by keeping it moist and then fully dried.

The surface shall be thoroughly cleaned. All loose dust particles shall be removed. Oil and grease if any shall be completely cleaned by use of detergent.

The adhesive shall be applied to fully dry surface in desired thickness uniformly. The adhesive shall also be applied to the backs and edges of the tiles and allowed to surface dry. The tiles shall be placed neatly on the surface exactly to the approved pattern and set with a suitable tool. If the edges tend to curl, weights are to be used to keep the edges down. Special care shall be taken to avoid formation of air pockets under the tiles. The

**TITLE:****TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 19 OF 22

joints shall be very fine. Any adhesive squeezed out through the joints shall be removed immediately.

e) Finishing

If any adhesive mark is there on the surface a soft cloth soaked in solvent shall be used to wipe it off. The surface shall be cleaned with soft soap, dried, and polished with an approved type of polish just before handing over.

2.02.07 Stone Slab Finish: Marble, Stone, and Similar Fine Grained Stone including Kota stone

a) Thickness

The underbed shall be minimum 12 mm and average 20 mm thick. The slabs will be 20 mm thick.

b) Stone Slab

The stone slabs shall be made from selected stock, which is hard, sound, homogeneous and dense in texture and free from flaws. Angles and edges shall be true, square, and free from chipping and surface shall be plane. The slabs shall preferably be machine cut to the required dimensions. Tolerance of ± 5 mm in dimensions and ± 2 mm in thickness will be allowed. Unless specified the slabs shall be minimum 300 mm x 300 mm.

The stone slabs shall come from specific regions and in specified quality with top surface fine chisel dressed. All sides shall also be fine chisel dressed to the full depth to allow finest possible joints.

The slabs shall be delivered to the site well protected against damages and stored in dry place under cover.

c) Mix: Underbed

Same as clause 2.02.01 (c).

d) Laying

The sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand stone and washed before laying.

The underbed mortar shall be evenly spread and brought to proper level on the area under each slab. The slab shall be laid over the underbed, pressed, and tapped down with wooden mallet to the proper level. The slab shall then be lifted and the underbed corrected as necessary and allowed to



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 13/02/2018

SHEET 20 OF 22

stiffen a little. Next, thick cement slurry shall be spread over the surface. The edges of the slab shall be buttered with slurry of cement, gray / white / mixed with pigment matching the colour of the stone slabs. The slab shall

be gently laid and tapped with wooden mallet to bed properly to a very fine joint and to the required level. All surplus cement slurry shall be removed and the surface mopped clean with wet soft cloth. The laid finish shall be cured for 7 days by keeping it wet.

e) Polishing, Finishing

Fine chiselling shall be done to remove the slight undulations that usually exist at the joints. The polishing and finishing shall be done as specified under clause 2.02.01 (e). However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for.

2.02.08 Stone Slab Finish: Sand Stone and Similar Coarse Grained Stone Finish

Generally, clause 2.02.07 shall be followed except that the workmanship and finish shall not be fine as which are explained hereunder.

The slabs shall be rough chiselled or fine chiselled as specified. Tolerance may be allowed upto ± 6 mm for rough finish, but no sharp unevenness and shall be allowed. For fine chiselling the unevenness shall be limited to ± 2 mm. The sides shall be chisel dressed at least to half slab depth so that the maximum deviation from straight line shall be within 25 mm. Beyond this depth the edge may be slightly splayed.

The joint thickness shall be kept limited to 5 mm in case of rough finish and 3 mm in case of fine finish unless wider joints are specified. The joints shall be grouted with white or coloured cement. If fine joints in the flooring are specified, the edges of slabs shall be cut in such a way that it shall form an inverted 'Y'.

3.00.00 ACCEPTANCE CRITERIA

The finish shall be checked specially for:

- a) Level, Slope, Plumb as the case may be
- b) Pattern and Symmetry
- c) Alignment of joints, dividing strip etc.
- d) Colour, texture

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FLOOR FINISH AND ALLIED WORKS	SPECIFICATION NO. PE-TS-635-600-C001	
		VOLUME -	
		SECTION - D	SUB-SECTION – D12
		REV.NO. 00	DATE 13/02/2018
		SHEET 21	OF 22
	e) Surface finish f) Thickness of joints g) Details at edges, junctions etc. h) Performance i) Precautions specified for durability		
4.00.00	I.S. CODES All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed. IS: 777 : Glazed earthenware tiles IS: 1196 : Code of practice for laying bitumen mastic flooring. IS: 1197 : Code of practice for laying of rubber floors IS: 1237 : Cement concrete flooring tiles IS: 1443 : Code of practice for laying and finishing of cement concrete flooring tiles. IS: 2114 : Code of practice for laying in situ terrazzo floor. IS: 3461 : PVC asbestos floor tiles IS: 4860 : Specification for acid resistant bricks IS: 5518 : Code of practice for laying of flexible PVC Sheet and tile flooring. IS: 5491 : Code of practice for laying in situ granolithic floor topping.		



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D12

REV.NO. 00 DATE 13/02/2018

SHEET 22 OF 22

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be for the complete work (including dividing strips, Ironite, metals, tiles etc. if any) as per the schedule of items. Rates shall be applicable for application on horizontal and vertical surfaces at all elevations and for all types of work including stairs tread and riser, laying in desired pattern and panels, cost of specials (if any) rounding of corners, mouldings etc.

Rates shall be including provision of side shuttering (if required) for casting of floor in alternate panels and or without dividing strips.

5.02.00 Measurement

The finished surface shall be measured in Sqm for area unless otherwise specified. Deduction shall not be made for opening or embedded articles having area not exceeding 0.1 Sqm.



TITLE:

**TECHNICAL SPECIFICATION FOR
SHEET WORK IN ROOF AND
SIDING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D13

REV.NO. 00 DATE 13/02/2018

SHEET 1 OF 6

SECTION - D

SUB-SECTION – D13

SHEET WORK IN ROOF AND SIDING

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
SHEET WORK IN ROOF AND
SIDING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D13

REV.NO. 00 DATE 13/02/2018

SHEET 2 OF 6

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	5
4.00.00	I.S. CODES	5
5.00.00	RATES AND MEASUREMENTS	6

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING	SPECIFICATION NO. PE-TS-635-600-C001	
		VOLUME -	
		SECTION - D	SUB-SECTION – D13
		REV.NO. 00	DATE 13/02/2018
		SHEET 3	OF 6
<u>SHEET WORK IN ROOF AND SIDING</u>			
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 stitching 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.		

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING	SPECIFICATION NO. PE-TS-635-600-C001	
		VOLUME -	
		SECTION - D	SUB-SECTION - D13
		REV.NO. 00	DATE 13/02/2018
		SHEET 4	OF 6
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 (PVF₂) of Dry Film Thickness (DFT) 20 microns (minimum) over primer. Inner side of external sheet shall be provided with suitable pre-coating of minimum 7 microns. ii. Galvanised M.S. sheets of minimum 0.6mm thickness shall be used as inner liner (internal face) of cladding system. The exposed face shall be permanently colour coated with silicon modified polyester paint of DFT 20 microns (minimum) over primer. Inner face of external sheet shall be provided with suitable pre-coating of minimum 7 microns. The rate of galvanization shall not be less than 275 gm/sqm. iii. The permanent colour coated sheet shall meet the general requirements of IS:14246 and shall conform to class 3 for the durability. iv. Inner sheet shall be fixed directly to side runners and Z spacers made out of at least 2 mm thick galvanized steel sheet of grade 375 as per IS:277. Inner sheet shall be fixed at the rate not more than 1.50M centre to centre to hold the insulation and external sheeting. The fasteners shall be of high quality corrosion resistant grade of self tapping / self drilling type provided with suitable cap. v. The insulation shall be of bonded mineral wool of minimum thickness 50mm conforming to IS:8183, having a density of 32 Kg/cum. for glass wool & 48 Kg/cum. for rock wool.		

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING	SPECIFICATION NO. PE-TS-635-600-C001	
		VOLUME -	
		SECTION - D	SUB-SECTION – D13
		REV.NO. 00	DATE 13/02/2018
		SHEET 5	OF 6
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.		

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING		SPECIFICATION NO. PE-TS-635-600-C001			
			VOLUME -			
			SECTION - D		SUB-SECTION – D13	
			REV.NO. 00		DATE 13/02/2018	
			SHEET 6		OF 6	
	IS: 1626	:	Specification for asbestos cement building pipes, gutters and fittings.			
	IS: 277	:	Specification for galvanized steel sheets (plain and corrugated).			
5.00.00	RATES AND MEASUREMENT					
5.01.00	Rates					
	Rates shall be unit rate for complete item described in “Schedule of Items” and shall include all wastage.					
5.02.00	Measurement					
	Sheeting work in roof & sides shall be measured in Sq.M. for net area of the work done. Profiled sheeting shall be measured flat and not girthed. Opening less than 0.40 Sqm shall not be deducted. No extra shall be paid for extra labour in cutting and for wastage etc. No payment shall be made for laps, flashings, sealing, fasteners etc. in sheeting works.					



TITLE:

**TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D14

REV.NO. 00 DATE 13/02/2018

SHEET 1 OF 6

SECTION - D

SUB-SECTION – D14

SUSPENDED CEILING

SPECIFICATION NO. PE-TS-635-600-C014



**Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301**



TITLE:

**TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D14

REV.NO. 00 DATE 13/02/2018

SHEET 2 OF 6

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	SAMPLES	5
4.00.00	SHOP DRAWINGS	5
5.00.00	ACCEPTANCE CRITERIA	6
6.00.00	RATES AND MEASUREMENTS	6



TITLE:

TECHNICAL SPECIFICATION FOR SUSPENDED CEILING

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D14

REV.NO. 00 DATE 13/02/2018

SHEET 3 OF 6

SUSPENDED CEILING

1.00.00 SCOPE

This section covers supply and installation of suspended ceiling together with the suspension system as shown on drawing or specified in schedule of item with all materials, labour and equipments. The work shall also include providing of openings in the ceiling for lighting, air-conditioning diffusers etc. as shown on drawings or as instructed by the Engineer.

2.00.00 INSTALLATION

2.01.00 Suspension System

2.01.01 General

Suspension system shall consist of the grid supporting the ceiling panels, intermediate runner supports for the grid if any and hangers, wall angles etc. required to suspend the grid or the runners from structural works, slabs and beams.

All members of the suspension system shall be of sufficient strength and rigidity to carry, the ceiling boards or sheets in a true and level plane without exceeding a deflection of 1/360th of their span. All joints in ceiling panels shall run straight and cross joint shall be at perfect right angles. Angle moulds where shown on drawings shall be securely fixed to walls. All drillings of structural concrete and installation of suitable anchoring device for installation including welding of the suspension system shall be included in the rate. All M.S. sections used for supports etc. shall be given one coat of synthetic enamel paint over a coat of red lead primer.

2.01.02 Metal Grid Suspension System

Aluminium grid ceiling system shall be "Bead lock" as manufactured by W A Beard shell and Co. Pvt. Ltd. or Ajit India Limited or approved equal. Steel grid ceiling system shall be 'Jolly Snap Grid' as manufactured by Jolly Board Limited or approved equal.

Steel tees as intermediate members and steel channels, as end pieces will be assembled in the form of grid. Size of tees and channels shall be as required.

The cross-tees shall intersect main tee runners in pattern shown on drawing and positively locked together with intersection members. All perimeter areas shall have tee runners fixed to vertical wall surfaces and end channels shall be fixed to runners leaving return air space between vertical wall and channels,



TITLE:

**TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D14

REV.NO. 00 DATE 13/02/2018

SHEET 4 OF 6

unless otherwise shown on drawings. Angle cleats or other suitable fixing device shall be fixed to the structural beams above for fixing of hangers. Main runners shall be hung by M.S. flats, angles, rods or 12G or heavier galvanized tie wire hangers at maximum 1.2 metre centres. Extra hangers shall be provided at light fixtures that are supported from the ceiling system. The spacing of main and cross runners shall be as shown on drawings. Turnbuckles shall be provided in M.S. rods for adjustment in levels.

2.02.00 Ceiling Panels

2.02.01 Material

Ceiling panels shall be best quality material in thickness and properties called for in the "Schedule of items". The Contractor shall submit test certificates to the Engineer for approval before bulk supply. The ceiling panels may be of following type:

- a) Plaster of Paris board (decorative)
- b) Expanded polystyrene insulation board with plastic fascia.
- c) Fibre Insulation board.
- d) Bonded wooden particle board (Plain and decorative)
- e) Glass fibre reinforced polystyrene sheets.
- f) Flat asbestos sheets (with plastic fascia).

2.02.02 Installation of Ceiling Panels

Installation of Ceiling panels shall be strictly as per manufacturer's instruction.

For concealed grid system, tiles shall be fixed to the supporting grid in manner shown on drawing or as specified by the manufacturer. Where V joints in tiles are called for in drawings, these shall be in true lines. Where flush surface is required, the joints shall be filled with approved filler material and finished to give a neat uniform surface. Special care shall be taken to neatly finish the ceiling at junctions with walls, light fixtures, diffusers etc.

2.02.03 Aluminium Lineal Ceiling System

Aluminium lineal ceiling system shall be "Luxalon 84C" or approved equal and the installation shall be strictly as per manufacturer's instruction/ specification subject to approval of the Engineer.

**TITLE:****TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D14

REV.NO. 00 DATE 13/02/2018

SHEET 5 OF 6

Aluminium lineal ceiling shall comprise of plain panels, 84 mm wide and 12.5 mm deep with a 23.9 mm recessed flange, roll formed out of 0.5 mm thick aluminium alloy panels stove enamelled on both sides, fixed on roll-formed carriers made of enamelled 0.95 mm thick aluminium, 32 mm wide and 39 mm deep with prongs to hold panels in the module of 100mm, at maximum spacing 1.2 M centre to centre. The carriers shall be suspended from roof by 4 mm dia. galvanised steel wire hangers with special height adjustment clips made out of spring steel at maximum spacing of 1.2 M c/c. Hangers shall be fixed to roof by 'J' hooks and nylon inserts. 25 mm thick resin bonded mineral wool (spintex 300 or equivalent) insulation bound in polythene shall be laid on top of panels. Lineal ceiling shall be fixed in pattern as per detailed drawings.

3.00.00 SAMPLES

Samples of Ceiling panels and metal suspension system components as noted below shall be submitted for Engineer's approval:

Panels : 3 samples approximately 300 mm square/long each

Suspension System : 3 samples of short length: each of main and secondary system

4.00.00 SHOP DRAWINGS

Shop drawings shall be submitted for approval as required and approval shall be obtained prior to delivery of suspended ceiling components. Shop drawings shall be co-ordinated with all related work and shall show the following information:

- a) A reflected ceiling plan of areas indicated to receive the ceiling showing electrical and mechanical features.
- b) Typical Intermediate framing for support where required.
- c) Hanger fastening details.
- d) Panels - unit support at ceiling penetrations.
- e) Details of splicing method for main and cross runners.
- f) A table indicating load bearing capacity of main and cross runner
- g) A note stating that the suspension system member furnished will not deflect more than 1/360 of the span under the indicated loading.

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR SUSPENDED CEILING	SPECIFICATION NO. PE-TS-635-600-C001 VOLUME - SECTION - D SUB-SECTION – D14 REV.NO. 00 DATE 13/02/2018 SHEET 6 OF 6
5.00.00	ACCEPTANCE CRITERIA Finished ceiling shall be at the correct plane and present a pleasing and uniform appearance, free from, sags, warps, disfigured, or damaged board. Cut-outs for light fixtures, diffusers etc. shall be of exact dimensions and in exact locations. 6.00.00 RATES AND MEASUREMENT 6.01.00 Rates Rates shall be for the complete item called for in the “Schedule of Items”. No extra payment will be made for alignment and adjustment of lighting fixtures, air-conditioning diffusers, access panels etc. The rate shall include all cutting and wastage from standard size sheets, runners/carries etc. 6.02.00 Measurement Actual area of work shall be measured in Sqm correct to second place of decimal. However, no deduction will be made for opening upto 0.25 Sqm. each in area.	



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 1 OF 23

SECTION - D

SUB-SECTION - D15

**WATER SUPPLY, DRAINAGE
AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C015



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

C O N T E N T



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D15

REV.NO. 00 DATE 13/02/2018

SHEET 2 OF 23

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	MATERIAL	3
3.00.00	INSTALLATION	6
4.00.00	TESTING AND ACCEPTANCE CRITERIA	17
5.00.00	I.S. CODES	20
6.00.00	RATE AND MEASUREMENT	21



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 3 OF 23

WATER SUPPLY, DRAINAGE AND SANITATION

1.00.00 SCOPE

This section covers supply of all materials labour and incidentals required for supply, laying and installation of under/over ground pipes for water supply, drainage and sanitation with all fittings, fixtures and jointing, construction of ancillary works like manholes, drop connections, gully chambers, septic tank, soak pits, surface drain etc.

The supply and installation of water supply/sanitation fixtures and accessories like water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap container etc. with all fittings, fixtures, water supply/sanitation pipes and water storage tanks etc.

2.00.00 MATERIAL

All materials, fittings, fixtures, and appliances shall be of the best quality conforming to relevant Indian Standard and shall be procured from approved manufacturers. Unless specifically allowed by the Engineer, the Contractor shall submit samples of fittings and fixtures, which will be retained by him for comparison when bulk supplies are received at the site. Ultimate choice of type, model, and manufacturer lies completely with the Engineer.

It shall be the responsibility of the Contractor to procure the materials selected by the Engineer. Hence orders are to be placed with the manufacturers in time, so that the materials are available at the site well ahead of their requirement.

The materials brought to the site, shall be stored in a separate secured enclosure away from the building materials. Pipe threads, sockets, and similar items shall be specially protected till final installation. Brass and other expansive items shall be kept under lock and key. Fragile items shall be checked thoroughly when received at the site and items found damaged shall not be retained at the site.

2.01.01 Pipes and Pipe Fittings

For water supply, galvanised mild steel pipe of medium grade confirming to IS: 1239 shall be used. The galvanising shall not be less than 400gm/sqm of pipe surface area. Galvanising shall be smooth and shall be subjected to testing as per IS: 2633 for uniformity of coating. The zinc coating shall be free from defects.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 4 OF 23

For Roof drainage and building sanitation works following type of pipe are coved in this Section:

- a) Cast Iron pipe
- b) Steel pipe (lined, coated with bituminous composition, out coated with cement concrete or mortar or galvanized)
- c) Concrete pipe
- d) Asbestos cement pipe
- e) PVC pipe
- f) Stoneware pipe
- g) Vitrified pipe
- h) Lead pipe (not to be used for portable water)

2.02.01

Fixtures

All material, fittings, fixtures, appliances, accessories shall be of approved quality and shall be procured from reputed brands like Hindustan/Pasriware/Cera or equivalent or as approved by Engineer. The bidder shall procure the fixtures from the above named reputed manufacturers and shall mention in his bid the type & make of the fixtures he intends to use.

All items brought to the site must bear the manufacturer's identification mark. Procurements shall be made well in advance and should get inspected & approved immediately by the Engineer. All fixtures shall be adequately protected, covered, and plugged till handing over.

All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. The chromium plating shall be of grade-2 (10micron thickness) confirming to IS: 4827. Powder coating shall be of approved colour and shall have minimum thickness (DFT) of 20micron. Stainless steel accessories shall be of grade SS-304 and from reputed manufacturer (like Salem Steel) and shall be polished bright finish.

Unless specified in the contract the fixtures shall be as specified hereinafter.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 5 OF 23

Water closet

a) European type

It shall consist of European type glazed vitreous china basin (confirming to IS: 2556, part-II), with siphon open front solid plastic seat and plastic cover, low level glazed stoneware flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. Colour of basin, cistern, seat and cover shall be as approved by the Engineer.

b) Squatting type

It shall consist of Orissa pattern glazed vitreous china squatting pan with integral foot rests (confirming to IS:2556, part-III) and high level cast iron flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. The flushing cistern shall be painted as specified by the Engineer.

Urinals

It shall consist of wall type glazed vitreous china urinals (conforming to IS:2556), cast iron automatic flushing cistern complete with supply connections, flush pipe, lead pipes, gratings, traps and all other necessary fittings. Frequency of automatic flushing shall be approximately once every five minutes. For every four urinals (maximum) located together may be served by one cistern of adequately capacity. All fittings shall be chromium plated.

Wash Basin

It shall be made of glazed vitreous china conforming to IS:2556, part-IV. The basin shall be flat back, wall hung by painted cast-iron brackets and complete with hot and cold CP brass faucets with nylon washers, PVC connection pipe with CP brass nuts, CP brass chain with rubber plug, 32mm dia. Chromium plated brass waste of standard pattern, 32mm dia. CP brass trap union complete with necessary fittings.

Sink

It shall be made of glazed vitreous china conforming to IS:2556, Part-V. It shall be wall hung by painted cast iron brackets and complete with one CP brass faucet with nylon washers, PVC connection pipe with CP brass nuts, CP brass chain with rubber plug, 40mm dia. chromium plated brass waste of standard pattern, 40mm dia. CP brass trap union complete with necessary fittings.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 6 OF 23

Bathroom mirror

It shall be made of the best quality 6 mm thick glass and produced by a reputed mirror manufacturer. It shall be wall mounted with adjustable revolving brackets. The brackets, screws, and other fittings shall be chromium plated.

Glass shelves

Glass shelves shall consist of 6 mm thick clear glass with guardrails and shall be wall mounted with brackets. All brackets, guardrails, and screws shall be chromium plated.

Towel rail

Towel rails shall be 20 mm dia chromium plated MS pipes wall mounted with steel brackets. The brackets, screws etc. shall also be chromium plated.

Soap holder

It shall be made of chromium plated strong members. The holders shall be wall mounted with chromium-plated screws.

Liquid Soap Dispenser

It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated.

Toilet roll holder

It shall be made of glazed vitreous china with suitable cover cum cutter. Wall mounting screw shall be chromium plated.

Valve, cocks, Taps

All valves, stop cocks, taps etc. shall conform to relevant Indian standard specification and shall be of best quality from approved manufacturers. These shall be suitable for normal working pressures. Nominal size and material shall be as required / specified.

2.03.00

Water Storage Tank

Water storage tank shall be PVC of approved brand and make (Syntex or equivalent). Reservoirs made of concrete masonry or fabricated steel shall be covered by respective work specifications.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 7 OF 23

3.00.00 INSTALLATION

3.01.00 General

Basic layouts may be available in the drawings provided, the details might have to be supplemented by the Contractor and get the approval of the Engineer before installation. Special attention shall be given to economise the layout. Symmetry of layout is very important. Fittings meant for operation shall be located and oriented to allow easy reach and operation. Maintenance, repairs, and replacements of pipes, fittings, and fixtures must be conveniently possible. All pipe lines, locations of fittings and fixtures, etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry, and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and so located as to allow easy maintenance.

All pipelines, fittings, and fixtures shall be installed leak proof. When the works under scope of this specification linked up with works executed by others, the connections shall be such as to prevent any splashing or spilling or emission of foul odour and gases.

3.02.00 Portable water supply Pipe Lines

3.02.01 Laying

In addition to fulfilling the functional requirements all pipelines shall be laid true to line, plumb and level and shall run on the surface of the walls, ceiling or in chases. Any deviation shall need approval of the Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer.

Pipes shall be laid on continuous unyielding surface or on reliable supports at least one near each joint and spacing as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. All pipes used for water supply should be thoroughly and efficiently disinfected before taken in to use.

3.02.02 Back Flow

The layout of pipe work shall be such that there is no possibility of back flow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. All pipe works shall be so laid or fixed and maintained as to be and to remain completely watertight, thereby avoiding waste of water, damage of property and the risk of contamination of the water conveyed.

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-635-600-C001	
		VOLUME -	
		SECTION - D	SUB-SECTION - D15
		REV.NO. 00	DATE 13/02/2018
		SHEET 8	OF 23
3.02.03	Contamination There shall be no cross connection whatsoever between a pipe/fitting for conveying or containing wholesome water and a pipe/fitting for containing impure water or water liable to contamination or of uncertain quality of water which has been used for any other purpose. No piping shall be laid or fixed so as to pass into or through any sewer, scour outlet or drain or any manhole connected therewith.		
3.02.04	Underground Piping		
	Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable. The size and depth of the trench shall be as approved by the Engineer. Back filling shall be done with selected fine earth, unless otherwise permitted, in 150 mm layers and carefully consolidated. Special care shall be taken while filling in the vicinity of the pipe to avoid damage. Before backfilling, the laid pipe shall be fully tested and approved. Where the pipe rests on rock it may be bedded on a layer of fine selected material or concrete to avoid local point support. The trench shall be so treated by gradient and filling in the area that it does not act as a drainage channel.		
3.02.05	Concealed Piping		
	Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the structure. The Contractor may co-ordinate with the building Contractor for leaving the chases, openings, and conduits as necessary. However, the Contractor will rectify if required the chases, openings, and conduits, supplement and make good after laying and testing of the concealed pipelines.		
3.02.06	Jointing of Pipes		
	All G.I. pipes shall be properly thread/weld jointed and made completely water tight and durable. Burr from the joints shall be removed after screwing. Union joints shall be provided for all required location to facilitate maintenance.		
3.02.07	Painting		
	Where required, underground G.I. pipes shall be given 2 coats of bituminous paint on the outside after laying. When painting is to be done above ground G.I. pipes shall be given one coat of red lead or zinc chromate primer and top coats shall be minimum 2 coats of best quality paint as specified.		



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 9 OF 23

3.03.00 RAINWATER DOWN COMERS

3.03.01 Pipes

Rainwater down comers shall be standard Cast Iron or Asbestos Cement Pipes. In case where specifically desired, M.S. pipes may also be used. M.S. pipes shall be painted outside with two coats of anticorrosive paints under a coat of primer.

Rainwater down comers shall run along and be secured to walls, columns etc. Where desired by the Engineer these may have to be installed in chases cut in the structure. All pipes shall be well secured and supported by adequately strong brackets. The brackets may be wrought iron clevis type, split ring type, or perforated strap iron type as approved by the Engineer. For vertical runs each pipe shall hang freely on its brackets fixed just below the socket. Suitable spacer blocks shall be provided against the vertical surface to which the pipe is fixed.

All bends and junctions shall be supplied with watertight cleanouts.

Roof and floor drains and yard gullies shall be installed, if required, by cutting into the structure and grouted with 1:2:4 cement concrete. All gutters shall be provided with removable gratings.

All horizontal pipes shall have a minimum fall of 1 in 100.

3.03.02 Khurras

The khurras shall be constructed before the work in parapet wall is taken up and it shall be 45x45 cm in size, unless otherwise specified and shall be formed of cement concrete of M-20 grade.

3.03.03 Gutters

The gutters shall be made of G.I. or A.C and procured from reputed specialised manufacturers. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. G.I. gutters shall have the edges strengthened by suitable means.

Unless noted otherwise the gutters shall have a minimum fall of 1 in 120. Adequate number of string supports shall be provided so that there is no sagging even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated M.S. brackets. All junctions shall be thoroughly watertight. The joints may be made by riveting, bolting or soldering. All joints between successive lengths of gutters shall



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 10 OF 23

have on overlap of at least 5 cm. The drop in the overlap shall always be in the direction of the fall of the gutter. Ends of gutters shall be closed watertight. Junction with rainwater down comers shall be made fully watertight and secured.

3.04.00 SOIL AND DRAINAGE PIPES

3.04.01 Gradients

If not specified, the minimum gradients of soil and drainage pipeline shall be as follows:

100 mm nominal dia.	:	1 in 35
150 mm nominal dia.	:	1 in 65
230 mm nominal dia.	:	1 in 120
300 mm nominal dia.	:	1 in 200

3.04.02 Relation with water supply pipelines

Unless specifically cleared by the Engineer, under no circumstances shall drainage and sewer pipes be allowed to come close to water supply pipelines.

3.04.03 Laying

Each separate pipe shall be individually set for line and for level. Where lengths of sewer or drain pipes are laid in trench, properly painted sight rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed. More sight rails shall be required at manholes, change of gradient and intermediate positions if the distance for sighting is more than 50 ft. apart. The excavation shall be boned in at least once in every 6 ft. The foot of the boning rod shall be set on a block of wood of the exact, thickness of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails.

3.04.04 Support and Protection of Pipelines

All pipes shall be laid with sockets leading uphill. Preferably the pipe shall rest on solid and even foundations for the full length of the barrel. However, the pipe manufacturer's instruction as approved by the Engineer shall be followed in the matter of support and jointing.

To achieve full and continuous support, concrete for bedding and packing is the best. Where pipes are not bedded on concrete, the floor shall be left slightly high and carefully placed so that the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low packing shall be



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 11 OF 23

done in concrete. Where laid on rock or very hard ground which cannot be easily excavated to a smooth surface, the pipes shall be laid on a cradle of fine concrete floor of gravel and crushed stone over laid with concrete or on a well consolidated gravel and crushed stone bed as desired by the Engineer. PVC or similar pipes shall be laid directly on stable soil and packed with selected soil.

The minimum support and protection for glazed stoneware pipes shall be as follows:

- a) When cover is less than 2 metre below ground level and where pipes are unavoidably exposed above ground surface, the pipes shall be completely encased or surrounded with concrete.
- b) Where pipes are laid on soft soil with the maximum water table laying at the invert of the pipe, the sewer shall be bedded on concrete.
- c) Where the pipes have to be laid on soft soil with the maximum water table rising above the invert of the pipe, but below the top of the barrel, the pipe sewer shall be haunched.
- d) Where maximum water table is likely to rise above the top of the barrel or wherever the pipe is laid on soft soil the pipe sewers shall be completely encased or surrounded with concrete.

Vitrified clay pipes shall be laid on a bed of 150 mm thick cement concrete (1:3:6) nominal mix by volume.

Cast iron pipes and concrete pipes may be supported on suitable concrete or brick support, where specified. The supports shall be unyielding and strong enough. At least one support shall be located close to ends. Spacing of intermediate supports shall be as decided by the Engineer. Pipes shall be secured to the supports by approved means.

Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the expected thrust.

3.04.05

Entry into structures

For entry of the pipe lines into any building of structure suitable conduits under the structure or sleeves shall be used. The conduits and sleeves shall be such as to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipelines, locations and sizes shall be marked and checked by the Engineer. After laying of the pipeline the openings and chases shall be mended.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 12 OF 23

3.04.06 Ducts

Where solid, waste and ventilating pipes are accommodated in ducts, access to cleaning areas shall be provided. Connection to drain shall be through a gully with sealed cover to guard against ingress of sewer gas, vermin, or backflow.

3.04.07 Traps and Ventilating Pipes

Pipes are carrying off the waste from water closets and waste water and overflow water from baths, wash basins, sinks to drains shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated whenever such ventilation is necessary to maintain water seal of the trap. Ventilating pipes shall be carried up vertically from the drain to a height of at least 600 mm above the outer covering of the roof of the building or as shown on drawings. All vertical ventilating, anti-siphonage and similar pipe shall be covered on top with a cowl. The cowl shall be made of C. I. unless desired otherwise by the Engineer.

3.04.08 Manhole & Inspection Chambers

At every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The maximum distance between manholes shall be 30 meter unless specially permitted otherwise. However, for truck route (for pipes above 900 mm dia.) this distance can be increased to 45 M. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 metres unless desired otherwise provision of IS: 4111 (Part-1) shall be followed for construction of a manhole. Manhole shall be constructed so as to be watertight under test. The change in alignment shall be carried out in such a manner as to provide no lodgement for any splashing in case of accidental flashing of the chamber. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement, sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow.

Connecting to existing sewer lines shall be through a manhole.

Unless otherwise specified, 560 mm dia. circular cast iron manhole cover with frame, heavy-duty, conforming to IS: 1726 shall be provided. The covers shall be close fittings so as to prevent gases from coming out.

3.04.09 Cutting of Pipes

Manufacturer's instructions shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave surface clean and square to the axis of the pipe.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 13 OF 23

3.04.10

Jointing

Jointing of pipes shall be so planned as to avoid completely any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone.

All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and watertight when underground. Method of jointing shall be as per instructions of the pipe and fittings manufacturer and as approved by the Engineer. However, in the absence of any instruction available from the manufacturer the methods as detailed hereunder shall be used.

a) Cast Iron Pipes

Socket and spigot pipes shall be jointed by the cast lead joints. The spigot shall be centred in the socket of the pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. When the gasket or hemp yarn has been caulked tightly a jointing shall be placed round the barrel and tightened against the face of the socket to prevent airlock. Molten lead shall then be poured in to fill the remainder of the socket and caulked with suitable tools right round the joint to make up for shrinkage of the molten metal on cooling and shall be finished 3 mm behind the socket face.

Joints in cast iron pipes with special jointing arrangements like 'Tyton' Joints etc. shall follow the instructions of the manufactures.

In special cases if flanged joints are accepted by the Engineer the joints shall be made leak proof by inserting approved type of rubber gaskets. The bolts shall be secured in stages to avoid uneven strain.

b) Concrete Pipes

Jointing of concrete pipes shall be generally of rigid type. Unless otherwise stated collar type joint shall be provided. IS: 783 shall be followed for general guidance.

The two adjoining pipes shall be butted against each other and adjoined in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The angular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement: 2 sand) which shall be rammed with caulking tool. After a day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured for 7 days.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 14 OF 23

c) Glazed Stoneware Pipes

Tarred gasket or hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly so as not to fill more than 1/4 of the total depth of the socket. The remainder of the socket shall be filled with a stiff mixture of cement mortar 1:1 (1 cement: 1 sand). A fillet shall be formed round the joint with a trowel, forming an angle of 45 deg. with the barrel of the pipe. The newly made joints shall be protected, until set and shall be cured by covering with damp cloth or other suitable materials.

d) Vitrified clay pipes

The vitrified clay pipe shall be made from refractory clay mixed with crushed pottery and stone and burnt at a high temperature. These shall be hard, compact, and glazed to make them acid resistant and impervious, and shall be obtained from approved manufacturer.

Special care shall be taken in handling these pipes. The pipes shall not be jointed until the earth has been partly refilled over the portion of the pipe between the joint holes. Before laying the second pipe, the socket of the first pipe laid shall be thinly painted all round on the inside with cement slurry (1 part of cement and 2 parts of clean, sharp sand). A ring of rope yarn (closely twisted hemp or jute) dipped in neat cement paste or tar or bitumen, shall be inserted in the socket of pipe and driven home with caulking tools. The rope shall fully encircle the spigot with a slight overlap and shall not occupy more than one-fourth of the total depth of the socket. Where the spigot end of the pipe is made for receiving the gasket, it shall be wrapped with two or three turns of tarred spun, as close to the end as possible, before inserting into the socket. The joint shall then be completely filled with cement mortar (1:1), which shall have very little water. A fillet shall be formed round the joint with trowel, forming an angle of 45 degrees with the outside pipe. Special care shall be taken so that any excess mortar etc. left inside the pipe joints is neatly cleaned off immediately after each joint is made. A semi-circular wooden scrapper or a rubber disc to which a long handle is fixed could be used for this purpose.

e) Lead Pipes

The joints in lead pipes shall be made as wiped solder joint. The minimum and the maximum length of the wiped solder joints shall be 8 cm. and 9 cm. respectively. The solders shall generally consist of two parts of lead and one part of tin.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 15 OF 23

f) Polyethylene Pipes

The joints shall be thermo welded or bolted as per manufacturer's instructions.

g) Jointing Cast Iron Pipes with Stoneware Pipes

Where any cast iron drain pipe, ventilating pipe or trap is connected with a stoneware or semi-vitrified waste pipe, the beaded spigot end of such cast iron drain pipe, waste or ventilating pipe or trap shall be inserted into a socket of such stoneware pipe and the joint made with mortar consisting of one part of cement and one part of clean sand after placing a ratted gasket or hemp yarn soaked in neat cement slurry round the joint and inserted in it by means of a caulking tool.

h) Jointing Stoneware with Cast Iron Pipes

Where any water closet pan or earth ware trap connected to such a pan is to be jointed with a cast iron soil pipe, the joint between the stoneware spigot and the cast iron socket shall always be of a flexible nature. Such joint shall be made with a mixture of bitumen and chopped asbestos fibre.

3.04.11 Trenches and other excavations

Width of the trench at the bottom shall be such as to provide 200 mm clearance on either side of the pipe for facility of laying and jointing.

Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the spoil bank shall not be allowed to endanger the stability of the excavation. Spoil may be carted away and used for filling the trench behind the work.

Turf, top soil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement.

All excavation shall be properly timbered, where necessary.

Efficient arrangements for dewatering during excavation and keeping it dry till backfilling shall be made to the satisfaction of the Engineer. Sumps for dewatering shall be located away from the pipe layout.

Where the excavation proceeds through roads necessary permissions shall be secured by the Contractors from the appropriate authorities.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 16 OF 23

Special care shall be taken not to damage underground services, cables etc. These when exposed shall be kept adequately supported till the trench is backfilled.

The backfilling shall be done only after the pipeline has been tested and approved by the Engineer. Special care shall be taken under and sides of the pipe during hand packing with selected material. At least 300 mm over the pipe shall also be filled with soft earth or sand. Consolidation shall be done in 150 mm layers. The surface water shall be prevented from getting into the filled up trench. Traffic shall not be inconvenienced by heaping up unduly the backfilling material to compensate future settlement. All future settlements shall be made good regularly to minimize inconvenience of traffic where applicable.

3.04.12 Protection

Open end of each pipe shall be protected during installation by suitable covers or plugs so that the ends, threads, sockets, or spigot are not damaged and no foreign material can find its way into the pipeline. Fittings and fixtures liable to be misused or stolen during the construction phase shall be fitted only before testing and handing over.

3.05.00 WATER STORAGE TANKS

Overhead/loft type water storage tank shall be made of PVC. These tanks shall be provided for each toilet block and placed on the roof/loft of the building. Tank shall be installed with proper supports and anchorage for applicable wind and seismic condition. Installation of tank shall be carried out according to the recommendation of IS: 12701. These tanks shall rest preferable on flat surface so as to distribute the load evenly. The tank shall be leak-proof and water tight.

The outlet pipe shall be 50 mm above the bottom of the tank and provided preferably with strainers. The wash out or draining pipe shall be connected at the lowest point and flush with bottom of tank.

Tank shall be provided with all fittings for inlet, outlet, overflow pipes and ball valves.

3.06.00 SEPTIC TANK AND EFFLUENT DISPOSAL

3.06.01 Septic tank

Septic tank shall consist of the tank itself with inlet and outlets there from complete with all necessary earthwork and backfilling. The details of septic tank shall be as shown on drawings. This item shall also include ventilating



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 17 OF 23

pipe of at least 100 mm dia. whose top shall be provided with a suitable mosquito proof wire mesh and cowl. Ventilating pipe shall extend to a height of about 2 meter when the septic tank is at least 15 meter away from the nearest building and to a height of 2 meter above the top of building when it is located closer than 15 meter. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed.

3.06.02 Effluent Disposal

The effluent from the septic tank shall be disposed by allowing it into an open channel or a body of water if the concerned authority approves or into a soak pit for absorption by soil or shall be allowed to be absorbed by soil through open jointed SW pipes laid in a trench filled with broken bricks.

3.06.03 Soak pit

The soak pit shall be complete. It shall consist of a 900 mm dia. pit 1000 mm in depth below the invert level of the inlet pipe. The pit shall be lined with stone; brick or concrete blocks set in cement mortar (1:6) and filled with brickbats. Inlet pipe shall be taken down to a depth of 900 mm from the top as an anti-mosquito measure.

3.06.04 Open jointed SW Pipe/dispersion trenches

Minimum dia. of the SW pipes shall be 150 mm nominal. The trench for laying the pipes shall be a minimum 600 x 600 mm. The joints of the pipes shall be left unsealed. The entire length of the pipe within the trench shall be buried in a 250 mm layer gravel or crushed stone of uniform size. On top of gravel/crushed stone layer is a 150 mm bed of well-graded coarse aggregate. Ordinary soil is used for filling the top of trench.

3.06.05 Commissioning septic tank

After the septic tank has been proved watertight and the sewage system is checked the tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall be seeded with well digested sludge obtained from septic tank or sludge digestion tank. In the absence of digested sludge, a small quantity of decaying organic matter such as digested cow-dung may be introduced.

3.07.00 Related Works

All works, like earthwork, masonry, concrete, steelwork, cutting holes, chases, repairs and rectification associated directly with installation of water supply and sanitation systems shall come under scope of the Contractor unless specifically excluded. These works are not detailed out in this Section.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 18 OF 23

3.08.00 Regulation

The work which is required to be carried out under this section, shall be executed by a licensed Plumber only (engaged by the Contractor) and he shall obtain all necessary sanctions, permissions, certificates etc., from Municipal and/or other Local Authorities and shall abide by all the rules of such Authorities.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 Inspection Before installation

All pipes, fittings, and appliance shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.

4.02.00 Testing of Water Supply pipe line

4.02.01 Testing of Mains After Laying

After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25 mm inlet with a stop-cock, allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 5 Kg/sq.cm or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of a large diameter, by a power driven test pump, provided that the pump is not left unattached. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable less for at least five minutes. The end of the main shall be closed by fitting a watertight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains.

4.02.02 Testing of Service Pipes and Fittings

The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely watertight. All piping, fittings, and appliances shall be checked for satisfactory support and protection from damage, corrosion, and frost.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 13/02/2018

SHEET 19 OF 23

4.03.00 Testing of Drain and Sewerage Pipelines

All soil pipes, waste pipes, ventilating pipes and all other pipes, when above ground, shall be gas tight. All sewers and drainpipes laid below ground shall be tested water tight. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final.

General guidance for the tests are given below:

a) Smoke test

All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tarpaper or similar material in the combustion chamber of a smoke machine. Chemical smokes shall not be used.

b) Water test

The pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under tests. The tolerance figure of two litres per centimetre of diameter per kilometre may be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system, with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

Subsidence of test water may be due to one or more of the following cases:

- a) Absorption by pipes and joints
- b) Sweating of pipes or joints
- c) Leakage at joints or from defective pipes
- d) Trapped air.

	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-635-600-C001 VOLUME - SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 13/02/2018 SHEET 20 OF 23
	Allowance shall be made for (a) by adding water until absorption has ceased and after which the test proper should commence. Any leakage and the defective part of the work shall be cut out and made good. c) For straightness i) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball will roll down the invert of the pipe end emerge at the lower end; and ii) By means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipeline is not straight. 4.04.00 Fittings and Fixtures etc. All fittings and fixtures shall be connected by water tight joints. No dripping of water shall be acceptable. 4.05.00 Testing Septic Tank The septic tank shall be tested for water tightness. It shall be filled up with water and allowed to soak for 24 hours. Then, it shall be topped up and allowed to stand again for 24 hours and loss of level recorded. The fall shall not be more than 15 mm in 24 hrs. 5.00.00 I.S. CODES Important relevant IS Codes for this specification are listed below: Latest editions shall always be consulted. IS: 404 : Lead pipes. IS: 407 : Brass tubes for general purposes. IS: 458 : Concrete pipes (with or without reinforcement) IS: 783 : Code of Practice for laying of concrete pipes. IS: 1172 : Code of basic requirements for water supply, drainage and sanitation. IS: 1200 : Laying of water and sewer lines, including appurtenant items. (Pt. XVI)	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-635-600-C001
		VOLUME -
		SECTION - D SUB-SECTION – D15
		REV.NO. 00 DATE 13/02/2018
		SHEET 21 OF 23
	IS: 1230 : Cast iron rain water pipes and fittings. IS: 1239 : Specification for Mild Steel Tubes and Mild Steel (Pt. I & III) Tubulars and other wrought steel pipe fittings (10 mm to 15 mm nominal diameter). IS: 1536 : Specification for centrifugally cast (Spun) iron pressure pipes for water gas and sewage. IS: 1537 : Specification for vertically cast iron pressure pipes for water, gas and sewage. IS: 1592 : Asbestos cement pressure pipes, IS: 1626 : Asbestos cement pressure pipes, gutters and fittings (Spigot and Socket types). IS: 2065 : Code of Practice for Water Supply in buildings. IS: 2501 : Copper tubes for general engineering purposes. IS: 2556 : Specification for vitreous sanitary appliances (vitreous china) Part – I - General requirement IS: 2633 : Method of testing, uniformity of coating on zinc coated articles. IS: 3076 : Low density polyethylene pipes for portable water supplies. IS: 3486 : Specification for Cast iron spigot and socket drain pipes (80 mm to 250 mm nominal diameter). IS: 3589 : Specification for Electrically welded steel pipe for water, gas and sewage (200 mm to 2000 mm nominal diameter). IS: 4827 : Specification for electro plated coatings of nickel and chromium on copper and copper alloy. IS: 4964 : High-density polyethylene pipes for portable water supplies. IS: 12701 : Rotational moulded polyethylene water storage tanks	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-635-600-C001
		VOLUME -
		SECTION - D SUB-SECTION – D15
		REV.NO. 00 DATE 13/02/2018
		SHEET 22 OF 23
6.00.00	RATE AND MEASUREMENT	
6.01.00	RATE	
6.01.01	G.I. Pipes for Water Supply	
	Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. with cutting, making chases and jointing of pipes, making good the walls.	
6.01.02	Rainwater Down-comers	
	Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. The rate also includes cost of jointing and making good the opening in structure.	
6.01.03	Sanitary Fixtures	
	Rate shall include providing and fixing of sanitary appliances & fixtures and at all elevation, including all accessories and fittings, connections pipes, waste trap and pipes all complete as per description of “Schedule of Items”. Rate shall also include the jointing of waste & traps to drain pipes.	
6.01.04	Drainage and Sewer Pipes	
	Rate shall be inclusive of providing, laying and jointing of pipes as specified. Rate also include cost of lead joints or other joint as specified, cost for painting and cutting and making good walls, floors etc.	
6.01.05	Floor and Gully Traps	
	Rate of traps is inclusive of all excavation, filling, repair, making good of opening in floor and walls, grating, painting etc. complete as described in “Schedule of Items”.	
6.01.06	Manholes, Septic Tank, Soak Pit and Cover	
	Rate of manholes, septic tank, soak pit shall be paid under respective items of work executed like brick work, plastering, concrete, reinforcement steel etc. provided for completion of the structure as per drawing and specifications. Manhole cover shall be paid separately as per description of item.	
6.01.07	Water Storage Tank	
	The rate for water storage tank is inclusive of supply and installation of tank with all fittings, inlets, outlets, valves etc. complete.	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-635-600-C001
		VOLUME -
		SECTION - D SUB-SECTION – D15
		REV.NO. 00 DATE 13/02/2018
		SHEET 23 OF 23
6.02.00 MEASUREMENTS 6.02.01 Pipe for Water Supply and Drainage For G.I. Pipe of water supply line, rainwater down comers, drainage and sewer pipe, the measurements shall be in running metres and shall be taken along centre line of pipe or specials. The pipe shall be measured separately according to dia. and class of pipe. Fixtures like bibcock, stopcocks, valves etc. shall be measured in numbers. 6.02.02 Sanitary Appliances & Fixtures and Allied Works All sanitary appliances & fixtures like sink, washbasin, WC, shall be measured in numbers for the complete work as described in schedule of items. Floor and gully traps shall be measured in numbers unless otherwise specified. Water storage tank shall be measured in numbers for the capacity as specified in “Schedule of Items”. The item of work executed for completion of manholes, septic tank & soak pit shall be measured in respective items of work like brick work, RCC, plastering etc. CI cover shall be measured in numbers as specified in “Schedule of Items”.		



TITLE:

**TECHNICAL SPECIFICATION FOR
ROOF DECKING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D19

REV.NO. 00 DATE 13/02/2018

SHEET 1 OF 7

SECTION - D

SUB-SECTION – D19

ROOF DECKING

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
ROOF DECKING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D19

REV.NO. 00 DATE 13/02/2018

SHEET 2 OF 7

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	MATERIALS	3
3.00.00	INSTALLATION	3
4.00.00	ACCEPTANCE CRITERIA	6
5.00.00	IS CODES	6
6.00.00	RATES AND MEASUREMENTS	7

	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-635-600-C001
		VOLUME -
		SECTION - D SUB-SECTION – D19
		REV.NO. 00 DATE 13/02/2018
		SHEET 3 OF 7
<u>ROOF DECKING</u>		
1.00.00	Scope This section of the specification covers the supply, fabrication and erection of profiled light gauge Metal Decks (coated and painted) as roof decking to the main plant building and any other area as indicated in the drawings.	
2.00.00	Material	
2.01.01	Roof of main plant TG and Deaerator bay and bunker building consists of permanently colour coated (on exposed face) galvanized MS trough metal sheet decking plate of approved colour over roof purlins for cast-in-situ roof slab as per IS: 14246 and conform to class 3. Thickness of deck plate shall be minimum 0.8mm and minimum trough depth of 44 mm and center to center of the valley shall be 130mm with minimum yield strength of 250 Mpa. Silicon modified polyester paint shall be used for permanent coating over galvanized surface with minimum rate of galvanization 150 gm/sqm. DFT of permanent colour coating shall be 20 microns. It shall serve as permanent shuttering for cast-in-situ roof slab. It should have adequate strength to support weight of green concrete and imposed load during construction. The thickness of the deck plate shall however be designed suitably according to the spacing of roof purlins.	
3.00.00	INSTALLATION The Contractor shall furnish all labour, equipment and materials as required for the design, fabrication, coating, erection and fixing of the decking over purlins, painting and for the complete performance of the work in accordance with the construction drawings and as described herein. The description, which follows, gives a general indication of the nature and extent of the work but is not necessarily exhaustive and does not purport to cover all the details/operations which will be necessary in order to carry out the work.	
3.01.00	Detailed Design of Roof Decking The Contractor, in conjunction with the manufacturer, shall be responsible for the detailing of the profiled decking, fittings and fixtures and shall submit with his tender particulars of the proposed manufacturer and of the particular product proposed for use. The detailing is to be based on typical details furnished by the Engineer. The Contractor shall submit to the Engineer, two copies of the general arrangement and detailed working drawings for the proposed design, together with all calculations necessary to verify the adequacy and completeness of the design & detailing of decking sheets, fixtures, flashings and trims. After approval he shall supply further eight copies.	

	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-635-600-C001
		VOLUME -
		SECTION - D SUB-SECTION – D19
		REV.NO. 00 DATE 13/02/2018
		SHEET 4 OF 7
	The Engineer will verify the correct interpretation of his requirements but may not necessarily check the design and details, and the Contractor shall be entirely responsible for the accuracy of the drawings and the correctness of the design and the suitability of the details. Manufacture of roof decking sheets shall not commence until the necessary approval of the Engineer has been obtained. 3.02.00 Erection & Fixing 3.02.01 Sequence of Manufacture/Erection Cutting Schedules, delivery to site and stacking arrangements in store shall ensure that sheets are erected in a sequence which follows that for the manufacture. The decking sheets shall be erected using an arrangement of sheets and joints to conform with the requirements of this specification. Decking erection for each elevation or feature shall commence at one end only and proceed towards the other end, in order to ensure tight fitting laps. 3.02.02 Position and Location of Laps Side and end laps of roof decking sheets shall be located and positioned in such a manner as to provide the maximum weather protection taking into account the direction of the prevailing wind. The lines formed by horizontal laps and fixing shall where possible, be continuous and coincide with the edges of large openings in the roof. 3.02.03 Alignment of Sheets and Fixings All roof decking sheets shall be fixed plumb and level with all fixings evenly spaced and accurately lined. All dirt and grease shall be removed from the surfaces of the sheets as the work proceeds. 3.02.04 Site Cutting Approval must be obtained before the roof decking sheets are cut at site. Generally cutting of sheets to length will not be permitted, only special cutting and trimming for small openings shall allowed. Where possible, site cut edges shall be concealed at laps. 3.02.05 Damaged Sheets Distorted, blemished or water stained sheets and any other fittings shall not be used.	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-635-600-C001			
		VOLUME -			
		SECTION - D		SUB-SECTION – D19	
		REV.NO.	00	DATE	13/02/2018
		SHEET	5	OF	7
3.02.06	Laps End laps and side laps to roof decking sheets shall be sufficiently large to ensure that the decking complies with the weather tightness and other requirements of this specification. The length of each decking sheet shall be adjusted so that the end laps shall bear on the purlins. In no case end laps shall not be less than 150 mm and side laps shall not be less than 53 mm.				
3.02.07	End Lap Fixings End lap fixings shall be located at least 25 mm from the end of each sheet.				
3.02.08	Side Lap Fixings The spacing of side lap fixings shall ensure compliance with this specification regarding tightness. The spacing of these fixing screws shall not exceed 500mm. The fixing shall be located in the bottom flat of the corrugation.				
3.02.09	Holes Holes in MS decking sheets shall be punched. In case holes are drilled holes, it is to be ensured that the holes do not go oversize due to the small thickness of the sheeting. All drilling swarf shall be removed from the surfaces of decking, supporting steel work, purlins etc.				
3.02.10	Location and Spacing of Fixings Fixings shall be accurately located in position in the centre of the corrugations to ensure that the heads of bolts, nuts and washers bear squarely down on the surface of the sheeting and are not located at the edge or on the joints in supporting purlins.				
3.02.11	Fixings The tenderer shall submit with his tender details of the proposed method for securing the roofing sheets to the metal purlins. The roof decking sheets are to be fixed to the roof purlins with hex washer head white zinc plated heat treated carbon steel self-drilling / self-tapping screws of minimum thread diameter of 5.6mm. These self-drilling screws shall be drilled through the roofing sheets and purlins supporting the roofing sheets. These purlins shall be suitably spaced as per the requirement of roofing sheets and the roofing sheets shall not sag more than span/250 for the loads likely to be imposed during concreting and in future. The self-drilling screws are to be spaced at a maximum distance of 390mm centre to centre along the length of the purlins and top chord of truss. The screws are to be located preferably in the valley only and shall be installed in accordance with the manufacturer’s				

	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-635-600-C001	
		VOLUME -	
		SECTION - D	SUB-SECTION – D19
		REV.NO. 00	DATE 13/02/2018
		SHEET 6	OF 7
	recommendations using tools approved by the manufacturer which do not damage the coating of the decking sheets.		
3.03.00	Protection during Construction Precautions shall be taken during the erection of the roof decking to ensure that partially erected decking are protected during inclement weather and damage at all times.		
3.04.00	Damage Any damage to coating & primer during transportation is to redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner.		
4.00.00	Acceptance Criteria The installation shall present a neat appearance and shall be checked for water tightness. The following shall be checked: a) Side and end laps b) Absence of damage in the sheeting. c) Conformity of fixings with the approved design.		
5.00.00	IS Codes All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed. IS: 513- Specification for cold rolled carbon steel sheets. IS: 3618 - Specification for phosphate treatment of iron and steel for protection against corrosion. IS: 4431 - Specification for carbon & carbon manganese free cutting steel. IS: 1573 - Electroplated Coatings of zinc on iron and steel.		

	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-635-600-C001 VOLUME - SECTION - D SUB-SECTION – D19 REV.NO. 00 DATE 13/02/2018 SHEET 7 OF 7
6.00.0	RATES AND MEASUREMENTS 6.01.00 Rates Rates shall be unit rate for complete item described in the Schedule of Items and shall include all wastage. 6.02.00 Method of Measurement Roofing shall be measured for net area of the work done. Profiled sheeting (coated & painted) shall be measured in plan area of sheets and not girthed. No deduction shall be made for openings measuring up to 0.1 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size. No payments shall be made for laps.	



TITLE:

**TECHNICAL SPECIFICATION
FOR FALSE FLOORING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D20

REV.NO. 00 DATE 13/02/2018

SHEET 1 OF 6

SECTION - D

SUB-SECTION – D20

FALSE FLOORING

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION
FOR FALSE FLOORING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D20

REV.NO. 00 DATE 13/02/2018

SHEET 2 OF 6

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	GENERAL	3
2.00.00	MATERIALS	3
3.00.00	INSTALLATION	4
4.00.00	ACCEPTANCE CRITERIA	5
5.00.00	IS CODES	6
6.00.00	RATES AND MEASUREMENTS	6



TITLE:

**TECHNICAL SPECIFICATION
FOR FALSE FLOORING**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D20

REV.NO. 00 DATE 13/02/2018

SHEET 3 OF 6

FALSE FLOORING

1.00.00 General

This section of the specification covers the supply, fabrication and installation of false flooring system having PVC top finish particle board, GI supporting system, painting etc. as per schedule of items in the main plant building and any other area as indicated in the drawings.

The scope of contractor covers supplies of all materials, fabrication & installation works required to be carried out for completion of false flooring in the area specified in the drawings.

2.00.00 MATERIAL

2.01.00 Supporting structure

Supporting pedestals shall be made of steel and will be of height as required. Supporting pedestal shall be truly vertical and located at distances to conform with size of floor panels and shall be equipped with locking devices to prevent disturbances of finished elevation. Base of pedestal shall have integral load dispersion plate of size 100x100x8mm to transmit the load evenly to the base floor. Adjustment of pedestal shall be provided by threaded vertical rod of 25mm diameter and elevating nut. The pedestal head shall provide positive interlocking of the steel grid channels supporting system and shall prevent lateral shifting.

The grid channels shall be made of galvanised steel of 40mm x 40mm x 3.15mm thick and shall be placed at 610mm centre to centre both ways to support floor panels in uniform levelled elevations. Nominal height of the false flooring system shall be 600 mm unless otherwise indicated. Pedestal head shall be equipped with conducting grounding pad if so desired by the Engineer

2.02.00 Floor Panels

The floor panels shall be made of fire resistant particle board, phenol formaldehyde bonded. Size of each panel shall be 610mm x 610mm with all panel edges finished to a tolerance of + 0.2mm. Floor panel shall have 2mm thick non-static PVC on top, 2mm thick hard PVC strip lipping on four edges and 26 G aluminium sheet fixed with araldite at bottom. Minimum thickness of the panel shall be 35mm, unless otherwise noted. All panels shall be completely interchangeable and easily removable with a suction lift tool. Panels shall be square within a tolerance of ± 0.25 mm on the diagonal. The floor panels shall be cut, wherever required for providing suitable outlets for cables and edges shall be lipped with hard PVC sheets.

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FALSE FLOORING	SPECIFICATION NO. PE-TS-635-600-C001 VOLUME - SECTION - D SUB-SECTION – D20 REV.NO. 00 DATE 13/02/2018 SHEET 4 OF 6
2.02.01	Strength Each 610mm x 610 mm floor panel must be capable of withstanding the designed service load. The ultimate strength shall provide a safety factor of 3. The false flooring shall be capable of carrying a axial load of 800 kg and uniform load of 2000 kg/sq.m with maximum deflection of 1/350. If required by the Engineer, the samples shall be accepted only after carrying out load tests. The Engineer may relax the test requirements with concentrated load in case cabinets are not handled with castor fitting arrangement. One additional pedestal shall be provided under floor stringer along front panel area of each control board for taking possible additional load that may occur from time to time. 2.02.02 Surface finish All removable panels shall have the top surface finished with 2 mm thick flexible PVC flooring conforming to IS:3462 and shall be fixed to the surface with compatible high-creep resistant adhesive. The PVC floor tile shall be in single piece for each floor panel. Under side of panels shall also be painted with suitable epoxy or oil based paint. 2.02.03 Damaged Floor Panels Distorted, blemished or stained floor panels shall not be used. 2.03.00 Skirting Skirting shall be 150 mm high and 2 mm thick, completely matching with false flooring surface finish materials and shall be fixed to the wall surface as per manufacturer's installation instructions. 3.00.00 INSTALLATION 3.01.00 Base The system shall be placed over a base of RCC floor slab and beams. Any grouting etc. that is necessary to fix the supporting structure shall be done. The concrete sub floor shall be sealed with two coats of polyurethane paint to prevent moisture from coming in contact with cables and to minimize dust problem. The floor panels and channels shall be completely interchangeable and remain in position without screwing or bolting under working/imposed loadings. Any damage to the sub floor during installation of the false flooring system	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FALSE FLOORING	SPECIFICATION NO. PE-TS-635-600-C001
		VOLUME -
		SECTION - D SUB-SECTION – D20
		REV.NO. 00 DATE 13/02/2018
		SHEET 5 OF 6
	shall be made good by the contractor without any extra cost to the Owner. All steel surfaces are to be protected by two coats of polyurethane paint over a compatible primer and any damage to the paint during installation shall be made good. In case the loads exerted by the weight of machines are above the stated characteristics of floor finish material, the floor shall be protected by overlaying hard board during installation of machine or equipment. All installation work of the false flooring system shall be supervised by the manufacturer's authorized representative. 3.03.00 Painting After fixing the false flooring supporting system the sub floor shall be given a coat of polyurethane paint. 3.04.00 Protection during Construction All precautions shall be taken during the erection of the false flooring to ensure that partially erected flooring are protected and shall not be damaged before handing over to owner. 3.05.00 Damage Any damage of coating to supporting system caused during transportation is to be redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner. 4.00.00 ACCEPTANCE CRITERIA The false flooring system shall only be accepted after completion of following checks: - Level - Alignment of joints - Thickness of joints - Surface finish - Colour and texture - Details of edges, junctions etc. - Performance - Criteria specified for strength.	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FALSE FLOORING	SPECIFICATION NO. PE-TS-635-600-C001 VOLUME - SECTION - D SUB-SECTION – D20 REV.NO. 00 DATE 13/02/2018 SHEET 6 OF 6
5.00.00	IS CODES All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed. IS:5318 Laying of flexible sheet and flooring. IS:3462 Flexible PVC flooring IS:3087 Wood particle boards (medium density) for general purposes.	
6.00.0	RATES AND MEASUREMENTS	
6.01.00	Rates	
	Rates shall be unit rate for complete item described in the Schedule of Items and shall include, but not limited to, supply & installation of floor panels, supporting systems, paintings etc.	
6.02.00	Method of Measurement	
	False flooring shall be measured in Sq.M for net area of the work done. No deduction shall be made for openings measuring up to 0.4 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.	



TITLE:

**TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 13/02/2018

SHEET 1 OF 16

SECTION - D

SUB-SECTION – D22

SITE LEVELLING & GRADING WORKS

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 13/02/2018

SHEET 2 OF 16

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	GENERAL	3
2.00.00	SCOPE	3
3.00.00	MATERIALS	4
4.00.00	QUALITY CONTROL	6
5.00.00	EXECUTION	6
6.00.00	RATES AND MEASUREMENTS	15

	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-635-600-C001 VOLUME - SECTION - D SUB-SECTION – D22 REV.NO. 00 DATE 13/02/2018 SHEET 3 OF 16
GENERAL TECHNICAL SPECIFICATION FOR SITE LEVELLING AND GRADING 1.00 GENERAL This specification covers the works to be carried out for “Site Levelling and Grading Works including Slope Protection” etc. for the entire plant and associated areas. The specified formation level(s) shall be achieved either by excavation or by raising with controlled fill with excavated/borrowed earth as the case may be. 2.00 SCOPE 2.01 The scope include all works involved in levelling the site to the lines, grades, cross sections and dimensions as shown on the approved drawings and/or as directed by the engineer including site clearance, setting out, earth work in excavation, stacking, loading, transportation, unloading, dewatering, drainage, filling, watering, compaction, turfing on slopes (if required), lighting, disposal of residual/surplus earth etc. It also includes supplying and providing all labour, materials, supervision, services, equipments, tools and plants, testing and all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work etc. 2.02 All tools and plants, equipments and machineries to be used in this work shall be of standard quality and manufactured by reputed concerns conforming to Indian Standard (IS) codes or equivalent thereof. 2.03 Work to be provided by the Contractor The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following. a) Supplying and providing all labour, supervision, services including as required under statutory labour regulations, materials, equipments, tools and plants, approaches, transportation etc. required for the completion of the work. b) Preparation and submission of detailed scheme of all operations required for executing the work (material handling, placement, services, approaches etc.) to the engineer for approval. c) Carrying out sampling and testing on fill materials/fills to assess the quality/moisture content/degree of compaction and submission of the test results whenever required by the engineer. d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc.		

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-635-600-C001
		VOLUME -
		SECTION - D SUB-SECTION – D22
		REV.NO. 00 DATE 13/02/2018
		SHEET 4 OF 16
2.04	Work to be provided by others No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract.	
2.05	Codes and Standards All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) codes unless specified otherwise. IS: 1200 Methods of measurement of building and civil engineering works, Part-1: Earthwork IS: 2720 Method of test for soils (Relevant parts) IS: 3764 Excavation work- Code of safety IS: 4081 Safety code for blasting and related drilling operations IS: 4701 Code of practice for earthwork on canals IS: 6922 Criteria for safety and design of structures subject to underground Blasts In case of conflict between this specification and those (IS codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by the specification or/and by the IS codes, any other standard practice as may be specified by the engineer shall be followed.	
2.06	Conformity with Designs The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.	
3.00	MATERIALS All materials required for the work shall be of best variety and approved by the engineer.	
3.01	Materials for Excavation For the purpose of identifying the various strata met during the course of excavation, the following classification is to be followed.	

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 13/02/2018

SHEET 5 OF 16

a) Soil

It includes all type of soil including laterite, moorum etc. with/without any percentage of kankar which can be excavated by normal means such as shovel, pick axe, crow bar, spade etc. and those which do not fall under **clause 3.01 (b) and (c)** etc.

b) Soft Rock

It includes the rocks (including weathered rock) which are removable by splitting with the help of crow bar, pick axe, wedges, pavement breakers, pneumatic tools, hammers or such implements etc. and not requiring blasting (for excavation) in the opinion of the engineer.

c) Hard Rock

It includes the rocks, which require blasting for excavation in the opinion of the engineer. Where blasting is prohibited for any reasons, the excavation shall be carried out by chiseling or any other method as approved by the engineer. The mere fact that the contractor resorts to blasting shall not classify the soft rock under hard rock.

However, the engineer's decision on the type of strata encountered during excavation shall be the final and binding on the contractor.

3.02**Materials for Filling**

Any coarse grained or fine grained low plastic soil free from vegetation, roots, shingle, salts, organic matters, sod and any other harmful chemicals shall be used for filling. The contractor shall test the fill material to establish its suitability and submit the results to the engineer for approval. Fill material shall be got approved by the engineer. The following type of materials shall not be used for filling.

- a) Materials from swamps, marshes and bogs
- b) Expansive clays
- c) Peat, logs, sod and perishable materials
- d) Materials susceptible to combustion
- e) Any material or industrial and domestic produce which will adversely affect other materials of work
- f) Materials from prohibited areas

The earth available by cutting the high grounds within the project site and the materials (if) available from the road excavation or any other excavation under the same contract shall be used for filling depending upon its suitability as fill material. Filling with excavated rock (in the project site) shall be done only with the written permission of the engineer in the following manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any



TITLE:

**TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 13/02/2018

SHEET 6 OF 16

approved earth to fill the voids as far as possible and the mixture shall then be used for filling. In case the earth required for filling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc. shall be borne by him. He shall obtain and submit the necessary clearances/permissions from the concerned authorities to the engineer for the borrow areas/materials acquired.

4.00

QUALITY CONTROL

All works shall conform to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

Sl. No.	Activity	Check
1	Lines, levels & grades	a) By periodic surveys b) By establishing markers, boards etc
2	Filling	(a) On quality of fill material (b) On moisture content of fill material (c) On degree of compaction achieved

5.00

EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of approaches, dewatering (if any), drainage and compaction etc. within 15 days of award of the contract to the engineer for approval.

5.01

Site Clearance

Before the commencement of earthwork, the entire area of cutting and filling shall be cleared of all trees, stumps, bushes, grasses, vegetation etc. with their roots, fences, logs, rubbish, water, slush etc. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below the existing ground level or 300mm below the formation level whichever is deeper. After the removal of roots of trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The trees shall be cut in to suitable pieces as instructed by the engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed off to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timbers, fire

If the excavation is done to a depth greater than that shown on the drawing or as directed by the engineer due to the contractor's fault, the excess depth shall be

	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-635-600-C001 VOLUME - SECTION - D SUB-SECTION – D22 REV.NO. 00 DATE 13/02/2018 SHEET 8 OF 16
	filled up to the required level with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer at the own risk and cost of the contractor. Suitable slope in cutting as per the requirements and as directed by the engineer shall be adopted to withhold the face of earth. The contractor shall be held responsible for any damage to any part of the work caused by the collapse of the side of excavations. 5.03.01 Excavation in Hard Rock Excavation in hard rock shall normally be done with blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. 5.03.02 Blasting a) General Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations). No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to transport the explosives as and when required for the work in a safe manner to the work spot. Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim. b) Materials	

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 13/02/2018

SHEET 9 OF 16

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

c) Storage of Explosives

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well-ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine.

Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100m distance from any magazine. Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful

* not to put their feet on the clean floor unless the magazine shoes on.

* not to touch the magazine shoes on ground outside the clean floor.

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 13/02/2018

SHEET 10 OF 16

* not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

d) Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

e) Use of Explosives

The contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his responsibilities. Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 13/02/2018

SHEET 11 OF 16

holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc. and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be

present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc. shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc. shall be taken during blasting operations.

	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-635-600-C001 VOLUME - SECTION - D SUB-SECTION – D22 REV.NO. 00 DATE 13/02/2018 SHEET 12 OF 16
5.03.04	Restrictions on Blasting a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted. b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted. c) Progressive blasting shall be limited to two third of the total remaining depth of excavation. d) No large scale blasting operations will be resorted to when the excavation reaches the last one meter and only small charge preferably black powder may be allowed so as not to shatter the parent rock. e) The last blast shall not be more than 0.50 m in depth. f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiseling or any other suitable method as approved by the engineer.	
5.04	Sorting of Excavated Materials	
	The excavated material shall be carefully sorted for use in filling the areas in the project site by removing roots, grasses, organic matters and other objectionable materials and be sorted out into different types of materials for use and as directed by the engineer. The excavated material which is not considered fit for filling purpose shall be immediately removed and disposed at such a place and in such a manner as will be directed by the engineer. The material found unusable should be got approved by the engineer before actually disposing it off. The useful materials that cannot be used directly shall be heaped in separate area as stock piles. Stockpiles shall be of regular size as for as possible for ease of measurement. The materials heaped shall be utilized as and when required and as directed by the engineer. The cost of complete item of earthwork includes the cost of rehandling of the materials and temporarily heaped and reused.	
5.05	Disposal of Surplus/ Waste Materials	
	Surplus and other waste materials shall be removed and disposed of from the construction site to the area demarcated by the engineer. No material shall be wasted unless approved by the engineer.	
5.06	Earth Work in Filling	
	Levelling by raising with controlled fill of approved excavated/borrowed earth shall be carried out where the existing ground levels are lower than the specified formation level. After clearing site as per clause 5.01, the original ground shall be compacted by rolling subject to a minimum 6 passes of 8 to 10 tons' roller. The approved earth/fill material shall then be spread in horizontal layers' not exceeding 300mm in compacted thickness. Each layer shall be watered and thoroughly compacted with proper moisture content and such equipments as may be required to obtain a minimum of 95% of its maximum dry density as	

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 13/02/2018

SHEET 13 OF 16

determined by standard Proctor's test as per IS: 2720 part-VII or 85% of relative density as per IS:2720 part-XIV as specified. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The fill material shall be tested for its optimum moisture content and maximum dry density as per IS: 2720, part-VII. Moisture content shall be checked at the source of supply in accordance with IS:2720 part- II and if found less than that required for proper compaction, the same shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from the hose line or from the truck-mounted water tank etc. making due allowance for evaporation losses and the fill material be thoroughly mixed by means of harrows, rotary mixers or by any other suitable approved method until the layer is uniformly wet. **Flooding shall not be permitted for watering purpose under any circumstances.** If the material delivered is too wet, it shall then be dried by aeration and exposure to the sun till the moisture content is suitable for compaction. Should circumstances arise owing to wet weather the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended. Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the layers before compaction. For each of the above tests on the fill material, one sample for every 10,000cu.m shall be tested. Additional samples shall be tested whenever there is a change of source or type of material.

Before start of filling, the contractor shall submit the engineer his proposal for the methodology to be adopted for compaction. The compaction equipments as approved by the engineer shall only be employed to compact the different type materials encountered during construction. If directed by the engineer, the contractor shall demonstrate the efficacy of the plant he intends to use by carrying out compaction trials. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The compacted layer shall be tested for its dry density as per IS:2720, part-XXVIII or XXIX as directed by the engineer. Samples shall be taken at the rate of one sample for every 10,000sq.m area of each compacted layer. In addition random checks shall be carried out in compacted layers by means of Proctor needle penetration test. Contractor shall submit all the test results to the engineer immediately after completion of the tests. A sample shall be deemed to have passed the test when the dry density of the compacted fill is equal to or more than 95% of its maximum dry density. When field density measurements reveal any soft areas in the fills, further compaction shall be carried out as directed by the engineer. If in spite of that, the specified compaction is not achieved, the material in the soft areas shall be replaced with approved material compacted to the density requirements and satisfaction of the engineer.

Subsequent layers shall be placed only after the finished layer has been tested and accepted by the engineer.

Where the filling is to be done across low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed

	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-635-600-C001 VOLUME - SECTION - D SUB-SECTION – D22 REV.NO. 00 DATE 13/02/2018 SHEET 14 OF 16
	layer of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers. 5.07 Dewatering and Drainage It shall be ensured that the area to be excavated/filled shall be free from water. The contractor shall remove the water (if any) by pumping or by any other means as approved by the engineer. At all times, the surface of cutting/filling during execution shall be maintained at such a cross fall as will shed water and prevent ponding. All existing drains/channels (if any) in the work area shall be suitably diverted by the contractor before taking up any excavation or filling. These diversions shall be such that it shall ensure effective disposal of water without any accumulation or flooding within the project site and in adjoining areas. 5.08 Finishing Operations Finishing operation shall include the work of shaping and dressing the excavated/filled ground to the required grades, levels, lines, side slopes, cross-sections and dimensions as shown on the approved drawings or as directed by the engineer. 5.09 Turfing Turfing shall be provided at the slopes and other locations as shown on the drawings or as directed by the engineer. The turf shall be of approved quality of grass. The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically free from weeds or other undesirable matter. The grass on the sod shall have a length of approximately 50mm and the sod shall be free of any debris. Thickness of the sod shall be as uniform as possible with 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that all the dense root system of the grasses is retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than about 300mm x 250mm size but not so large so that it is convenient to handle and transport without damage. The area to be sodded shall be previously constructed to the required slope and cross section. Prior to placing the sods, the slopes shall be roughened and wetted in order to have a satisfactory bond. The strips of sod shall be laid in close contact with each other and be tamped firmly in place so as to fill and close the joints between them. The turfing so laid shall be well watered and protected until final acceptance.	

	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-635-600-C001 VOLUME - SECTION - D SUB-SECTION – D22 REV.NO. 00 DATE 13/02/2018 SHEET 15 OF 16
	5.10 Approaches The contractor shall provide proper approaches for workmen and inspection. 5.11 Lighting Full scale lighting is to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the edges of excavations and fills. 6.00 RATES AND MEASUREMENTS 6.01 Rates a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding sections in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the technical specification. b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way from those shown on the tender drawings. c) The unit rate quoted shall include minor details which are obviously and fairly intended and which may not have been included in these documents but are essential for the satisfactory completion of the work. d) The bidder's quoted rate shall be inclusive of supplying and providing all labour, men, materials, equipments, tools and plants, supervision, services, approaches, schemes etc. 6.02 Measurements Method of measurements are specified in the proceeding sections. Where not so specified, the latest version of IS:1200, Part-1 shall be applicable. a) The length, breadth and depth shall be measured correct to the nearest centimeter if measurements are taken by tape. Rounding of numerical shall be as per relevant IS Codes. If the measurements are taken with staff and level, the levels shall be recorded correct to 5mm. The area and volume shall be worked out in square meter and cubic meter correct to the nearest of two decimal places. b) For earth work in excavation, the ground levels shall be taken before and after completion of the work in the actually excavated area. The quantity of earth work in cutting shall be computed from these levels in cubic meter.	

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 13/02/2018

SHEET 16 OF 16

c) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in

stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

d) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rocks so arrived shall be taken as soil.

e) For earth work in filling, the actual measurements of fill shall be calculated by taking levels of the original ground before start of the work but after site clearance and after compaction of fills. The quantity of earth work in filling shall be computed from these levels in cubic meter.

f) For turfing, the measurement shall be made on the finished work in square meter.



TITLE:

**TECHNICAL SPECIFICATION
FOR ANTI-TERMITE
TREATMENT**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION - D23

REV.NO. 00 DATE 13/02/2018

SHEET 1 OF 5

SECTION - D

SUB SECTION - D23

ANTI-TERMITE TREATMENT

SPECIFICATION NO. PE-TS-635-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION
FOR ANTI-TERMITE
TREATMENT**

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D23

REV.NO. 00 DATE 13/02/2018

SHEET 2 OF 5

TABLE OF CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	SCOPE	3
2.00.00	EXECUTION	3
3.00.00	ACCEPTANCE CRITERIA	4
4.00.00	RATES	4
5.00.00	METHOD OF MEASUREMENT	4
6.00.00	I.S. CODES	5

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT	SPECIFICATION NO. PE-TS-635-600-C001	
		VOLUME -	
		SECTION - D	SUB-SECTION – D23
		REV.NO. 00	DATE 13/02/2018
		SHEET 3	OF 5

**TECHNICAL SPECIFICATION FOR
ANTI-TERMITE TREATMENT**

1.00.00

SCOPE

The scope of work is to set up a chemical barrier against attack by subterranean termites while the building is under construction.

2.00.00

EXECUTION

2.01.00

General

All work shall in general be executed as specified in IS: 6313 Part II-1981 and as per approved specification of the agency having special know-how for the job.

All necessary work to ensure uniform distribution and proper penetration of treatment of treating solution shall be done according to the instruction of the Engineer.

Soil treatment shall not be done when it is raining or when the soil is wet with rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.

2.02.00

Chemicals and Rate of Application

Any of the following chemicals (conforming to relevant Indian Standards) in water emulsion shall be applied by pressure pumps, uniformly over the area treated.

Chemicals	Concentration by Weight, Percentage
Chlorpyrifos Emulsifiable (IS 8944 - 1978)	: 1.0
Heptachlor Emulsifiable Concentrate (IS: 6439 - 1978)	: 0.5
Chlordane Emulsifiable Concentrate (IS: 2682 - 1984)	: 1.0

2.02.01

Treatment of Column Pits, Wall Trenches and Basement Excavations

Foundations, basements etc. may either be fully enveloped by the chemical barrier or the treatment may start 500 mm below ground level. The bottom surface and sides of excavation (upto a height of about 300 mm) for column

	TITLE: TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT	SPECIFICATION NO. PE-TS-635-600-C001 VOLUME - SECTION - D SUB-SECTION – D23 REV.NO. 00 DATE 13/02/2018 SHEET 4 OF 5
	pits, walls trenches and basements shall be treated with chemicals at the rate of 5 litres / M² of surface area. Backfills around columns, walls etc. shall be treated at the rate of 7.5 litres / M² of the vertical surface. Chemical treatment shall be done in stages following the compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by rodding the earth at 150 mm centres close to the wall surface and spraying the chemicals in the specified dose. 2.02.02 Treatment of Top Surface of Plinth Filling Holes 50 mm to 75 mm deep at 150 mm centres both ways shall be made with crowbars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5 litres / M² of surface shall be applied prior to laying soling or sub-grade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces. 2.02.03 Treatment of Soil Surrounding Pipes, Wastes and Conduits Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 mm and a depth of 75 mm at the point where they enter the building. 2.02.04 Treatment of Expansion Joints These shall receive special attention and shall be treated in a manner approved by the Engineer. 2.02.05 Treatment at Junction of the Wall and the Floor Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surfaces from ground level up to the level of the filled earth surface. A small channel 30 x 30 mm shall be made at all the junctions of wall and columns with the floor. Rod holes made in the channel up to the ground level 150 mm apart and the chemical emulsion poured along the channel at the rate of 7.5 litres per square meter of the vertical wall or column surface. The soil should be tamped back into place after this operation. 3.00.00 ACCEPTANCE CRITERIA The Contractor shall give a 10-year service guarantee in writing supplemented by a separate and unilateral guarantee from the specialised agency for the job to keep the building free of termites for the specified period.	



TITLE:

TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT

SPECIFICATION NO. PE-TS-635-600-C001

VOLUME -

SECTION - D | SUB-SECTION – D23

REV.NO.	00	DATE	13/02/2018

SHEET 5 OF 5

4.00.00 RATES

Rates shall be of complete work per unit area as stated in the Schedule.

5.00.00 METHOD OF MEASUREMENT

Complete work of anti-termite treatment shall be measured for plinth area treated.

This includes treatment, to foundations, walls, trenches, basements, plinth, buried pipes, conduits etc. The extended portions of foundation and like beyond plinth limit shall be the part of complete work.

6.00.00 I.S. CODE

Relevant code applicable for this Specification.

IS: 6313 (Part-II) 1981 : Code of Practice of Anti-Termite Measures in Buildings
Pre-constructional chemical treatment measures.

Annexure**C1**

DATE:31/08/2021

**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 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised Rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (BEYOND USEFUL LIFE)
I.	CRANES :-			
1	Portal Gantry Crane 500T	15	24500.00	24500.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	11370.00	10940.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	56290.00	53560.00
4	PORTAL CRANE, 360T	15	14070.00	13390.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	55460.00	52770.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded)	15	68610.00	65280.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	33510.00	31880.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	20940.00	19920.00
9	MANITOWOC M-250T TRUCK CRANE	15	30160.00	28690.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	31660.00	30130.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	26390.00	25110.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	36110.00	34580.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	15130.00	14390.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	18850.00	18050.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	16750.00	15940.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	21780.00	20720.00
15	CRAWLER CRANE SUMITOMO, 150T	15	10890.00	10360.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	13400.00	12750.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	10830.00	10420.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	10720.00	10200.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	8880.00	8440.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	10050.00	9560.00
20	CRAWLER CRANE 100 T (KH 500)	15	10050.00	9560.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	5410.00	5210.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6140.00	5880.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5370.00	5150.00
24	Mobile Crane, 55MT (TIL)	12	4410.00	4230.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3030.00	2910.00
26	MOBILE CRANE, 20MT (TIL)	10	2270.00	2180.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2270.00	2180.00
28	MOBILE CRANE ESCORTS- 14MT	10	710.00	680.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	390.00	370.00

Annexure**C1**

DATE:31/08/2021

**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 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (BEYOND USEFUL LIFE)
30	FORK LIFT 5T	5	650.00	640.00
31	FORK LIFT 3T	5	540.00	530.00

**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 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE)
I.	CRANES :-			
1	Portal Gantry Crane 500T	15	27230.00	27230.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	12630.00	12160.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	62550.00	59520.00
4	PORTAL CRANE, 360T	15	15630.00	14880.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	61620.00	58630.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	76230.00	72540.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	37230.00	35420.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	23270.00	22140.00
9	MANITOWOC M-250T TRUCK CRANE	15	33510.00	31880.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	35180.00	33480.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	29320.00	27900.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	40120.00	38420.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	16810.00	15990.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	20950.00	20060.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	18610.00	17710.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	24200.00	23020.00
15	CRAWLER CRANE SUMITOMO, 150T	15	12100.00	11510.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	14890.00	14170.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	12030.00	11580.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	11910.00	11330.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	9860.00	9380.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	11170.00	10620.00
20	CRAWLER CRANE 100 T (KH 500)	15	11170.00	10620.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	6010.00	5790.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6830.00	6540.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5970.00	5720.00
24	Mobile Crane, 55MT (TIL)	12	4900.00	4700.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3370.00	3240.00
26	MOBILE CRANE, 20MT (TIL)	10	2520.00	2430.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2520.00	2430.00
28	MOBILE CRANE ESCORTS- 14MT	10	790.00	760.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	430.00	410.00

**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 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE)
30	FORK LIFT 5T	5	720.00	710.00
31	FORK LIFT 3T	5	600.00	590.00

**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 01/09/2021 to 31/8/2023
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 OIL)	1360
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL)	1820
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL)	3640
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH	1270
9	Low Vacuum de-hydration unit	630
10	DIESEL GENERATING SET,250 KVA	1770
11	DIESEL GENERATING SET,25 KVA	500

**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 01/09/2021 to 31/8/2023
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
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 m³/Hr)	1160
22	Air Blower (Flow: 20000 m³/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

**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 01/09/2021 to 31/8/2023
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
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 DIAGNOSTIC REPAIR KIT	2000
56	SECONDARY INJECTION RELAY TEST KIT	5270
57	MICRO OHM METER	1450
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 $\mu\Omega$ TO 20K Ω	3230
59	PMI Machine OLYMPUS make	3350
60	Móbile 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

**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 01/09/2021 to 31/8/2023
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
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
96	Plasma Cutting Machine (With complete accessories)	310
97	JCB make DG Set 80 KVA	670
98	Diesel Generating Set 82.5 KVA	610
99	Portable Jacking Oil Pump	1080
100	Alloy Analyser	1770

**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 01/09/2021 to 31/8/2023
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	ELECTRIC WINCH 5T	1410
6	ELECTRIC 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 FILTRATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	7070
3	-DO-, WITH STORAGE TANK	8080
4	OIL FILTRATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	1010
5	OIL FILTRATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL)	1510
6	OIL FILTRATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL)	2020
7	OIL FILTRATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL)	4040
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH	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
17	AIR COMPRESSORS 250/300/330/360/350 CFM	3030
18	AIR COMPRESSORS 140/150/190/210 CFM	1010

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 01/09/2021 to 31/8/2023
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 m³/Hr)	1290
22	Air Blower (Flow: 20000 m³/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
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

**RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS
ETC. FOR OUTSIDE AGENCIES**

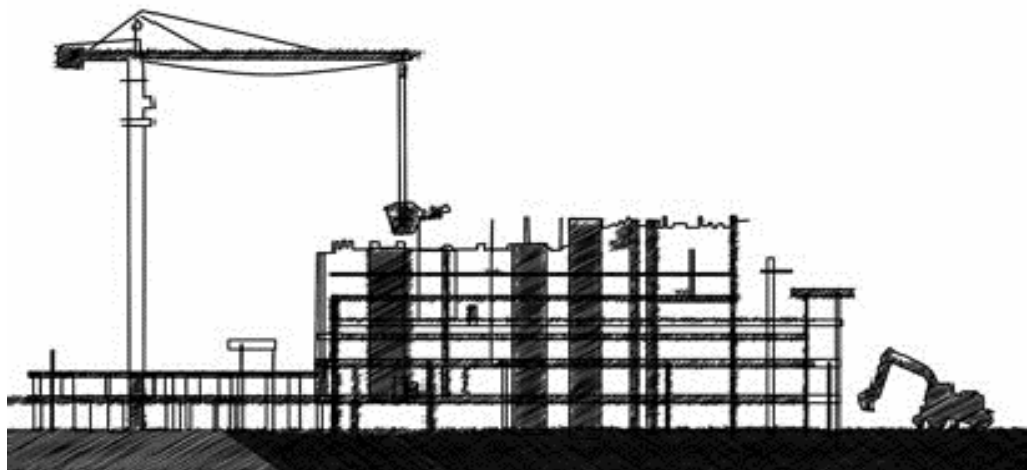
SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	130
37	ISKAMATIC 'A'	3550
38	CALIBRATOR '03'	1110
39	48 POLE EXTENDER CARD	220
40	MULTIJET NPM	440
41	OSCILLOMETER	11320
42	VOC EQUIPMENT	1550
43	BINARY SIGNAL GENERATOR	320
44	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 DIAGNOSTIC REPAIR KIT	2220
56	SECONDARY INJECTION RELAY TEST KIT	5860
57	MICRO OHM METER	1610
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 $\mu\Omega$ TO 20K Ω	3590
59	PMI Machine OLYMPUS make	3730
60	Mobile Lighting Mast - 9 metres (4X400 W)	960
61	10KVA RESISTANCE BRAZING MACHINE	160
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	510
63	HYDROGEN GAS LEAK DETECTOR	60
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	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 AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR	520
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR	480
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	2010
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1400
75	5KV Insulation Tester	500

**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 01/09/2021 to 31/8/2023
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
96	Plasma Cutting Machine (With complete accessories)	340
97	JCB make DG Set 80 KVA	740
98	Diesel Generating Set 82.5 KVA	680
99	Portable Jacking Oil Pump	1200
100	Alloy Analyser	1970

**HSEP14**

Health, Safety & Environment Plan for Site Operations by Subcontractors



INDEX OF CONTENTS

SN	Description	Page No.
SECTION A: CRITICAL RESOURCES FOR HSE IMPLEMENTATION		
1	SHARING OF OPERATING COSTS OF FACILITIES	5
2	RESOURCES TO BE SOLELY PROVIDED BY CONCERNED SUBCONTRACTOR	5
3	ESTABLISHMENT OF COMMON FACILITIES	5
4	CRITICAL REQUIREMENTS W.R.T. EQUIPMENT & PPES	6
5	HSE PERSONNEL TO BE SOLELY PROVIDED BY THE SUBCONTRACTOR	8
6	COMPETENCY OF OPERATORS/ DRIVERS OF CRANE, WINCH, LIFTING/ CONSTRUCTION EQUIPMENT ETC.	11
7	STRINGENT REQUIREMENT OF BHEL'S CUSTOMER	11
8	REFERENCES	11
9	BHEL POWER SECTOR HSE MANAGEMENT SYSTEM	12
10	CLEARANCE OF MONTHLY RUNNING BILLS SUBJECT TO SAFETY COMPLIANCE	13
11	HSE PERFORMANCE EVALUATION	13
12	HSE PENALTIES	13
13	PUNITIVE ACTIONS ON WORKERS FOR CRITICAL SAFETY VIOLATIONS	16
14	LEGAL IMPLICATIONS	17
15	HSE REVIEW MEETING	17
16	OTHER REQUIREMENTS	18
17	MEMORANDUM OF UNDERSTANDING	19
SECTION B: OPERATIONAL REQUIREMENTS		
1	PURPOSE	22
2	SCOPE	22
3	OBJECTIVES AND TARGETS	22
4	BHEL HEALTH, SAFETY & ENVIRONMENT POLICY	23
5	ILLUSTRATIVE HSE RESPONSIBILITIES OF VARIOUS SUBCONTRACTOR OFFICIALS	24
6	HSE PLANNING BY SUBCONTRACTOR	27
7	MOBILIZATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR	28
8	MOBILIZATION OF MANPOWER BY SUBCONTRACTOR	28
9	PROVISION OF PERSONAL PROTECTIVE EQUIPMENT (PPES)	29
10	ARRANGEMENT OF INFRASTRUCTURE	31
11	HSE TRAINING & AWARENESS	35
12	HSE COMMUNICATION AND PARTICIPATION	39
13	SAFETY DURING WORK EXECUTION	40

14	ENVIRONMENTAL CONTROL & SOCIAL RESPONSIBILITY	43
15	HOUSEKEEPING	44
16	WASTE MANAGEMENT	44
17	TRAFFIC MANAGEMENT SYSTEM	45
18	EMERGENCY PREPAREDNESS AND RESPONSE	48
19	HSE INSPECTION	49
20	TERMS AND DEFINITIONS	52
	ANNEXURES	
A	ANNEXURE A: Specification of Ambulance	
A.1	ANNEXURE A.1: Typical calculation for sharing of operational cost of common facilities	
B	ANNEXURE B: Specifications of HSE Displays	
C	ANNEXURE C: HSE Tools, Equipment and Devices to be Provided by the Subcontractor	
D	ANNEXURE D: Specifications of Rest Sheds	
E	ANNEXURE E: Minimum Requirements of Labor Accommodation/ Colony	
F	ANNEXURE F: Specifications & Availability for Toilets at Site	
G	ANNEXURE G: Specifications for Numbers and Types of Fire Extinguishers	
H	ANNEXURE H: HSE Compliance Certificate Sample	
I	ANNEXURE I: Detailed Safety Requirements/ Precautions for Various Hazardous Activities/ Conditions	
J	ANNEXURE J: Details & Contents of First-Aid Box	
K	ANNEXURE K: Vertigo Test Procedure	

SECTION A

CRITICAL RESOURCES FOR HSE IMPLEMENTATION

1. SHARING OF OPERATING COSTS OF FACILITIES

TABLE A.1

SN	FACILITY
1	Ambulance with 24 hr. First Aid Trained Driver (Specs in Annexure A)
2	Operation of Medical center, Nurses, Medical Consumables etc. (Specs in Annexure A)
3	Training Center Consumables
4	Water sprinkling for dust suppression
	(Others:)

Note:

- Responsibility of operation of above facilities shall rest with BHEL
- Operating cost of the above shall be deducted from subcontractors on 'proportional to contract' value basis. Sample deduction table enclosed as Annexure A.1
- "Contract value" defined above & subsequently in the document shall be considered as "Awarded contract value".
- No overhead cost/ enabling cost of BHEL shall be levied on the contractors for common facilities.
- These running costs shall be recovered from all the available subcontractors at site for the complete operational duration of the site
- No overheads shall be charged on shared operating costs

2. RESOURCES TO BE PROVIDED SOLELY BY THE SUBCONTRACTOR

TABLE A.2

SN	ITEM	SPECIFICATIONS
1.	HSE DISPLAYS, Posters and signage	Annexure B
2.	HSE Tools/ Equipment/ Devices	Annexure C
3.	Rest Sheds for Workers	Annexure D
4.	Labor Colony	Annexure E
5.	Toilets (Latrines & Urinals) - in Site and Labor Colony	Annexure F
6.	Fire Extinguishers	Annexure G

Note:

In case subcontractor fails to provide the required resources, same will be procured and deployed by BHEL with applicable overhead on total procurement cost

3. ESTABLISHMENT OF COMMON FACILITIES

In green field projects BHEL shall arrange and provide the following facilities which shall be used by all subcontractors for their employees and workers. These shall be

- Medical Centre
- Safety park with facilities of audio-visual training & vertigo test center.
- No cost shall be deducted from the subcontractors for the structure part only.
- The running cost with basic inputs already mentioned at Point 1 above shall be shared by all contractors.
- The sub-contractors shall be required to ensure participation in trainings, medical checkup and vertigo test as per the guidelines laid in this document and required as per statutory HSE requirements.

- vi. However, in projects where in these facilities are not provided by BHEL, subcontractors shall ensure the training, medical/ vertigo test of all workers at site in consultation and guidance of BHEL HSE team at site in line with provisions of this document.
- vii. The overall onus of compliance to HSE practices pertaining to training, medical checkup including vertigo test shall lie on the subcontractor only.

4. CRITICAL REQUIREMENTS W.R.T. EQUIPMENT & PPES

- i. Conventional Hydra crane with carriage in front shall not be permitted. Pick & carry tyre mounted Front Cabin mobile crane (FX or TRX/ NextGen series of 'ESCORT' or equivalent make) shall only be permitted.
- ii. Any Heavy equipment (cranes, winch machines, etc.) shall be deployed only after pre-safety Inspection by safety dept. Valid AMCs/ Fitness/ other statutory clearances as per local rules shall be required to be submitted before mobilizing the equipment at site.
- iii. All other Hand tools and power tools should not be older than 5 years.
- iv. For Chimney passenger lift, winch to have double drum rope for passenger and double safety devices must be used. Winch should not more than 3 years old and winch rope must be inspected with valid certificate from competent authority within 6 months and should meet the IS standard 9507 provision of OLR and push back button arrangement or dead man switch.
- v. Gate pass for all the lifting T&Ps and construction machinery/ equipment shall be made after obtaining written acceptance (Pre-entry Safety Clearance) from BHEL Site Safety Department after physical verification and checking all requisite documents/ compliance to Safety norms
- vi. All motor vehicles should have valid registration certificate, insurance, Pollution under control (PUC) and fitness certificate as per Motor Vehicle Act 2020. The certificates should be pasted in the glass from inside.
- vii. PPEs shall be from reputed manufactures viz. 3M, Udyogi, Karam, Frontier, Freedom, Honeywell, Liberty, Bata, Nomex, Acme, Unicare, Life Gear or equivalent. In case Subcontractor recommends any other name the same can be approved at site level by the Construction manager & Site HSE
- viii. For height work, where fall could result in death or disability, a secondary means of fall protection (Safety Net, Retractable Fall Arrestor etc.) shall be mandatorily provided by the subcontractor, failing which, a penalty of INR 10000 per case will be imposed. In addition, there should be constant supervision for such critical height work. Any non-erection activities at height eg. Housekeeping etc. shall also fall under the category of height work
- ix. **Scaffold Tagging**

Scaffolds being erected, modified or dismantled must be tagged as suitable for use. Tagging shall be done with standard tag holder. Scaffolding tag should be certified by scaffolding inspector having valid certificate.

- **GREEN** scaffold tag- shall be fixed when scaffold is complete and safe for use, signed and dated by the scaffolding competent person daily.
- **RED** scaffold tag – to be fixed if scaffold is in some way defective and cannot be used or is still under erection.
- **YELLOW** scaffold tag – to be fixed if scaffold is in under construction/ maintenance.



FIG. A.4.1 SAMPLE SCAFFOLD TAGS AND TAG HOLDER

x. **T&P Color Coding:**

- a. Inspections and tests shall be documented by means of color coding which shall verify that inspections or testing are current and that all receptacles, portable Power tools, Lifting Tools & Tackles have been inspected and tested as required. The color codes used on the project shall be:

GREEN	BLUE	YELLOW	PURPLE
January	April	July	October
February	May	August	November
March	June	September	December

TABLE. A.4.2: T&P COLOR CODES

- b. The cycle of colors shall be Quarterly as a minimum or as decided by BHEL. The color code tape / Sticker shall be clearly visible to designate the period for which the inspections and tests were conducted.
- c. Following the initial inspection, the equipment must be color-coded quarterly as per color-coding instructions that will be issued by the subcontractor.
- d. Fire extinguisher with the current month color-coding inspection sticker must be provided and secured in the platform.
- e. All slings shall be regularly inspected in accordance with the requirement of the project for frequent and periodic inspections and discard immediately if they fail to meet the minimum requirements of the project.
- f. The Subcontractor's HSE Officer shall ensure that all PPE is inspected prior to its issue. He is to ensure all subcontractor personnel are using safe and proper PPE equipment. Regular

inspections on the PPE shall be carried out and personnel not adhering to those inspections shall be removed immediately from the site.

- g. A Ten (10) day interval period shall be given into each monthly color code change. During this Ten (10) day period either color shall be acceptable.

xi. **T&P Tagging:**

All deployed Wire Rope Slings, Chain Pulley Blocks, Hooks, slings etc. shall be Tagged using aluminum or any other metal tag with punching.

5. HSE PERSONNEL TO BE PROVIDED SOLELY BY THE SUBCONTRACTOR

5.1. NUMBERS OF HSE PERSONNEL (APPLICABLE FOR EACH WORK SHIFT)

Number of HSE Officers and Supervisors shall be in proportion to number of workers as per Table A.6 below

TABLE A.5

No. of Workers	No. of HSE Supervisors	No. of HSE Officers
Up to 100	1	1
101 to 250	2	1
251 to 500	4	1
501 to 1000	6	2
1000 to 2000	6+ One additional supervisor up to every additional 250 workers	3
2000-3000	10+ One additional supervisor up to every additional 250 workers	4
3000-4000	14+ One additional supervisor up to every additional 250 workers	5

5.1.1. DEPLOYMENT PLAN

- Above requirement is for every shift for each unit.
- The dynamic deployment plan of Safety manpower at various locations containing names, areas, time periods, shifts etc. shall be submitted to BHEL for approval by subcontractor
- BHEL may modify the deployment plan based on nature and volume of jobs, Risks and hazards associated etc.
- For less than 20 workers HSE Officer is not mandatory. In case the number of workers exceed 20 for 3 consecutive months, HSE Officer is to be engaged. The HSE Officer shall be deployed for a minimum period of 6 months even if the number of workers fall below 20 in any month subsequent to deployment. If within that 6-month period, the number of workers is more than 20 for at least 3 months, the deployment duration of HSE Officer will extend further 6 months after completion of previous 6-month period.
- For Site Material Management/ Handling (Loading/ Unloading) contracts, 1 no. HSE Officer shall be required irrespective of the total manpower deployed.
- HSE Officers/Supervisors of all the vendors may be required to report directly to BHEL HSE Officer at site & shall comprise as a total team for handling all HSE issues. However, each safety officer/ agency shall be individually responsible for the safe execution of work in their respective areas.

5.2. QUALIFICATION & EXPERIENCE REQUIREMENTS OF HSE PERSONNEL

5.2.1. HSE OFFICER

First HSE Officer to be mandatorily as per Option I as under and shall be designated Senior HSE Officer. In case of non-availability of HSE Officers with Option I configuration, the subsequent HSE Officers can be as per Option II below with recorded reasons and approval of Site Construction Manager of BHEL. All these deviations should be reported to Region HSE and PSHQ HSE.

A. Option I

- i. possesses a recognized degree in any branch of engineering or technology or architecture and had a practical experience of working in a building or other construction work in a supervisory capacity for a period of not less than two years or possesses a recognized diploma in any branch of engineering or technology and has had practical experience of building or other construction work in a supervisory capacity for a period of not less than five years;
- ii. possesses a recognized degree or diploma in industrial safety with at least one paper in construction safety (as an elective subject/ part thereof);
- iii. has adequate knowledge of the language spoken by majority of building workers from the construction site in which he is to be appointed.

B. Option II:

Graduation Degree in Science with Physics & Chemistry and degree or diploma in Industrial Safety (All Degrees/ Diploma from any Indian institutes recognized by AICTE or State Council of Technical Education of any Indian State) with practical experience of working in a building, plant or other construction works (as HSE Officer, in line with Indian Factories Act, 1958 or BOCW Act, 1996) for a period of not less than five years

Note:

- i. HSE Officer as per Option II shall be valid only on availability of Senior HSE Officer as per Option I at site.
- ii. In case of resignation of the Senior HSE Officer, the same has to be replaced within 15 days else all subsequent HSE Officers as per Option II (in case of multiple HSE Officers with a single agency) shall not be considered as valid.
- iii. The penalty shall be deducted considering non-availability of any HSE Officer at site.

5.2.2. HSE SUPERVISOR: EITHER OF X OR Y BELOW

X. Recognized Degree in any branch of Engineering OR Diploma in any branch of engineering with at least one-year construction experience

OR

Y. A recognized graduation Degree in Science (with Physics & Chemistry) or a recognized diploma in Engg. or Tech.

Additional requirements for option (Y) above

Bharat Heavy Electricals Limited, Power Sector

Regd. Office: BHEL House, Siri Fort, New Delhi-110049

- i. Trained in fire-fighting as well as in safety / occupational health related subjects, with:
- ii. Minimum Two years of practical experience in construction work environment or in the field of safety and

Note:

- i. Option a above is by default, b is under special approval from Site HSE & Construction manager
- ii. In both cases the candidate should possess requisite skills to deal with construction & fire safety related day-to-day issues.

5.3. HSE IN-CHARGE

In case there is more than one HSE Officer with any subcontractor, one of them, who is senior most by experience & meets qualification as per option 1 as mentioned in clause 2.1 A above (in HSE discipline), may be designated as HSE In-charge who will be the nodal point of contact on HSE matters.

5.4. SUPPORTING STAFF TO HSE TEAM

- i. Supporting Staff shall include scaffolders, scaffolding inspectors, riggers, skilled and unskilled manpower
- ii. Subcontractor shall provide adequate number of workers as and when required, in order to attend and comply to Safety observations raised by BHEL/ Customer.

5.5. AVAILABILITY AND PENALTY FOR NON-DEPLOYMENT

- i. The subcontractor shall submit the certificates of qualification & experience of HSE manpower before deployment for BHEL to assess suitability as per requirement detailed in this document
- ii. In case of rejection, subcontractor shall arrange additional candidates and submit resume to BHEL. Penalties will be applicable during the period of non-deployment in such cases as well.
- iii. Subcontractor shall ensure physical availability of safety personnel at the place of specific work locations.
- iv. The Subcontractor shall deploy the HSE Officers as per the site's requirement. Non-deployment shall lead to stoppage of the work and final decision shall rest with Site HSE & Construction manager.
- v. The Subcontractor shall prepare an organization chart identifying the areas of operations, responsibilities and reporting structure of all safety personnel for each shift and submit the same to BHEL.
- vi. The subcontractor shall deploy sufficient HSE Officers, supervisors, as per numbers & qualifications mandated in this Section since mobilization of first batch of manpower and add more in proportion to the added strength in work force. Any delay in deployment will attract a penalty at following rates:

Non-deployment of HSE Officer –	Rs. 75,000 per man-month
Non-deployment of HSE Supervisor –	Rs. 50,000 per man-month

- vii. Penalty shall be collected for the period of non-availability of safety personnel after allowing a grace period of 15 days for finding a replacement. The same shall be deducted on pro-rata basis till the required manpower is deployed.
- viii. In case of abnormal delay & frequent rejections of candidates proposed by the subcontractor, BHEL shall exercise the right to deploy the safety manpower & deduct the amount from subcontractor's running bill with applicable overheads. In such cases also, the provision of logistics, transportation, food and other logistical support to the HSE personnel shall be in the scope of subcontractor in addition to the salary. After deployment of manpower by BHEL, the penalty for non-deployment specified above shall not be applicable.

6. COMPETENCY OF OPERATORS/ DRIVERS OF CRANE, WINCH, LIFTING/ CONSTRUCTION EQUIPMENT ETC.

- i. The Operators/ Drivers of crane, winch, construction/ lifting equipment etc. shall be experienced and have valid driving license for the class of vehicle / machinery as applicable (like Crane/ Forklift/ Rig, Construction equipment driving license etc.).
- ii. Minimum HMV driving license is required for all heavy equipment/ heavy vehicle (trailer/ Hyva /dumper /TM) operators at site.
- iii. The subcontractor shall certify competence of these persons in writing as and when they are posted at site.
- iv. Crane, Winch, Construction & lifting equipment operator should have certificate on subject course or experience certificate in employer letterhead.
- v. Where state is providing license for operating crane, tractor and other construction vehicles, same to be ensured.

Note: In case the statutory requirements i.e. State or Central Acts and / or Rules as applicable like the Building and Other Construction Workers' Regulation of Employment and Conditions of Service- Act, 1996 or State Rules (wherever notified), the Factories Act, 1948 or Rules (wherever notified), etc. are more stringent than above, the same shall be followed.

- 7. In case of any stringent requirement of BHEL's customer over and above the specifications mentioned in current document, the same shall also be required to be complied at site by subcontractor.

8. REFERENCES

The Safety Rules for Construction & Erection as outlined hereunder, while setting out a broad parameter of safety norms, are not exhaustive. The subcontractor and his agencies are advised to refer to the following statutory provisions as amended from time to time for details and strict compliance therewith.

8.1.FOR GREENFIELD PROJECTS

- a) Building and Other Construction Workers (regulation of employment and conditions of service) Act, 1996 (briefly referred to as BOCW Act),
- b) Building and other construction workers (regulation of employment and conditions of service) Central Rules, 1998 (briefly referred to as BOCW Rules) as adopted by the various State Governments,

8.2. FOR EXPANSION, MODIFICATION, ALTERATION AND, OR CONSTRUCTION ACTIVITY WITHIN AN EXISTING PLANT OPERATING AS PER APPROVED SITE PLAN UNDER THE FACTORIES ACT

- a) Factories Act, 1948,
- b) Factories Rules, as adopted by the various State Governments
- c) BOCW Act
- d) BOCW Rules
- e) In case a new act/ statutory guideline/ modification/ consolidation of acts is implemented the same shall be required to be adhered by the subcontractor.
- f) The latest amendment of the above-mentioned acts/ rules shall be followed at site.

9. BHEL POWER SECTOR HSE MANAGEMENT SYSTEM

The Systems and procedures of BHEL Power Sector HSE Management System shall be implemented by the subcontractor, including:

- HSE PROCEDURE FOR REGISTER OF OHS HAZARDS AND RISKS
- HSE PROCEDURE FOR REGISTER OF ENVIRONMENTAL ASPECTS AND IMPACTS
- HSE PROCEDURE FOR REGISTER OF REGULATIONS
- HSE PROCEDURE FOR TRAINING AND AWARENESS
- HSE PROCEDURE FOR EMERGENCY PREPAREDNESS AND RESPONSE PLAN
- HSE PROCEDURE FOR PERMIT TO WORK
- HSE INSPECTION AND OTHER FORMATS

Note:

- i. BHEL reserves the right to revise/ update these systems and procedure as per requirement to address any changing HSE needs
- ii. BHEL will provide hard / soft copies of applicable HSE Procedures, Work Permits, Operational Control Procedures, Inspection/ Other Formats etc. that are necessary for ensuring safe work to the successful bidder at Site. It is the responsibility of the subcontractor to ensure availability of these documents before commencing work at site.
- iii. The subcontractor can get soft copies of these documents from respective Region SCT/ HSE for reference. The signed hard copies of the same shall not be required to be submitted along with tender document
- iv. Subcontractor shall use the Digital (Web & App-Based) HSE management Software Systems provided by BHEL whenever provided. In case not provided, hard copy systems will continue to be used. All information technology resources (Computers, mobile phones, mobile data, internet access etc.) for the use of such systems shall be ensured by the subcontractor.

10. CLEARANCE OF MONTHLY RUNNING BILLS SUBJECT TO SAFETY COMPLIANCE

- The monthly running Bills of the subcontractor shall be released subject to compliance to HSE requirements as per checklist in Annexure H
- BHEL site HSE Head and Package In-charge shall be authorized to issue the clearance
- Site Construction Manager of BHEL shall be the final authority on the matter.

11. HSE PERFORMANCE EVALUATION

- Subcontractor shall be assessed on monthly basis for HSE Compliance by BHEL Safety In-charge at site.
- The HSE evaluation shall be based on HSE Performance Evaluation System of BHEL covering the contractual, statutory and regulatory requirements of HSE.
- BHEL shall reserve the right to use these performance scores for evaluating bidder's capacity for future tenders
- 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, provided the execution performance is satisfactory.

12. HSE PENALTIES

- Nonconformity of safety rules and safety appliances will be viewed seriously and BHEL has right to impose fines on the subcontractor for every instance of violation noticed.
- As per contractual provision HSE penalties shall be imposed on subcontractors for non-compliance on HSE requirement as per following format.
- Following are the applicable penalties for various Safety violations:

Sub: MEMO for Penalty for non-compliances in Safety

Following lapse (tick marked) was observed and penalty (in Rs.) is imposed as stated at the bottom of this memo. It is requested that such occurrences be please avoided in future.

S. No	Nature of Non - Compliance	Penalty (in INR)	Remarks
A. System Violations			
1	Working without valid Work Permit/ HIRA/ Method Statement / JSA	2000	Per case
2	Controls as per Work Permit/ HIRA/MS/JSA not ensured	2000	Per case
3	Reported Safety Violations Not Closed within Stipulated Time	1000-10000	Per case
4	Absence of required Subcontractor Officials (Site Head, HS Head) in Safety Reviews/Meetings	5000	Per case
5	Not providing required PPEs (Safety Harness, Lifeline, Safety Net, Fall arrestor, Safety Helmet, Gloves, Shoes etc.) for the work by subcontractor	2000	Per case
B. Competency/ Training/ Induction Violations			

1	Incompetent personnel deployed for specialized jobs like height work, hot work, rigging, vehicle operation etc. (without valid license/ certificate etc.)	3000	Per case
2	Work without induction training & medical check	2000	Per case
3	Height Work without Vertigo Test and height work training	2000	Per case
C. PPE Violations – Height Work			
1	Not wearing/ hooking Double Lanyard Safety Harness while working at height (> 1.2 meters) or not anchoring to lifeline	1000	Per case
2	Not Providing Lifeline for height work	3000	
3	Unsafe platforms – without Top, Mid Rails and Toe-Guards for Height Work	3000	
4	Not providing secondary means of fall protection for height work (Safety Nets, Retractable Fall Arrestors etc.)	3000	Per case
D. PPE Violations – General			
1	Not wearing safety helmet	1000	Per case
2	Wearing of helmets without chin straps	1000	Per case
3	Not Wearing safety shoes	500	Per case
4	Not wearing gloves	500	Per case
6	Not using grinding goggles/ face shield during grinding/ cutting	2000	Per case
E. Electrical Safety Violations			
1	Broken/ exposed wires/ cables	2000	Per case per day
2	Electrical plug not used for connection/ hand machines	1000	Per case per day
3	Not using proper ELCBs for electrical equipment	2000	Per case per day
4	Improper earthing of welding & Other electrical machines (Lack of double earthing, improper/ untested earth pit etc.)	2000	Per case per day
5	Not using 24 V supply for lighting in confined spaces	2000	Per case
6	Cables haphazard/ blocking way/ not organized properly	1000	Per case per day
F. Lifting & Rigging Violations			
1	Using Sling/ Chain Pulley Block and other Small T&Ps without proper, traceable Tag and Test Certificate	2000	Per T&P per day
2	Using damaged slings or not slinging properly	2000	Per T&P per day
3	Use of lifting equipment without having valid Test certificate	5000	Per equipment per seven days
4	Lifting hooks used without latches	2000	Per hook per day
5	Not effectively barricading area below lifting activity	5000	Per case
6	Using untrained/ unqualified rigger	5000	Per case
G. Housekeeping			
1	Non-removal of scrap from platforms	5000	Per Event Per location per 7 days
2	Not conducting scheduled housekeeping drives	5000	Per drive
H. Hot Work Safety Violations			
1	Gas cutting without flash back arrestor at both ends	5000	Per machine per incidence
2	Gas cutting at height without fire blanket	2000	Per event

3	Not keeping gas cylinders vertically	2000	Per event
4	Lifting cylinders without cage or rolling of cylinders	2000	Per incidence
5	Leakage in gas cylinder	2000	Per incidence
I. Vehicle Safety/ Operation			
1	Not having valid driving license for the type of vehicle/ T&P	2000	Per driver per incidence
2	Two-wheeler entry in construction area	2000	Per vehicle
3	Using Hydra for material movement at site in unsafe manner	2000	Per case
4	Using Two Hydra in Tandem for material movement without proper precautions as per OCP	2000	Per case
5	Vehicles, Hydras, Cranes, Dumpers and Earth Movers not having automatic back horns linked to gear	2000	Per Equipment per day
6	Not providing proper hard barricades around excavations/ unpermitted areas	5000	Per location per day
7	Not using guide rope while transporting material using Hydra or Cranes	2000	Per event
8	Over speeding	5000	Per case
9	Using Conventional Hydra crane	50000	Per day /crane
J. Accidents/ Incidents/ Near Misses			
1	Non-reporting of Near Miss/ Incident	20000	Per case
2	Major Accident – Worker unable to resume work within 48 hrs	100000	Per incident
3	Fatal Accident	500000	Per incident
K. Miscellaneous			
1.	Not providing the facility (drinking water, rest shed, labor colony etc. as per the specifications/ requirement)	5000	Per month per violation
2.	Not nominating the required number of workers for training as per plan	5000	Per incidence
3.	Lack of proper arrangement for disposal of sewage/ waste water/ effluents etc.	10000	Per incidence

Details (if any) related to non- compliance (Name of persons, Nature of deficiency, etc.):

Penalty Amount:

1. Rate as per above chart
2. No. of Persons/ machine/ event/ labor
3. No. of times the same error is repeated: Repetition factor
4. Total Penalty= 1. X 2. X 3. =

Witnessed by:

(Sub- Subcontractor representative)
representative)

(BHEL

Signature

Name

Bharat Heavy Electricals Limited, Power Sector

Regd. Office: BHEL House, Siri Fort, New Delhi-110049

- Distribution: 1 Copy: to Sub- subcontractor Site In-charge,
1 Copy to Site Construction Manager (BHEL)
1 Copy to Site Finance

Note:

- i. In case the amount of penalty imposed by BHEL's Client on BHEL for Safety violation/ incident due to or in the area of the subcontractor is more than those indicated above, same shall be imposed back-to-back on the subcontractor. However, in case such an amount is less than the specified above, penalty amount indicated above shall be imposed on the subcontractor.
- ii. For same violation only one penalty (higher of the two mentioned below) shall be applicable
 - a. Penalty imposed by BHEL's Customer over BHEL.
 - b. Penalty as indicated in current document.
- iii. For repeated violation for the same equipment/ location, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.
- iv. For repeated fatal incident in the same Unit incremental penalty shall be imposed: The subcontractor will pay 2 times the previously paid penalty in case there is repeated major/ fatal incident under the same subcontractor for the same package in the same unit.
- v. 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.
- vi. 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.
- vii. The penalty amount shall be recovered by BHEL Finance department from subcontractors from the RA/Final bill.

13. PUNITIVE ACTIONS FOR "CRITICAL SAFETY VIOLATIONS":**"Critical Safety Violations" include:**

- i. Not wearing required PPEs when provided and not following safe work procedure
- ii. Taking unnecessary risks especially in height work, hot work, radiation work, lifting activity
- iii. Coming to work under influence of sedatives like alcohol, drugs etc.
- iv. Coming to work without ID Card/ Gate Pass (if provided)
- v. Intimidating/ threatening at work
- vi. Using cell phones during height work, hot work, lifting activity, driving.

In case any worker carries out any of the critical safety violations as above, BHEL reserves the right to enforce punitive action in following manner:

First Offence:	1 Punch on Gate Pass/ Induction Card/ ID Card etc. and 1-hour HSE Training. With one day off from duty
Second Offence:	2 Punches and 2-hours HSE Training with one day off from duty

Third Offence:	3 Punches and the worker will be dismissed. Gate pass to be confiscated

In case any employee of subcontractor carries out any of the critical safety violations as above, subcontractor Site In-charge shall issue warning letter to concerned employee with copy to BHEL

Note:

- i. For above violations, guilt of the worker/ employee has to be established through appropriate evidences and records maintained.
- ii. If worker/ employee has not been given the required PPEs and safety equipment by the agency and/or not facilitated by the agency to follow safety rules, he/ she will not be considered liable but the agency will be penalized as per penalty provision in this document. In such cases, the subcontractor shall not pass the penalty over to the worker/ employee through wage deduction etc.
- iii. These critical safety violations and their consequences shall be shared with all workers and employees during induction and other training programs/ meetings, toolbox talks etc.
- iv. Gate Pass shall have provision of Tagging as indicated above
- v. The appellate authority (only for final dismissal) in this case shall be the BHEL Site In-charge whose decision shall be final on the matter and binding on all parties.

14. LEGAL IMPLICATIONS

Any legal Costs incurred by BHEL, on account of accidents taking place in the activities of the subcontractor, shall be debited to the subcontractor on actual cost basis.

For any accident occurring at site to any worker/ employee of the subcontractor leading to legal implications to BHEL Employee/ Management shall be safeguarded by BHEL legal department. All legal expenses incurred by BHEL on this account shall be recovered from the subcontractor. The accident also includes fire, loss of property or life at site.

15. HSE REVIEW MEETING

- i. Subcontractor Site In-charge and HSE In-charge shall attend the HSE Review Meeting as and when called by BHEL.

The indicative agenda points are given below:

- a) Implementation of earlier MOM points
- b) Compliance Status of HSE Observations
- c) Incidents & Near Misses, their Root Causes and Actions Taken
- d) HSE performance review
- e) HSE inspection findings
- f) HSE audit and CAPA
- g) HSE training
- h) Health check-up camp
- i) HSE planning for the erection and commissioning and installation activities in the coming month

- j) HSE reward and promotional activities
- ii. MOM on the discussion along with HSE observations will be circulated to the subcontractor for action.
- iii. The subcontractor shall close the observations to the satisfaction of BHEL within stipulated time frame

16. OTHER REQUIREMENTS

- i. 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 and the cost shall be debited to the subcontractor with applicable overheads.
- ii. 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.
- iii. 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.
- iv. 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.
- v. 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.
- vi. The subcontractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard.
- vii. 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.
- viii. 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.

17. 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 while executing the Contract Number _____

M/s.....have gone through and understood all the HSE requirements of the contract including HSE manpower, tools & equipment, systems & procedures, and agree to fulfill the same as a minimum. Any additional resources and support required for ensuring fulfillment of HSE Objectives shall be provided by subcontractor at no extra cost.

M/s..... agree that in case they fail to comply to the HSE requirements as stipulated in the contract, BHEL shall have the right to implement the same and the cost shall be recovered from the subcontractor with applicable overheads.

M/s..... shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be imbibed in 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.

M/s..... agree that the subcontractor shall seek HSE clearance as per BHEL format before each RA bill as mentioned in clause no. 9. The penalty amounts for not providing Safety manpower and various Safety violations have also been reviewed and agreed.

M/s..... agree to share the HSE Costs (running costs) of common facilities created by BHEL on proportional to contract value basis as calculated at Site by BHEL.

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

Name :

Place & Date:

SECTION B

OPERATIONAL REQUIREMENTS

1. 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 in complementary manner.
- 1.3. Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy wherein the relevant statutory guidelines supersedes this document, the same shall be followed.
- 1.4. In case there's any specific HSE requirement from BHEL's Client, not explicitly indicated in this document the same shall be required to be fulfilled as per the decision of BHEL Site construction manager.

2. SCOPE:

The document is applicable to BHEL's Subcontractors at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations

3. OBJECTIVES AND TARGETS:

- i. To achieve "Zero Incident at Site"
- ii. 100% compliance to all legal/statutory requirements related to EHS.
- iii. 100% Health, Safety and Environmental Induction training attendance for all workers.
- iv. 100% High Risk activities to be carried out only after approved Method Statement, HIRA / Aspect-Impact / JSA / OCP and Permit to Work are implemented.
- v. 100% PPEs compliance in high and medium risk activities.
- vi. 100% incident reporting, recording and reviewing for corrective actions.
- vii. Regular Safety Reviews to assess HSE program compliance and closure of any recognized gaps to improve safety management and incident prevention
- viii. Prevent injury and ill health of all workers at site ('Workers' refers to all personnel including managerial, supervisory, professional, technical, clerical and other workers including contract laborers)
- ix. Prevent pollution to environment
- x. Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
- xi. Ensure protection of environment of the work site.
- xii. Comply at all times with the relevant statutory and contractual HSE requirements.
- xiii. Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- xiv. Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.

- xv. Provide all personnel with adequate information, instruction, training and supervision on the safety aspect of their work.
- xvi. Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including subcontractors in respects of HSE.
- xvii. Establish effective communication on HSE matters with all relevant parties involved in the Project works.
- xviii. Ensure that all work planning considers all persons that may be affected by the work.
- xix. Ensure fitness testing of all T&Ps/Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent person.
- xx. Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
- xxi. Ensure continual improvements in HSE performance.
- xxii. Ensure conservation of resources and reduction of wastage.
- xxiii. Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
- xxiv. Ensure timely implementation of correction, corrective action and preventive action.
The subcontractor shall also comply with HSE Targets stipulated by BHEL from time to time.

4. BHEL HEALTH, SAFETY & ENVIRONMENT POLICY:

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

- ❖ Developing safety and sustainability culture through active leadership and by ensuring availability of required resources.
- ❖ Ensuring compliance with applicable legislation, regulations and BHEL systems.
- ❖ Taking up activities for conservation of resources and adopting sound waste management by following Reduce/Recycle/Reuse approach.
- ❖ Continually identifying, assessing and managing environmental impacts and Occupational Health & Safety risks of all activities, products and services adopting approach based on elimination/ substitution/reduction/control.
- ❖ Incorporating appropriate Occupational Health, Safety and Environment criteria into business decisions, design of products & systems and for selection of plants, technologies and services.
- ❖ Imparting appropriate structured training to all persons at workplace and promoting awareness amongst customers, subcontractors 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.

Chairman & Managing Director/ BHEL

Bharat Heavy Electricals Limited, Power Sector

Regd. Office: BHEL House, Siri Fort, New Delhi-110049

5. ILLUSTRATIVE RESPONSIBILITIES OF SUBCONTRACTOR EMPLOYEES

5.1 HSE - A LINE RESPONSIBILITY

- i. HSE is a "Line Responsibility".
- ii. The term "Line" includes management, Executives, Supervisors, Foremen, and Workers who are part of the workforce. Line is to be fully involved in HSE Planning & Implementation with the aid and advice of HSE organization.
- iii. "Line", having control of resources and manpower is responsible for overall implementation of HSE Systems and closure of HSE observations.

5.2 SITE IN -CHARGE:

- i. Shall sign Memorandum of Understanding (MoU)
- ii. Shall ensure availability of all necessary resources required for implementation of HSE at Site
- iii. Shall engage qualified HSE Officer(s) and supervisors (s)
- iv. Shall adhere to the rules and regulations mentioned in this code, practice very strictly in area of work in consultation with concerned engineer and the safety coordinator.
- v. Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
- vi. Shall not engage any employee below 18 years.
- vii. Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job.
- viii. Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent person.
- ix. Shall ensure closure of all HSE non-conformities reported by BHEL or observed during internal inspection by providing appropriate resources in a timely manner.
- x. Shall ensure the implementation of provisions of applicable acts and rules pertaining to HSE.
- xi. Shall ensure availability of updated (Hazard Identification and Risk Assessment) Register for the area of activity
- xii. Shall ensure availability of Method Statements & Job Safety Analysis for all hazardous activities
- xiii. Shall ensure necessary controls to minimize risk in all applicable hazardous activities including Height Work, Hot Work, Lifting & Rigging, Confined Space, Maintenance, excavation, Radiography, Loading/ Unloading, Drilling/ Blasting etc.
- xiv. Shall ensure implementation of HSE requirements mentioned in this document and as specified in the BHEL HSE management System including training, inspection, awareness, reporting etc.
- xv. Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- xvi. Shall ensure a secondary means of fall protection (Safety Net, Retractable Fall Arrestor etc.) for preventing fall from height
- xvii. Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.

- xviii. Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /HSE officer of BHEL.
- xix. Shall ensure that Horseplay is strictly forbidden.
- xx. Shall ensure that adequate illumination is arranged during night work.
- xxi. Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
- xxii. Shall ensure display of adequate signage/posters on HSE.
- xxiii. Shall ensure that mobile phone is not used by workers while working.
- xxiv. Shall ensure conductance of HSE audit, mock drill, medical camps, induction training and training on HSE at site.
- xxv. Shall ensure full co-operation during HSE audits.
- xxvi. Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- xxvii. Shall ensure good housekeeping.
- xxviii. Shall ensure adequate valid fire extinguishers are provided at the work site.
- xxix. Shall ensure availability of sufficient number of toilets (preferably bio-toilets) /restrooms and adequate drinking water at work site and labor colony.
- xxx. Shall ensure adequate emergency preparedness.
- xxxi. Shall be member of site HSE committee and attend all meetings of the committee
- xxxii. Power source for hand lamps shall be maximum of 24 v.
- xxxiii. Temporary fencing should be done for open edges if Hand – railings and Toe-guards are not available
- xxxiv. To record all incidents including near miss and report to BHEL and to ensure analysis & corrective actions for the same
- xxxv. Shall conduct weekly Safety Walks in the work area and record the findings.
- xxxvi. Construction of Canteen at Site, Office Infrastructure: Printer, PC, Fire Extinguishers etc.
- xxxvii. Shall analysis HSE Performance regularly in work area and take steps to improve the same
- xxxviii. Shall ensure stoppage of work in case of unacceptable Safety hazards

5.3 HSE OFFICER:

- i. Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
- ii. Facilitate inclusion of safety elements into Work Method Statement and creation of Job Safety Analysis (JSA)
- iii. (HSE Head) To prepare deployment plan of HSE personnel for all shifts, so as to ensure constant supervision of all areas. The plan to be submitted to BHEL
- iv. Highlight the requirements of safety through Tool-box / other meetings.
- v. Help concerned HOS to prepare Job Specific instructions/ JSA for critical jobs.
- vi. Conduct investigation of all incident/dangerous occurrences & recommend appropriate safety measures.
- vii. Advice & co-ordinate for implementation of HSE Systems & Procedures.
- viii. To stop work in case of any critical safety violation until the violation is cleared
- ix. Convene HSE meeting & minute the proceeding for circulation & follow-up action.

- x. Plan procurement of PPE & Safety devices and inspect their healthiness.
- xi. Report to BHEL on all matters pertaining to status of safety and promotional program at site level.
- xii. Facilitate administration of First Aid
- xiii. Facilitate screening of workmen and safety induction.
- xiv. Conduct fire Drill and facilitate emergency preparedness
- xv. Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
- xvi. Apprise BHEL on safety related problems.
- xvii. Notify site personnel non-conformance to safety norms observed during site visits / site inspections.
- xviii. 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.
- xix. To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.
- xx. Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
- xxi. Shall work as interface between various agencies such customer, package-in-charges, subcontractors on HSE matters.

5.4 HSE SUPERVISOR:

- i. All requirements as per 5.1
- ii. To monitor allotted area for Safety violations, take required action and inform the concerned Safety Supervisor / Officer
- iii. To assist HSE Officer

5.5 PACKAGE IN-CHARGES, ENGINEERS & ALL EMPLOYEES:

- i. To be aware of, get involved in and ensure implementation of all HSE related Systems and Procedures including but not limited to:
 - a. BHEL HSE Management System including HSE Procedures and OCPs, HIRA, JSA etc.
 - b. Work Permit System
 - c. Emergency Preparedness Response Plans
 - d. Contractual HSE requirements
 - e. Legal Requirements
 - f. Penalty System
 - g. Training requirements
- ii. To ensure that the persons engaged in respective area follow the safety rules like using appropriate PPEs.
- iii. To develop Method Statements and ensure availability of Job Safety Analysis for all activities in scope
- iv. To ensure that the reported HSE non-conformities in the work area are resolved immediately before resuming work
- v. To record all incidents including near miss and report to BHEL.

- vi. To adopt safe working practices at all times and act as role model for Safety
- vii. To take immediate corrective action actions in case any non-conformity is observed on product / process / system with respect to Occupational Health, Safety and Environment.
- viii. In case any particular activity / work has extremely high consequential risk or high environmental impact, same shall be brought to the notice of BHEL Package In-charge before starting the work.
- ix. To interfere/ stop work as & when identified unsafe.
- x. To maintain & promote improved level of house-keeping all the time at site.
- xi. To support/co-operate with audit team members as & when safety audits are carried out.
- xii. To involve in investigation, if any incident occurs in his work area.
- xiii. To participate in safety promotional programs
- xiv. To attend the safety committee meeting, if member/invitee
- xv. To ensure that only fit T&Ps and qualified persons are engaged for all activities.
- xvi. Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- xvii. Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
- xviii. Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent authorities.

6. HSE PLANNING BY SUBCONTRACTOR:

6.1 HAZARD ANALYSIS & RISK ASSESSMENT (HIRA), METHOD STATEMENT (MS) & JOB SAFETY ANALYSIS (JSA):

- i. Subcontractor shall identify all OHS Hazards and Risks applicable to all activities in scope and plan & implement the required control measures. HIRA Register shall be maintained.
- ii. Subcontractor shall develop Method Statements & Job Safety Analysis documents for all hazardous activities in scope and ensure the required control measures. Job Safety Analysis is to be attached along with any Work Permit request

6.2 REGISTER OF REGULATIONS:

Subcontractor shall prepare a register of applicable rules and regulations in the scope and plan to ensure compliance.

HIRA Register, Method Statements, Job Safety Analysis and Register of Regulations are dynamic documents and shall be revised (as applicable):

- i. At fixed frequency of 3 months
- ii. Addition/ deletion/ modification of a process/ activity
- iii. After an accident/ incident
- iv. After any change in applicable rules/ regulations/ laws.

6.3 MONTHLY HSE PLAN COVERING THE FOLLOWING AS A MINIMUM SHALL BE PREPARED AND SUBMITTED TO BHEL FOR APPROVAL:

- i. HSE Trainings covering all activities/ hazards/ workers
- ii. HSE Inspection Plan covering all areas/ activities/ equipment/ hazards
- iii. HSE Activities: Safety walks, Awards, housekeeping, reviews etc.

Note: Online/ App-based system shall be used for HSE Planning and Implementation/ Update whenever provided by BHEL otherwise Hard-copy based system shall continue

6.4 MONTHLY HSE PLANNING & REVIEW OF HSE ACTIVITIES ALONG WITH BHEL:

Monthly planning and review of HSE activities shall be carried out by subcontractor as per provided **format** jointly along with BHEL

7. MOBILIZATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR:

- i. 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.
- ii. 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. Inspection by Third Party competent person shall be arranged:
 - a. Before first time use at site
 - b. After carrying out any modification
 - c. After repairs subsequent to involvement in any accident/ incident
- iii. As a further measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and comply with legislative and owner requirement, inspection as per provided format shall be arranged by in-house expert / competent authority (preferable) for acceptance. The equipment considered for this purpose shall include all those in the T&P list in the tender document.

8. MOBILIZATION OF MANPOWER BY SUBCONTRACTOR:

- i. As a measure to ensure that manpower being mobilized to the construction site is fit and competent for safe working, screening arrangement shall be made by the sub-subcontractor to ensure competency and fitness through following measures:
 - a) **Medical Checkup:** Examination of medical fitness shall be conducted through qualified medical professional for all workers to be deployed as per provided **format**. For height workers, vertigo (height phobia) test to be carried out as qualification criteria as per Annexure K and recorded in provided **format**.

- b) **Induction Training:** Induction training of all workers to be ensured as per **provided procedure and format**. Training evaluation to be carried out and training to be repeated if not passed
- c) Only on successfully meeting above criteria, permanent gate passes to be issued
- ii. The subcontractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.
- iii. 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.
- iv. 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.
- v. Appropriate accommodation to be arranged for all workmen in hygienic condition.
- vi. Cost of contractual, statutory and regulatory requirements like Training, medical checks, PPEs etc. shall not be transferred to the workers and such activities shall be considered as part of the job.

9. PROVISION OF PERSONAL PROTECTIVE EQUIPMENT (PPEs):

- i. Personnel Protective Equipment (PPEs), shall be provided by the subcontractor to all workers as per requirement of the job.
- ii. The choice of PPEs to ensure multiple (at least more than 1) means of protection against any hazard. All applicable safety precautions for a job shall be ensured notwithstanding the duration or perceived importance of the task.
- iii. The applicability of PPEs shall be as per the concept of Hierarchy of controls, i.e.:
- iv. Elimination->Substitution->EngineeringControls->AdministrativeControls-PPEs
- v. Relying solely on PPEs without ensuring necessary controls to be strictly avoided.
- vi. The following matrix recommends usage of minimum PPEs against the respective job.

Activity	Type of Protection						Remarks, if any
	Hand	Eye	Ear	Body	Respiratory	Others	
Gas Welding & Cutting	LG	WG	-	LA	*SCBA/ OLBA	-	* for confined space
Electric Arc Welding	LG	HMWS	-	LA	*SCBA/ OLBA	-	* for confined space
Rigging	CG	SG	-				--
Working at Height	-	SG	-	DLCBH	-	*FAS	* for vertical columns
Grinding & Chipping	CG	FS / SG	-	LA	-	-	--
Working in High Noise	-	-	EP / EM	-	-	-	--
Handling of Cement Concrete	RG	SG	-	-	DM	-	

Blasting	CG	SG	EP*	-	-	-	* at noise area
Excavation	CG	SG	-	-	DM	-	*Gum boot in place of Safety shoe for foot
Chemical Handling	PVCG	CSG	-	PVCA	-	-	*Full body rubber suit with hood
Electrical and C&I	ERG*	SG	-	-	-	-	*For high voltages
Sand/shot blasting	CG	-	EP/EM	CA	SAMH	-	

ABBREVIATIONS: FS: Face Shield, CSG: Chemical splash goggles, HMWS: Helmet mounted welder's shield, GB: gum boot, DLFBH: Double lanyard full body harness, SG: Safety goggles, DM: Dust mask, SAMH L Supplied air mask/hood, EP/EM: Ear plug/Ear Muff, CG: Cotton hand gloves, LG: Leather hand gloves, LA: Leather apron, RG: Rubber gloves, PVCG: PVC Gloves, PVCA: PVC Apron, SCBA: Self-contained breathing apparatus, WG: Welding goggles, ERG: Electrical Rubber Gloves. OLBA: Online breathing apparatus

The list is not exhaustive. Additional PPEs to ensure Safe Work may need to be deployed as per the requirement of the task at no additional cost.

- vii. The PPEs shall conform to the relevant standards as below (illustrative list) and bear ISI mark.

RELEVANT IS-CODES FOR PERSONAL PROTECTION

PPEs	IS Codes
Industrial Safety Helmets.	IS: 2925 – 1984
Rubber gloves for electrical purposes.	IS: 4770 – 1968
Industrial Safety Gloves (Leather & Cotton Gloves).	IS: 6994 – 1973 (Part-I)
Leather safety boots and shoes.	IS: 1989 – 1986 (Part-I-II)
Industrial and Safety rubber knee boots.	IS: 5557 – 1969
Code of practice for selections care and repair of Safety footwear.	IS: 6519 – 1971
Leather Safety footwear having direct molding sole.	IS: 11226 – 1985
Eye protectors.	IS: 5983 – 1978
Ear protectors.	IS: 9167 – 1979
Eye & Face protection during welding	IS: 1179-1967
Industrial Safety Belts and Harness	IS: 3521 – 1983
Guide for selection of industrial Safety equipment for body protection	IS: 8519 -1977
Respiratory Protective Devices	IS: 9473-2002, 14166-1994, 14746-1999

- viii. 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

Bharat Heavy Electricals Limited, Power Sector

Regd. Office: BHEL House, Siri Fort, New Delhi-110049

- ix. All the personnel and visitors shall mandatorily use safety helmet (with company logo), safety shoe and reflective vests, in addition to any other PPEs as deemed appropriate for the area of work/ visit.
- x. Following Color scheme for Helmets shall be followed:
 - a. Workmen: Yellow
 - b. Safety staff: Green or white with green band
 - c. Electrician: Red
 - d. Others including visitors: White
 - e. For height workers, special marking on helmets besides indication on Gate Pass/ ID Card
- xi. The subcontractor shall maintain register for issue and receipt of PPEs.
- xii. All the PPEs shall be checked for quality before issue and the same shall be periodically re-checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be replaced.
- xiii. The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.
- xiv. The body harnesses shall be serial numbered.

10. ARRANGEMENT OF INFRASTRUCTURE:

10.1 DRINKING WATER:

- i. Drinking water shall be provided and maintained at suitable places at different elevations such that minimum quantity of 5 liters is available for each worker during the day.
- ii. Drinking water tank shall be so installed so as to be available within 200 meters of each working area
- iii. Container should be labeled as “Drinking Water” in languages understood by the workers
- iv. Cleaning of the container shall be ensured at least once in a week. Mild cleaning detergents as used for cleaning vessels shall be applied and scrubbers (3M or equivalent) shall be used for removing scales and deposits on the inside surface. The tank shall be thoroughly cleaned with potable water only before it is refilled (also applicable to labor colony).
- v. Suitability of water source for drinking to be tested as per IS10500 at least once in six months.

10.2 WASHING FACILITIES:

- i. In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
- ii. 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.
- iii. Water suitable for washing and not for drinking shall be clearly indicated as “Not for Drinking” in language understood by workers.
- iv. 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.

10.3 LATRINES AND URINALS:

- i. Latrines and urinals shall be provided in every work place as indicated in Section A
- ii. Urinals shall also be provided at different elevations.
- iii. They shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times, by appointing designated person.
- iv. Separate facilities shall be provided for the use of male and female worker if any.

10.4 PROVISION OF REST SHEDS FOR WORKERS DURING REST PERIOD:

Proper Rest Shed (s) with shelter shall be provided for rest during break so as to accommodate all workers as indicated in Section A

10.5 MEDICAL FACILITIES:

10.5.1 GENERAL

- i. Provision of Medical Center, Ambulance etc. shall be as per Section A of this document
- ii. Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste – Management and Handling Rules, 1998)
- iii. Every injury shall be treated, recorded and reported.
- iv. All First Aid injuries shall be recorded as per provided Format
- v. List of qualified first aiders and their contact numbers to be displayed at conspicuous places.

10.5.2 FIRST AIDER/ FIRST AID BOX

- i. The first aider along with facilities should be available at a point nearest to the work location wherein majority of the workers are working.
- ii. 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.
- iii. 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.
- iv. 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.
- v. The first aid box shall be distinctly marked with a Green Cross on white background.
- vi. Details of contents of first aid box is given in Annexure J
- vii. A slip of contents shall be pasted on the First Aid Box with following details
- viii. Monthly inspection of First Aid Box shall be carried out by the owner as per provided format
- ix. The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

10.5.3 HEALTH CHECK UP

The persons engaged at the site shall undergo health check-up as per provided format before induction. In addition, the persons engaged in the following works shall undergo health check-up at least once in a year:

- i. Height workers
- ii. Drivers/crane operators/riggers
- iii. Confined space workers
- iv. Shot/sand blaster
- v. Welding and NDE personnel

10.5.4 HEIGHT PHOBIA/ VERTIGO TEST:

- i. The persons engaged in working at heights (above 2 meters) to be assessed for Vertigo and associated conditions and recorded as per provided format. Suggested Vertigo Test Procedure is given in Annexure K
- ii. Such workers are to be allowed only on successful completion of test, otherwise shall be allocated ground-based jobs.
- iii. IDs / Height passes shall be issued to such workers, besides special markings on helmets for easy identification.

10.5.5 PROVISION OF CANTEEN FACILITY:

- i. Canteen facilities shall be provided for the workmen of the project inside the project site where worker strength is 250 or more.
- ii. Proper cleaning and hygienic condition shall be maintained.
- iii. Proper care should be taken to prevent biological contamination.
- iv. Adequate drinking water should be available at canteen.
- v. Fire extinguisher shall be provided inside canteen.
- vi. Regular health check-up and medication to the canteen workers shall be ensured as per applicable regulations.
- vii. Canteen waste to be disposed of in hygienic manner

10.6 PROVISION OF ACCOMMODATION/LABOR COLONY FOR WORKFORCE:

- i. Proper accommodation for workforce to be provided in line with minimum requirements indicated in Section A
- ii. Labor colony shall be inspected each week by HSE Officer and report submitted to BHEL as per provided format

10.7 PEST CONTROL:

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

10.8 SCRAPYARD:

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

10.9 ILLUMINATION:

- i. 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.
- ii. Lamp (hand held) shall not be powered by mains supply but either by 24V or dry cells.
- iii. Lamps shall be protected by suitable guards where necessary to prevent danger, in case of breakage of lamp.
- iv. Emergency lighting provision for night work shall be made to minimize danger in case of main supply failure.
- v. Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II).

SUITABLE ILLUMINATION LEVELS FOR VARIOUS AREAS SHALL BE DECIDED BASED ON BROAD GUIDELINES INDICATED BELOW:

S. No.	Location	Lux Level (lumens/sqm)
A.	Construction Site	
1	Outdoor areas like store yards, entrance and exit roads	20
2	Platforms	50
3	Entrances, corridors and stairs	100
4	General illumination of work area	150
5	Rough work like fabrication, assembly of major items	150
6	Medium work like assembly of small machined parts	300
7	Fine work like precision assembly, precision measurements etc.	700
8	Sheet metal works	200
9	Electrical and instrument labs	450
B.	Office	
1	Outdoor area like entrance and exit roads	20
2	Entrance halls	150
3	Corridors and lift cars	70
4	Lift landing	150
5	Stairs	100
6	Office rooms, conference rooms, library reading tables	300
7	Drawing table	450
8	Manual telephone exchange	200

- vi. Illuminations shall be inspected on weekly basis as per provided **format** using a calibrated lux meter.

11. HSE TRAINING & AWARENESS:

11.1 TRAINING PLAN:

- i. All training programs to be carried out in a planned manner. Monthly/ Annual Training Calendar to be submitted to BHEL for approval and shall cover HSE Training requirements of all activities, workers, hazards applicable to the area(s) of work.
- ii. Subcontractor shall nominate workers as per the schedule of specific training plan, failing which, penalty shall be imposed.
- iii. Training records of all workers along with attendance, signatures, faculty details etc. shall be maintained in soft/ hard copy as per provided **formats**.
- iv. Each labor should undergo at least 0.5% of total man-hours worked in HSE training.

11.2 HSE INDUCTION TRAINING

- i. All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL /subcontractor before being assigned to work.
- ii. The induction training shall be imparted through audio-visual medium (Classroom specialized training), and shall be minimum of 1 Complete Day.
- iii. Evaluation to be carried out after training and training shall be repeated in case of failure.
- iv. Safety Induction Card shall be printed by Subcontractor and provided to all trained workers. A Safety induction book shall also be printed and issued to each worker after induction training (Format for the same may be provided by BHEL).
- v. Induction training subjects shall include but not limited to:
 - a. Briefing of the Project details.
 - b. Safety objectives and targets.
 - c. Site HSE rules.
 - d. Critical Safety Violations and consequences
 - e. Site HSE hazards and aspects.
 - f. First aid facility.
 - g. Emergency Contact No.
 - h. Incident & Near Miss reporting.
 - i. Fire prevention and emergency response.
 - j. Rules to be followed in the labor colony (if applicable)
 - k. Accident case studies
- vi. General:
 - a. 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.)
 - b. They must arrive fully dressed in safety wear & gear to attend the induction.
 - c. Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.

- d. On completing attending subcontractor's in-house HSE induction, each employee shall sign an induction training form to declare that he had understood the content and shall abide to follow and comply with safe work practices.
- e. They may only then be qualified to be issued with a personal I.D. card, for access to the work site subject to clearing the medical fitness test.

SAFETY INDUCTED	
Name :	
Date :	
Sign By Trainer :	

ABOVE STICKER SHALL BE PASTED ON HELMET OF WORKERS AFTER SAFETY INDUCTION TRAINING

11.3 JOB-SPECIFIC SKILL BASED HSE TRAINING

The contracting agency shall also impart job specific skill-based safety training to all its employees (Minimum one day) on various related safety topics using internal/external safety professionals/consultants as per the matrix given below. Record of such trainings and attendance particulars shall be maintained in a register for ready reference to statutory authorities/engineer-in charge as per provided format.

TRAINING MATRIX

Name of topic	Executives	Supervisors	Skilled Workmen	Other Workers
Safety Induction	Y	Y	Y	Y
Accident_ Causes, factors, cost	Y	Y	Y	-
Industrial hazards & Accident Prevention	Y	Y	Y	-
Investigating, reporting, records	Y	Y	-	-
Personal Protective Equipment	-	Y	Y	Y
Construction Safety & Role of Supervisory personnel	-	Y	-	-
Permit to Work (PTW)	-	Y	Y	y
Statutory Provisions (BOCW Act/Rules, Factories Act 1948 etc.)	Y	Y	y	y
Material handling	-	y	Y	Y
Emergency Management	Y	Y	Y	-
Electrical Safety	-	Y	Y	-
Fire safety	Y	Y	Y	Y
First Aid & CPR (cardio pulmonary resuscitation)	-	Y	Y	Y (Selected)
Safety in Welding & Cutting	-	-	Y	-
Safety Audit	Y	Y	-	-
Safety in Lifting Tools & Tackles	-	Y	Y	y

Safety in Working at height	-	Y	Y	Y
Safety in Confined space work	-	Y	Y	Y
Defensive Driving	-	Y*	Y*	Y*

*for construction vehicle operators, helpers & crane operators

Y=YES

Note:

- Subcontractor shall prepare a training plan/ matrix covering all hazards and implement the same after approval of BHEL.
- It is to be ensured that every worker undergoes Job-Specific training once every 3 months.
- Records of training programmes along with attendance shall be maintained by the subcontractor
- Each worker to be issued a Card indicating the types of trainings undergone.

11.4 HSE TOOL-BOX TALK:

- HSE tool Box talk shall be conducted by frontline foreman/supervisor of subcontractor to specific work groups prior to the start of work and shall be randomly attended by subcontractor engineers/ officials. The agenda shall consist of the following:
 - 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.
- Tool box talk to be conducted before start of work in every shift.
- During toolbox talk, visual check-up of workers regarding health, any signs of fatigue, intoxication etc. shall be conducted and any suspected workers to be acted upon.
- Record of Tool box talk shall be maintained as per provided **format**

11.5 TRAINING ON HEIGHT WORK:

- Training on height work shall be imparted to all workers working at height by in-house/external faculty at least once every 3 months.
- For Height Workers Separate pass shall be provided by the subcontractor.
- The training shall be of minimum 2-hour duration, through audio-visual medium and followed by evaluation. In case of poor scoring, training shall be repeated.
- The training shall include following topics:
 - Proper use of PPEs – safety harness, lanyard, fall arrester, retractable fall arrester, life line, safety nets etc.
 - Provision of secondary means of fall protection

- c. Safe climbing through monkey ladders.
- d. Inspection of PPEs.
- e. Medical fitness requirements.
- f. Mock drill on rescue at height.
- g. Dos & Don'ts during height work.
- h. Accident case Studies

11.6 RE-INDUCTION TRAINING

The induction training shall be repeated for every worker after at least 1 year and shall be a pre-requisite for renewal of Gate Pass/ ID card.

11.7 PENALTY TRAINING

The personnel involved in Safety Violations/ Incidents shall mandatorily undertake penalty training pertaining to the violation/ incident. Penalty training shall be at least half-day duration.

11.8 HSE PROMOTION-SIGNAGE, POSTERS, COMPETITION, AWARDS ETC.:

- i. HSE Displays shall be installed as indicated in Section A
- ii. Contracting agencies shall arrange for display of safety hoardings depicting suitable safety cartoons/messages/ cautionary notices at appropriate places of project site to remind the workers to perform their duties safely.
- iii. Apart from safety hoardings, each agency should maintain a safety bulletin board at all their work locations. Such safety bulletin boards should depict the activities being planned for the day, good practices, permit details etc.
- iv. Safety suggestion boxes shall be kept at each subcontractor's office at site for obtaining safety suggestions from the workers. Best suggestions should be implemented and may be rewarded suitably to encourage the workers for safety.
- v. Safety awareness campaigns, competitions, plays, movie shows, songs etc. to be organized for workers at Site and Labor colony from time to time to enhance Safety Awareness

11.9 HSE REWARDS & INCENTIVE SCHEME

Subcontractor shall implement a reward & incentive scheme for workers & supervisors displaying adherence to safety principles. Such workers shall be felicitated in a monthly function, attended by Subcontractor top management and BHEL representatives. Suitable gift shall be given to such workers for encouragement.

11.10 HSE AWARENESS PROGRAM FOR OFFICIALS:

Subcontractor shall arrange monthly HSE awareness program on different topics including medical awareness for all engineers/ supervisors / officials working at site. This program can be part of progress/ safety review meetings.

12. HSE COMMUNICATION AND PARTICIPATION:

12.1 HSE INCIDENT REPORTING, INVESTIGATION & CORRECTIVE ACTION:

- i. All incidents (near misses, property damage, first-aid cases, minor, major and fatal incidents) shall be reported to BHEL as they happen immediately through SMS and Hard/Soft copy as per provided format
- ii. All incidents including near miss, minor, major and fatal incidents shall be recorded
- iii. All incidents shall be investigated for Root Causes and corrective actions ensured to prevent recurrence shall be implemented.
- iv. Work shall be put on hold in the area till corrective actions are verified by BHEL
- v. The Root Cause Analyses and Corrective actions taken shall be recorded

12.2 HSE EVENT REPORTING:

- i. 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
- ii. Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported as mentioned above.

12.3 MONTHLY HSE REPORTING:

- i. All routine and non-routine HSE activities shall be reported to BHEL on monthly basis by the subcontractor as per provided format. The reporting medium can be hard/soft as per BHEL requirement.
- ii. The period of reporting shall be 25th of the preceding month to 24th of the present month and shall be submitted by the end of the calendar month.
- iii. Report shall include good quality images of HSE Activities

12.4 DAILY HSE ACTIVITY REPORTING:

Daily HSE activities shall be reported by subcontractor to BHEL as per provided format

12.5 HSE SUGGESTIONS:

All workers and employees shall be encouraged to provide suggestions for improvement in Health, Safety & Environment performance at site. The suggestions shall be recorded in a "Suggestions Register" as per provided format. Suggestions found suitable for implementation shall be implemented and recognition / reward to be given to the submitter.

Suggestion Register to be placed at Site and Labor Colony and shall be reviewed on periodic basis

12.6 CLIENT COMMUNICATION:

All HSE related communication from BHEL, customer / external statutory and regulatory agencies to be handled on priority. Same to be recorded and issues to be resolved in expeditious manner

13. SAFETY DURING WORK EXECUTION:

Safety during work execution shall be ensured by following appropriate Safety Rules, providing adequate resources, deploying competent and trained manpower, regular training & inspection and non-conformity resolution. Main aspects are indicated as under:

13.1 OPERATIONAL CONTROL PROCEDURES:

In order to reduce the risk associated with hazardous activities, applicable OCPs (Operational control procedures) will be followed by subcontractor as per BHEL instructions, outcomes of Hazard Analysis & other requirements. This will be done as part of normal scope of work. Illustrative list of reference OCPs is given below.

TABLE 13.1 ILLUSTRATIVE LIST OF REFERENCE OCPs

No.	Topic	No.	Topic	No.	Topic
0	General Safety	22	Steam blowing	44	Material preservation
1	Handling of chemicals	23	Working in confined area	45	Electro-resistance heating
2	Electrical safety	24	Operation of passenger lift, material hoists & cages	46	Blasting
3	Energy conservation	25	Vehicle/ Crane maintenance	47	Transformer charging
4	Welding and gas cutting operation	26	Radiography	48	Handling of battery system
5	Fire safety	27	Waste disposal	49	DG set
6	Use of hand tools	28	Handling & storage of mineral wool	50	Sanitary maintenance
7	First aid	29	Working at night	51	Piling rig operation
8	Food safety at canteen	30	Computer operation	52	Passivation
9	Use of cranes	31	Storage in open yard	53	EDTA Cleaning
10	Storage and handling of gas cylinders	32	Drilling, reaming and grinding(machining)	54	Chemical cleaning of Pre boiler system
11	Manual arc welding	33	Stress relieving	55	Boiler Light up
12	Use of helmets	34	Hydraulic test	56	Rolling and Synchronization
13	Good house keeping	35	Trial run of rotary equipment	57	Loading of Unit

14	Safe excavation	36	Batching	58	Air compressor
15	Working at height	37	Cable laying/tray work	59	Hydra Operation
16	Filling of hydrogen in cylinder	38	Spray insulation	60	Duct Pre-assembly
17	Illumination	39	Compressor operation	61	Resumption of construction activities after lockdown and prevention of coronavirus infection during site operations
18	Handling and erection of heavy metals	40	Gas distribution test		
19	Acid cleaning	41	Cleaning of Hot well / Deaerator		
20	Oil flushing	42	Electrical maintenance	61A	Prevention of Covid-19 infection in labour colony
21	Alkali boil out	43	O&M of control of AC plant & system	62	Truss/ Structure fit-up and alignment

- The reference OCPs shall be suitably modified by subcontractor as per specific requirements to control the hazards.
- In case any other OCP is found to be applicable during the execution of work at site, then subcontractor will prepare and follow those as well.

13.2 WORK PERMIT SYSTEM:

- The following activities shall be carried out by the subcontractor strictly after obtaining Permit to Work from BHEL
 - Height working
 - Hot working
 - Confined space Work
 - Excavation more than 2-meter depth
 - Radiography
 - Heavy / Complex / Critical Lifting Activity
 - Night / Holiday Work
 - Material Loading / Unloading
 - Grating, Safety Net, Safety Facility Removal
 - Live Electrical Maintenance etc. - Lockout / Tagout
 - Beam / truss/ duct/ structure alignment
- The Work Permit Formats shall be provided by BHEL at Site. It is the responsibility of the subcontractor to ensure their availability
- The above list is not exhaustive. BHEL reserves right to introduce additional Permits or modify requirements for usage of existing Permits. The conditions for using the Permit are specified in the Format (General Requirements).
- Where customer is having separate Work Permit System the same shall be followed in conjunction / merged to ensure all activities and checks are covered in all systems.
- Details of working Group to be attached along with work permit request.

- vi. All the Permits along with JSA/HIRA must be initiated by Agency Execution Team
- vii. Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with Job Hazard Analysis.
- viii. All Permit signatories (including subcontractor's package in-charge and HSE Officer) shall physically visit the work area and check that all the safety control measures necessary for the activity are in place. Only then the permit shall be issued.
- ix. Signatory shall physically visit the area of work and ensure all required safeguards before signing the Permit
- x. Signatory shall periodically visit the area to confirm the availability of required safeguards throughout the currency of the permit
- xi. In case any Permit requirement is not available, work will be stopped till it is made available
- xii. Permit holder shall implement and maintain all control measures during the period of permit. The permit will be closed after completion of the work.
- xiii. Online Work Permit System shall be used whenever provided by BHEL, otherwise hard copy shall be used

13.3 ACTIVITY-SPECIFIC PRECAUTIONS/ CONTROLS

Detailed HSE precautions for various activities undertaken at Site by the subcontractors are specified in **Annexure I**. Same are to be ensured by the Sub-subcontractor while carrying out respective activities at Site

Index of **Annexure I** is given as under

SN	Description	Page No.
1.	General	2
2.	Work at height	2
2.1	Personnel fall protection system must include	3
2.2	Working Platform	4
2.3	Scaffolding	5
2.4	Ladder Safety	7
3.	Excavation & Civil Works	8
3.1	Excavation	8
3.2	Piling	9
3.3	Batching Plant Operation	9
3.4	Mobile Plant	10
3.5	Concrete Vibrators	11
3.6	Concrete Mixers	11
4.	Welding & Gas Cutting Safety (Hot Work)	11
5.	Lifting & Rigging Safety	13
5.1	Cranes & Hoisting Equipment	15
6.	Demolition Work	20
7.	T&Ps General	20
8.	Chemical Handling	20
9.	Electrical Safety	20

10.	Use of Hand Tools and Power-Operated Tools	25
11.	Start Up, Commissioning and Testing:	27
12.	Fire Safety	27
13.	Painting	28
14.	Hazardous Energy” Control Procedure/ Lockout/Tagout (LOTO)	29
15.	Risk Assessment	36
16.	HSE Preparedness for Adverse Climates and Weather	37
16.1	Summer	37
16.2	Monsoon	38
16.3	Emergency Weather Conditions	40
16.4	Prevention of Covid-19 At Project Site & Labor Colony	41
16.5	Noise Mitigation	43

14. ENVIRONMENTAL CONTROL & SOCIAL RESPONSIBILITY

- i. 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. Banned substances like asbestos and 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.
- ii. 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).
- iii. 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
- iv. All subcontractors shall be responsible for the cleanliness of their own areas
- v. Regular dust suppression using sprinklers shall be carried out in respective area
- vi. 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.
- vii. 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, enhancing good relation with local populace etc.
- viii. 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.

15. HOUSEKEEPING

- i. Keeping the work area and access roads 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 have to be done by subcontractor within quoted rate, on daily basis.
- ii. If such activity is not carried out by subcontractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost along with BHEL overheads will be deducted from subcontractor's bill. Such decisions of BHEL shall be binding on the subcontractor
- iii. Dedicated Housekeeping gangs shall be deployed, who shall be provided all required PPEs and safety training
- iv. Mass housekeeping shall be carried out for half a day in a week
- v. Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis.
- vi. All surplus earth and debris are removed/disposed off from the working areas to identified locations.
- vii. Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
- viii. All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations.
- ix. Sufficient waste bins shall be provided at different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high locations.
- x. Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
- xi. Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
- xii. Labor camp area shall be kept clear and materials like pipes, steel, sand, concrete, chips and bricks, etc. shall not be allowed in the camp to obstruct free movement of men and machineries.
- xiii. Fabricated steel structures, pipes & piping materials shall be stacked properly.
- xiv. 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.
- xv. Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas.

16. WASTE MANAGEMENT

- i. 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.
- ii. Details of E-Waste, Hazardous Waste, biomedical waste etc. and their disposal plan, shall be submitted to BHEL every 6 months as per provided **formats**.

16.1 BINS AT WORK PLACE

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

16.2 STORAGE AND COLLECTION

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

16.3 SEGREGATION

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

16.4 DISPOSAL

- i. Sufficient containers and scrap disposal area should be allocated.
- ii. All scrap bin and containers should be conveniently located.
- iii. Provide self-closing containers for flammable/spontaneously combustible material.
- iv. Keep drainage channels free from choking.
- v. Make schedule for collection and disposal of waste.

16.5 WARNING AND SIGNS

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

17. TRAFFIC MANAGEMENT SYSTEM

17.1 SAFE WORKPLACE TRANSPORT SYSTEM

- i. 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.

- ii. 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.
- iii. For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
- iv. Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.
- v. Speed limits shall be clearly displayed for each kind of vehicle.
- vi. Speed ramps preceded by a warning signs or marker are necessary.
- vii. 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.
- viii. Safest route shall be provided between places where vehicles have to call or deliver.
- ix. Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse
- x. Safe areas shall be provided for loading and unloading.
- xi. Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
- xii. Ensure road crossings are minimum and clearly signed.
- xiii. Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.
- xiv. Set sensible speed limits which are clearly sign posted.
- xv. Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.
- xvi. Forklift trucks shall not pass over road hump unless of a type capable of doing so.
- xvii. Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
- xviii. 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.

17.2 TRAFFIC ROUTE FOR PEDESTRIANS

- i. Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
- ii. 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.
- iii. Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.

- iv. Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.
- v. Provide high visibility clothing for people permitted in delivery area.

17.3 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:

- i. A high level of stability.
- ii. A safe means of access/egress.
- iii. Suitable and effective service and parking brakes.
- iv. Windscreens with wipers and external mirrors giving optimum all round visibility.
- v. Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
- vi. Provision of seat belts.
- vii. Guards on dangerous parts.
- viii. Driver protection - to prevent injury from overturning and from falling objects/materials.
- ix. Driver protection from adverse weather.
- x. No vehicle shall be parked below HT/LT power lines.
- xi. Valid Pollution Under Control certification for all vehicles
- xii. Wheel stopper shall be use during the parking of vehicle
- xiii. Helper to be deployed in each vehicle as per site requirement.

17.4 DAILY CHECK BY DRIVER

- 1. There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used.

Brakes	Mirrors	Warning signals
Tires	Windscreen waters	Specific safety systems i.e. controls & interlocks
Steering	Wipers	

- 2. Management should ensure that drivers carry out these checks.

17.5 TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES

- i. 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.
- ii. 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.
- iii. All overhangs shall be made clearly visible and restricted to acceptable limits
- iv. Load shall be checked before moving off and after traveling a suitable distance.
- v. 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.

- vi. Warning signs shall be displayed during transportation of material.
- vii. All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement.
- viii. Wheel stopper shall be use during the parking of vehicle
- ix. Helper to be deployed in each vehicle as per site requirement.

17.6 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.

18. EMERGENCY PREPAREDNESS AND RESPONSE

- i. Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by BHEL
- ii. Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its subcontractors
- iii. 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.
- iv. Assembly point shall be earmarked and access to the same from different location shall be shown
- v. Fire exit shall be identified and pathway shall be clear for emergency escape.
- vi. Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
- vii. 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.
- viii. First aid center shall be developed at site with trained medical personnel and ambulance
- ix. Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
- x. Tie up with fire brigade shall be done in case customer is not having fire station.
- xi. Tie up with hospital shall be done in case customer is not having hospital.
- xii. Disaster Management group shall be formed at site
- xiii. Mock drill shall be arranged at regular intervals. Monthly report of the above to be given to BHEL HSE Officer as per prescribed BHEL formats
- xiv. Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

19. HSE INSPECTION

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSE 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 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.

Online/ App-based HSE Inspection system shall be used for inspection whenever provided by BHEL otherwise Hard-copy based system shall continue

 ☐ OK	☐ NOT OK
Contractor Name:	
Equipment Identification No :	
Inspection Date :	
Next Inspection Date :	
Inspected By :	

Every Inspected Equipment shall display above sticker

19.1 INSPECTION PLAN

Subcontractor shall prepare an inspection plan covering all areas/ activities/ equipment/ hazards and implement the same after getting approval of BHEL. Responsibility to ensure coverage of all areas/ activities rests with the subcontractor.

All Inspections shall be witnessed by BHEL – only then they shall be considered as valid

19.2 INSPECTION REPORTS

Monthly inspection reports as per plan shall be submitted to BHEL HSE Head

19.3 NON-CONFORMANCES

Any non-conformances identified during inspection observed shall be addressed on priority.

The responsibility of resolution shall rest with the Subcontractor Site In-charge

In case immediate closure of non-conformities is not possible:

- work to be halted in the area
- non-conformance to be generated and submitted to responsible person and BHEL
- non-conformance to be resolved through responsible agency / person

Only after closure of non-conformances, work to be allowed to resume

19.4 DAILY HSE CHECKS

Both the Site Supervisors and HSE 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:

- i. Personal Safety wears & gear compliance.
- ii. Complying with site safety rules and permit-to-work (PTW).
- iii. Positions and postures of workers.
- iv. 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.

19.5 INDICATIVE LIST OF INSPECTIONS AND PERIODICITIES

Indicative list & periodicity of Inspections is given as under. It is the responsibility of the subcontractor to develop an inspection plan covering all areas & activities in the scope.

SL. No.	Format Name	Frequency of check (if applicable)
01	Inspection of First Aid Box	Weekly
02	Inspection of PPE	Weekly
03	Inspection of T&Ps	Monthly
04	Inspection of Cranes	Monthly
05	Inspection of Winches	Monthly
06	Inspection on Height Working	Weekly
07	Inspection on Welding & Gas Cutting	Monthly
08	Inspection on Electrical Installation	Monthly
09	Inspection on Elevator	Weekly
10	Inspection of Excavation	Weekly
11	Inspection of Labor Colony	Monthly
12	Inspection of Illumination Levels	Weekly

The checklists shall be provided by BHEL at Site. It is the responsibility of the subcontractor to ensure their availability before start of work

19.5.1 INSPECTION OF PPE

- i. PPEs shall be inspected by HSE officer at random once in a week as per provided **format** for its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
- ii. The applicable PPEs for carrying out particular activities are listed below.

19.5.2 INSPECTION OF TOOLS & PLANTS (T&Ps)

- i. A master list of T&Ps shall be maintained by each subcontractor in provided **format**.
- ii. All T&Ps being used at site shall be inspected by HSE officer once in a month as per provided **format** for its healthiness and maintenance.
- iii. 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.

- iv. BHEL shall be given advance intimation of Third-Party Inspection. BHEL shall associate with Inspection as per discretion.
- v. The validity of T&P shall be monitored as per provided **format**

19.5.3 INSPECTION OF CRANES AND WINCHES

- i. 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.
- ii. Cranes and Winches shall be inspected by HSE officer once in a month as per provided **format** for healthiness, maintenance and validity of third-party inspection.
- iii. The date of third-party inspection and next due date shall be painted on cranes and winches.
- iv. The operators/drivers shall be authorized by sub-subcontractor based on their competency and experience and shall carry the I-card.
- v. 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.

19.5.4 INSPECTION OF HEIGHT WORKING

- i. Any activity carried out at more than 2 m height is classified as height work.
- ii. Inspection of height working shall be conducted daily by Supervisors before start of work to ensure safe working condition including provision of
 - a. Fall arrestor
 - b. Lifelines – connected to rigid & independent structure
 - c. Safety nets deployed below all height work activities
 - d. Fencing and barricading
 - e. Warning signage
 - f. Covering of opening
 - g. Proper scaffolding with access and egress.
 - h. Illumination
- iii. For full duration of height work, constant supervision to be maintained by dedicated HSE personnel
- iv. Inspection on height working shall be conducted once in a week by HSE officer as per provided **format**.
- v. Medical fitness of height worker shall be ensured.
- vi. Height working shall not be allowed during adverse weather.

19.5.5 INSPECTION OF WELDING AND GAS CUTTING OPERATION

- i. Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
- ii. Gas cylinders shall be kept upright.
- iii. Use of Flash back arrestor shall be ensured at both ends.

- iv. Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per provided **format**.
- v. Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
- vi. Availability of fire extinguisher at vicinity shall be ensured.

19.5.6 INSPECTION OF ELECTRICAL INSTALLATION / APPLIANCES

- i. Ensure proper earthing in electrical installation
- ii. Use ELCB at electrical booth
- iii. Electrical installation shall be properly covered at top where required
- iv. Use appropriate PPEs while working
- v. Use portable electrical light < 24 V in confined space and potentially wet area.
- vi. Inspection shall be carried out as per provided **format**.

19.5.7 INSPECTION OF ELEVATOR

- i. Elevators shall be inspected by concerned supervisors once in a week as per provided **format**
- ii. All elevators shall be inspected by competent person and validity shall be ensured.
- iii. The date of third-party inspection and next due date shall be painted on elevator.

19.5.8 INSPECTION OF EXCAVATION

Excavation activities shall be inspected as per provided **format**

19.5.9 INTERNAL/ EXTERNAL HSE AUDITS/INSPECTIONS

- i. All non-conformities and observations on HSE identified during internal or external HSE audit shall be disposed of by site in a time bound manner and reported back the implementation status.
- ii. Corrective action and Preventive action on HSE issues raised by certification body issued by BHEL shall be implemented by site and reported to Site management.

20. TERMS AND DEFINITIONS:

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.

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".

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 labors. 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.

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.

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. 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.

7. Type of Incidents & Their Reporting:

The three categories of Incident are as follows:

8. Non-Reportable Cases:

An incident, where the injured person is given medical help and discharged for work without counting any lost time.

9. Reportable Cases:

In this case the injured person is disable for 48 hours or more and is not able to perform his duty.

10. 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.

11. 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:

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

12. 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:

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

13. Incidence Rate:

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

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

14. HIRA:

Hazard Identification and Risk Assessment (HIRA) is a process of identifying Hazards in work area and then assessing them properly

15. Method Statement:

A method statement is prepared by the Execution/ Engineering Department detailing the steps, equipment, competencies and safety precautions required for carrying out any activity

16. Job Safety Analysis:

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

17. Safety Walk:

It's conducted periodically by an official - it's a walk through a portion or whole of a site as a HSE officer who notes down HSE observations, speak to concerned workmen and supervisor on observation, get the same corrected with personal follow up- this sends out a strong message on Management's commitment to safety.

18. Heavy & Complex Lifting:

A heavy and complex lifting activity includes:

1. Lifting above 20 Tons
2. Tandem Lifting using multiple cranes
Total load exceeding 75% of capacity of crane. Depending up the condition of cranes, hydra cranes, winch machines & other lifting accessories
3. Lift of unusual difficulty or geometry or rigging
4. Lift over operating units
5. Any other lift as decided by site HSE / Erection

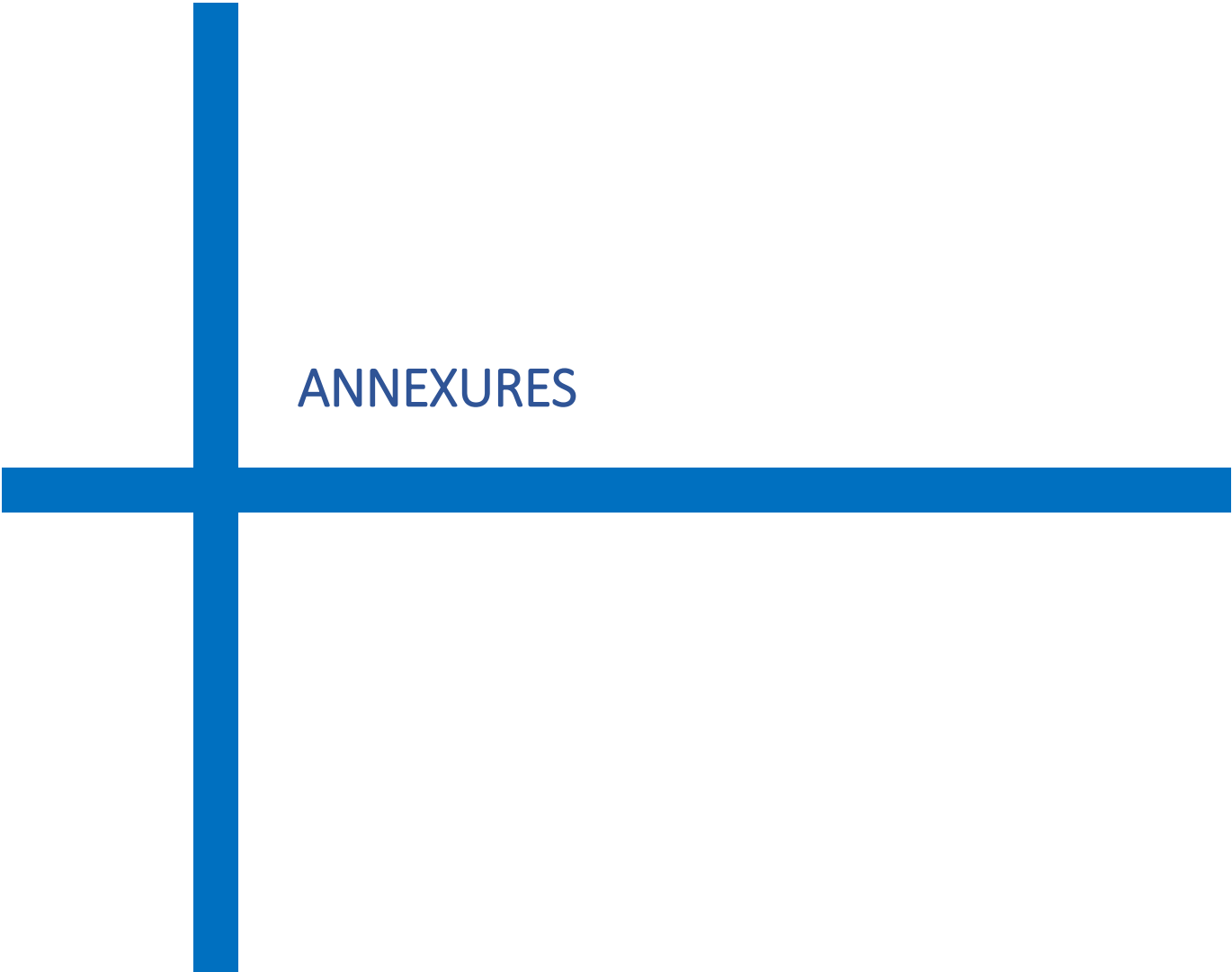
19. Safety Committee:

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

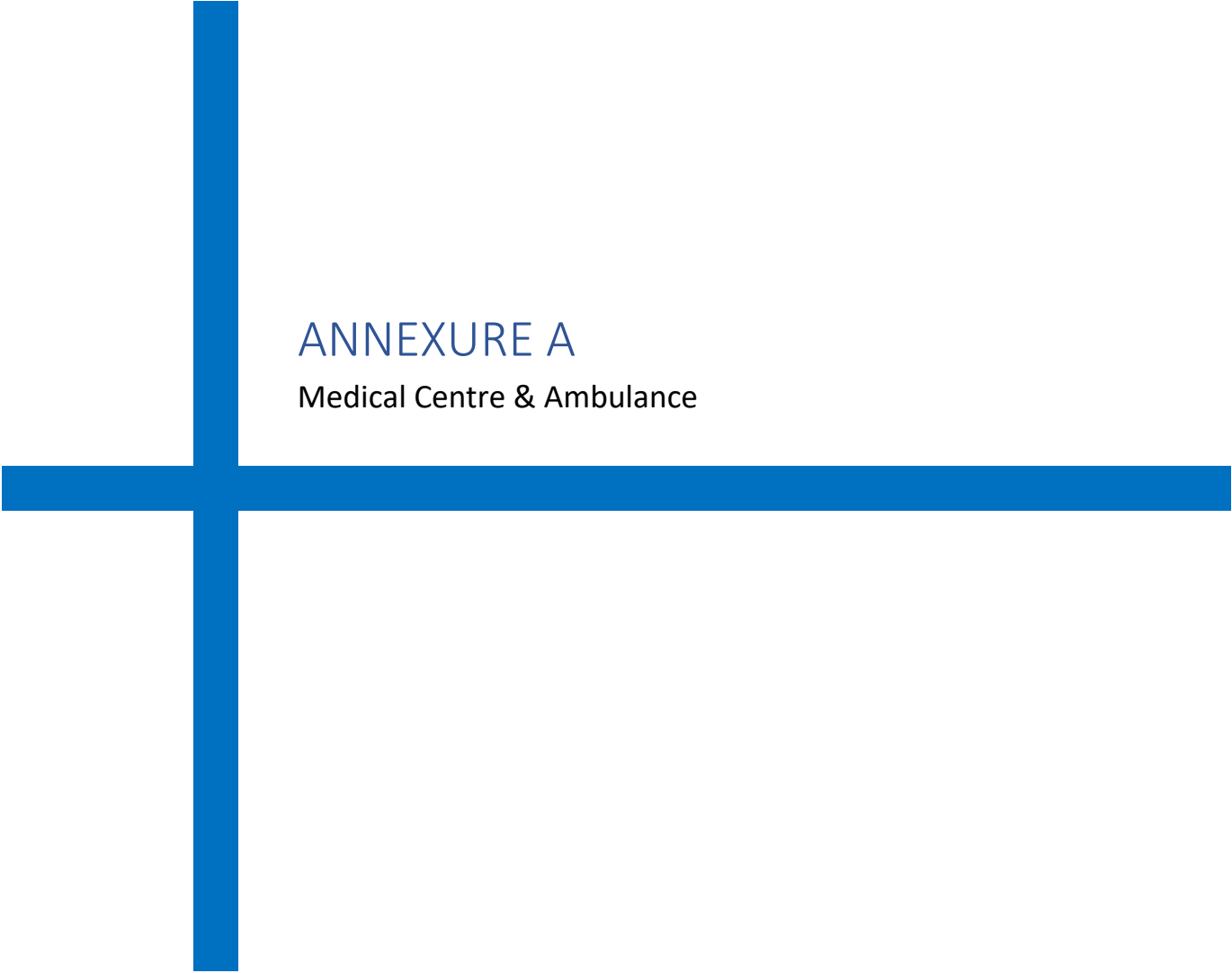
20. Night Work:

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





ANNEXURES



ANNEXURE A

Medical Centre & Ambulance

A. Medical Centre

1. Paramedical staff
 - a. When < 500 workers, 1 Trained Male Nurse (round the clock deployment)
 - b. When >=500 workers*:
 - i. Registered Medical Practitioner (Qualified MBBS) to be deployed for at least 8 hours in a day, 5 days per week
 - ii. 2 Trained Male Nurses (round the clock deployment)
 2. All articles as per Schedule IV of BOCW Central Rules, 1998 to be made available in the Medical Centre (given under for convenience)
 3. Basic Facilities/ Requirements to be provided as per location eg. Refrigerator, Air Conditioner, Anti Venom Serums etc.
 4. Tie-ups with speciality hospitals to be ensured for referring serious patients
- * In case the number of workers is envisaged to exceed 500, a medical practitioner is to be engaged.

SCHEDULE IV (BOCW CENTRAL RULES, 1998) ARTICLES FOR AMBULANCE ROOM [SEE RULE 226 (C)]

- i. A glazed sink with hot and cold water always available.
- ii. A table with a smooth top at least 180 cm x 105 cm.
- iii. Means for sterilising instruments.
- iv. A couch.
- v. Two stretchers.
- vi. Two buckets or containers with close fitting lids.
- vii. Two rubber hot water bags
- viii. A kettle and spirit stove or other suitable means of boiling water.
- ix. Twelve plain wooden splints 900 cm x 100 cm x 6 cm.
- x. Twelve plain wooden splints 350 cm x 75 cm x 6 cm.
- xi. Six plain wooden splints 250 cm x 50 cm x 12 cm.
- xii. Six woollen blankets.
- xiii. Three pairs of artery forceps.
- xiv. One bottle of spiritus annemias arematations (120 ml).
- xv. Smelling salt (60 gm).
- xvi. Two medium size sponges.
- xvii. Six hand towels.
- xviii. Four kidney trays.
- xix. Four cakes of toilet, preferably antiseptic soap.
- xx. Two glass tumblers and two wine glasses.
- xxi. Two clinical thermometers.
- xxii. Two tea spoons.
- xxiii. Two graduated (120 ml) measuring glasses.
- xxiv. Two minimum measuring glasses.
- xxv. One wash bottle (1000 cc) for washing eyes.
- xxvi. one bottle (one litre) carbolic lotion 1 to 20.
- xxvii. Three chairs.
- xxviii. One screen.
- xxix. One electric hand torch.
- xxx. Four first-aid boxes or cupboards stocked to the standards prescribed in
- xxxi. An adequate supply of tetanus toxoid.
- xxxii. Injections—morphia, pethidine, atrophine, adrenaline, coramine, novocaine (6 each).
- xxxiii. Cramine liquid (60 ml).
- xxxiv. Tablets—antihistaminic antispasmodic (25 each).
- xxxv. Syringes with needles—2 cc, 5 cc, 10 cc and 500 cc.

- xxxvi. Three surgical scissors.
- xxxvii. Two needle holders, big and small.
- xxxviii. Suturing needles and materials.
- xxxix. Three dissecting forceps
 - xl. Three dressing forceps
 - xli. Three scalpels.
 - xlii. One stethoscope and a B. P. apparatus.
- xliii. Rubber bandage—pressure bandage.
- xliv. Oxygen cylinder with necessary attachments.
- xlv. Atropine eye ointments.
- xlvi. I. V. Fluids and sets 10 nos.
- xlvii. Suitable, foot operated, covered, refuse containers.
- xlvi. Adequate number of sterilised, paired, latex hand gloves.

B. Ambulance

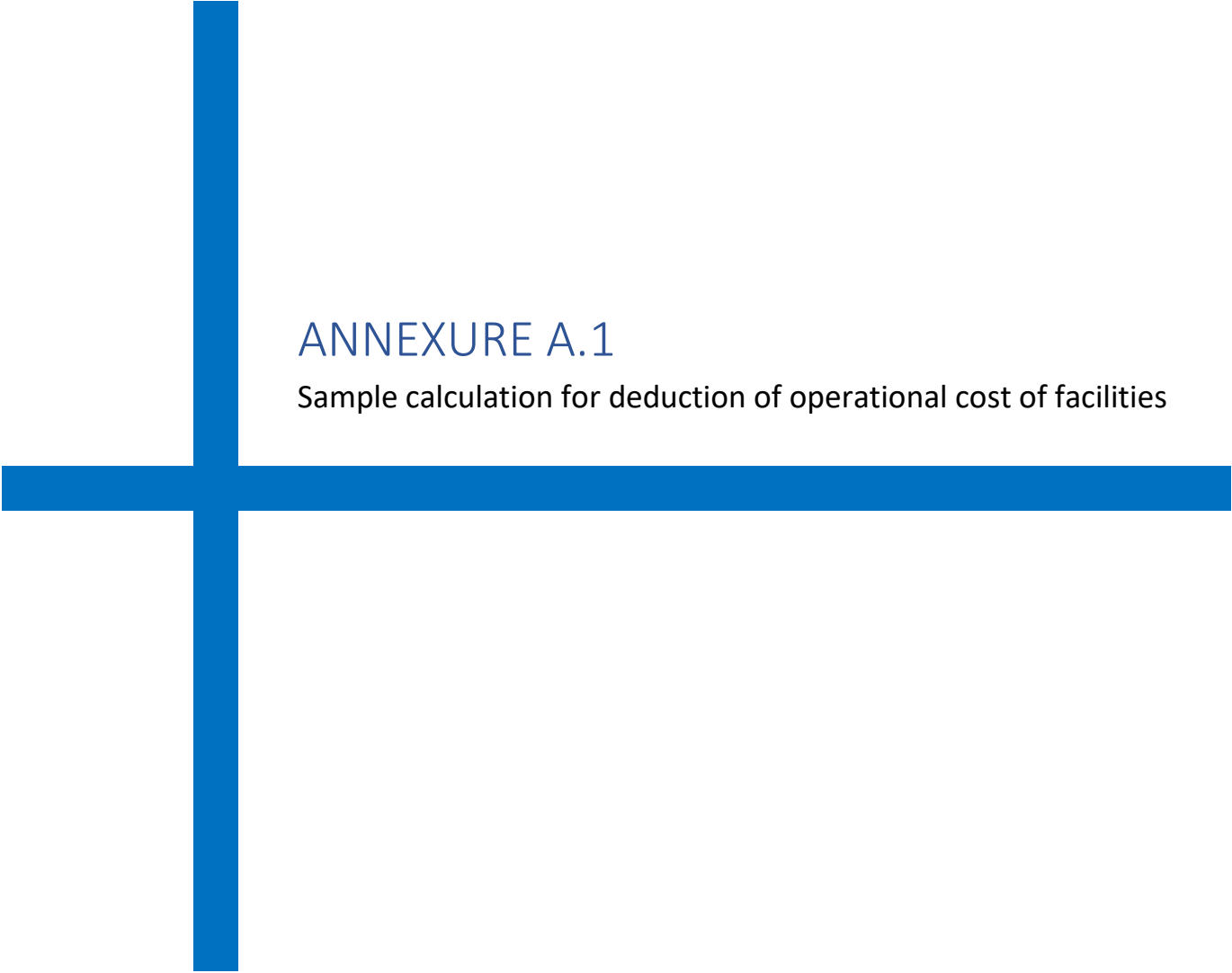
1. When number of workers is <500:
If the distance to a major hospital capable of handling critical injuries expected at Site is ≤ 50 KM from Site, then 1 BLS (Basic Life Support)/ Type B Ambulance otherwise ALS* (Advanced Life Support)/ Type D Ambulance
2. If no. of workers increases to >2000 workers one additional BLS Ambulance to be deployed
3. Minimum Articles as per Schedule V of BOCW Central Rules to be ensured in each Ambulance. (given under for convenience)

*Final call to be taken at Site in consultation with all the contractors

SCHEDULE V (BOCW CENTRAL RULES, 1998) CONTENTS OF AMBULANCE VAN OR CARRIAGE [SEE RULE 227]

The Ambulance Van shall have equipment prescribed as under:

- a) General—a portable stretcher with folding and adjusting devices with the Head of the stretcher capable of being tilted upward. Fixed suction unit with equipment. Fixed oxygen supply with equipment. Pillow with case, sheets, blankets, towels, emergency bag, bed pan, urinal glass.
- b) Safety Equipment—Flaros with life of three thousand minutes, floor lights, flash lights, fire extinguishers (dry power type), insulated guntlets.
- c) Emergency Care Equipment—
 - i. **Resuscitation**—Portable suction unit, portable oxygen unit, bag valve mask, hand operated artificial ventilation unit, airways, mouth gag tracheostomy adapters, short spine board, I.V. FLUIDS with administration unit, B. P. manometer cuff stethoscope.
 - ii. **Immobilisation**—Long and short padded boards, wire ladder splints, triangular bandage—long and short spine boards.
 - iii. **Dressing**—Gauze pads—100 m x 100 mm universal dressing 250 x 1000 mm, roll of aluminium foils—soft roller bandages 150 mm x 5 mm yards adhesive tape in 75 mm roll safety pins, bandage sheets, burn sheets.
 - iv. **Poisoning**—Syrup of Ipecac, activated charcoal pre packeted dose, snake bit kit, drinking water.
 - v. **Emergency Medicines**—As per requirement (under the advice of construction Medical Officer).



ANNEXURE A.1

Sample calculation for deduction of operational cost of facilities

Annexure A.1**Cost Calculation Methodology of Operation of Facilities (Data is indicative only)**

(Period of 48 months is considered - shall be on actual basis)

A. Project Info:

Total time of Project	48 months
Project cost	1000 Crore
No. of packages	10 (A1-A10)

B. Item-wise Calculation:

Item	Nos.	Rate	Unit	Amount
Ambulance with Driver	2		Monthly/Unit	170000
Nurse/First aider	2 X 2 shifts	15000	Per month	30000
Training center one time cost	1	100000	Once	100000
Medical center one time cost	1	200000	Once	200000
Medicines at medical center	1	10000	Monthly	10000
Dust suppression water tank	2	2000	Monthly	4000
Doctor	1	70000	Monthly	70000
Cleaning staff	1	12000	Monthly	12000
Recurring monthly expenditure				296000
Total one-time expenditure				300000

C. Package-wise Deduction Plan for a period of 48 months

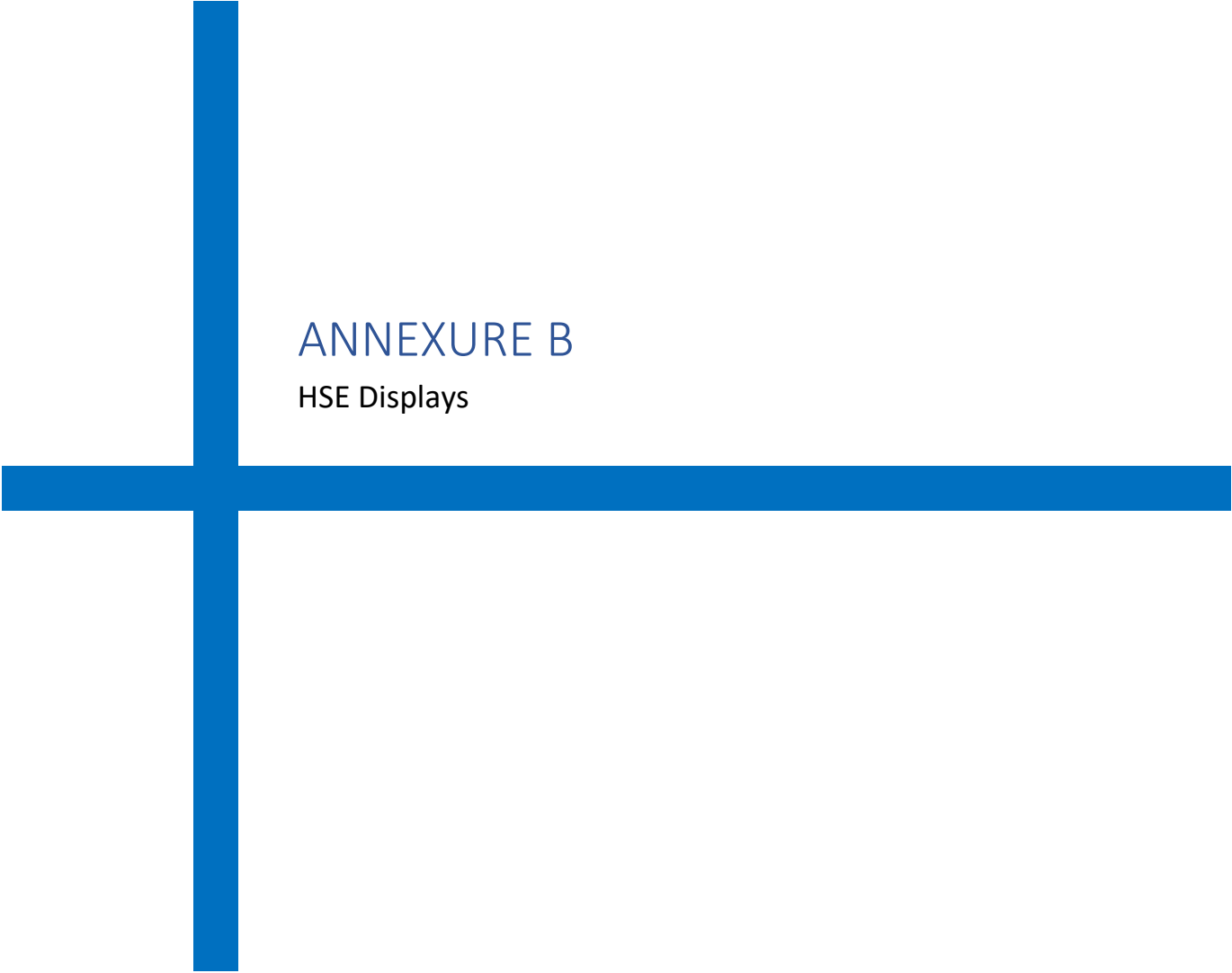
Period (In Months)	6	36	6
	For 1-6 months	For 7-42 months	For 43-48 months
Cost to be incurred from contractors	7%	81%	12%
	1.17% per month	2.25% per month	2.00% per month

D. Calculation For One-Time Running Cost

Packages/ Contracts	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10				
Contract Values (in Thousands)	100000	250000	2000000	200000	500000	1500000	1000000	1000000	250000	200000	7000000			
Share of common facilities one time running cost (in Thousands)	4	11	86	9	21	64	43	43	11	9	Individual Pkg value X Total one time running cost / All Pkg award values			
Timeline of work	1-6	1-8	2-48	6-36	7-15	10-48	6-48	7-40	40-48	41-48				
Month Count of work	6	8	47	31	9	39	43	34	9	8				
Deduction per month (in Thousands)	1	1	2	0	2	2	1	1	1	1	Total of One time Running cost (in thousands)	% deduction share of one time running cost per month	Nos. of active packages in month	
Month No.														
1	1	1									2	1%	2	
2	1	1	2								4	1%	3	
3	1	1	2								4	1%	3	
4	1	1	2								4	1%	3	
5	1	1	2								4	1%	3	
6	1	1	2	0			1				5	2%	5	
7		1	2	0	2		1	1			8	3%	6	
8		1	2	0	2		1	1			8	3%	6	
9			2	0	2		1	1			7	2%	5	
10			2	0	2	2	1	1			8	3%	6	
11			2	0	2	2	1	1			8	3%	6	
12			2	0	2	2	1	1			8	3%	6	
13			2	0	2	2	1	1			8	3%	6	
14			2	0	2	2	1	1			8	3%	6	
15			2	0	2	2	1	1			8	3%	6	
16			2	0		2	1	1			6	2%	5	
17			2	0		2	1	1			6	2%	5	
18			2	0		2	1	1			6	2%	5	
19			2	0		2	1	1			6	2%	5	
20			2	0		2	1	1			6	2%	5	
21			2	0		2	1	1			6	2%	5	
22			2	0		2	1	1			6	2%	5	
23			2	0		2	1	1			6	2%	5	
24			2	0		2	1	1			6	2%	5	
25			2	0		2	1	1			6	2%	5	
26			2	0		2	1	1			6	2%	5	
27			2	0		2	1	1			6	2%	5	
28			2	0		2	1	1			6	2%	5	
29			2	0		2	1	1			6	2%	5	
30			2	0		2	1	1			6	2%	5	
31			2	0		2	1	1			6	2%	5	
32			2	0		2	1	1			6	2%	5	
33			2	0		2	1	1			6	2%	5	
34			2	0		2	1	1			6	2%	5	
35			2	0		2	1	1			6	2%	5	
36			2	0		2	1	1			6	2%	5	
37			2			2	1	1			6	2%	4	
38			2			2	1	1			6	2%	4	
39			2			2	1	1			6	2%	4	
40			2			2	1	1	1		7	2%	5	
41			2			2	1		1	1	7	2%	5	
42			2			2	1		1	1	7	2%	5	
43			2			2	1		1	1	7	2%	5	
44			2			2	1		1	1	7	2%	5	
45			2			2	1		1	1	7	2%	5	
46			2			2	1		1	1	7	2%	5	
47			2			2	1		1	1	7	2%	5	
48			2			2	1		1	1	7	2%	5	
Total	4	11	86	9	21	64	43	43	11	9	300	100%		

D. Calculation For Recurring Running Cost

Packages/ Contracts	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10		
Contract Values (in Thousands)	100000	250000	2000000	200000	500000	1500000	1000000	1000000	250000	200000	7000000	
Timeline of work	1-6	1-8	2-48	6-36	7-15	10-48	6-48	7-40	40-48	41-48	Total of Recurring cost (in thousands)	Nos. of active packages in month
Month No.	6	8	47	31	9	39	43	34	9	8		
1	85	211									296	2
2	13	31	252								296	3
3	13	31	252								296	3
4	13	31	252								296	3
5	13	31	252								296	3
6	8	21	167	17			83				296	5
7		15	120	12	30		60	60			296	6
8		15	120	12	30		60	60			296	6
9			126	13	31		63	63			296	5
10			95	10	24	72	48	48			296	6
11			95	10	24	72	48	48			296	6
12			95	10	24	72	48	48			296	6
13			95	10	24	72	48	48			296	6
14			95	10	24	72	48	48			296	6
15			95	10	24	72	48	48			296	6
16			104	10		78	52	52			296	5
17			104	10		78	52	52			296	5
18			104	10		78	52	52			296	5
19			104	10		78	52	52			296	5
20			104	10		78	52	52			296	5
21			104	10		78	52	52			296	5
22			104	10		78	52	52			296	5
23			104	10		78	52	52			296	5
24			104	10		78	52	52			296	5
25			104	10		78	52	52			296	5
26			104	10		78	52	52			296	5
27			104	10		78	52	52			296	5
28			104	10		78	52	52			296	5
29			104	10		78	52	52			296	5
30			104	10		78	52	52			296	5
31			104	10		78	52	52			296	5
32			104	10		78	52	52			296	5
33			104	10		78	52	52			296	5
34			104	10		78	52	52			296	5
35			104	10		78	52	52			296	5
36			104	10		78	52	52			296	5
37			108			81	54	54			296	4
38			108			81	54	54			296	4
39			108			81	54	54			296	4
40			103			77	51	51	13		296	5
41			120			90	60		15	12	296	5
42			120			90	60		15	12	296	5
43			120			90	60		15	12	296	5
44			120			90	60		15	12	296	5
45			120			90	60		15	12	296	5
46			120			90	60		15	12	296	5
47			120			90	60		15	12	296	5
48			120			90	60		15	12	296	5
Total	143	388	5676	329	235	3102	2334	1772	132	96	14208	



ANNEXURE B

HSE Displays

A. Types of Displays**1. Based on Content**

SN	Type
1.	HSE Hazards & Precautions Height Work, Housekeeping, Fire Safety, PPEs, Hot Work, Lifting & Rigging Activity, Site-specific Hazards – eg. for Refineries, Nuclear plants etc.; COVID Precautions; Environment Protection etc.
2.	Other Displays, Signage etc. HSE Policy, ISO Certificate, Safety Statistics, Assembly Area Location/ Route, Emergency Contact Numbers, Site Safety Rules & Regulations, Speed Limit, Work in Progress, Lock-Out Tag-Out (LOTO) Boards etc.

2. Based on Mounting

[Type 1]	[Type 2]	[Type 3]
Flex Sign Boards of Wooden Frame – directly mounted on Structures (walls, stairs, railings etc.)	Flex Sign Boards with Wooden Frame – mounted on metallic/ wooden legs – preferably double-sided	Coloured weather-proof Paintings on Walls (after due concurrence of BHEL/ Customer – Type 1 in case of no concurrence/ space)

B. General Requirements:

- Displays should be weather-proof as per installation location, i.e. rain-proof, wind-proof and sun-proof.
- Installation location and size to ensure visibility for the intended viewers (workers and moving personnel)
- Displays to have at least 50% graphical elements preferably (as applicable). Language should be understandable by majority of the workers
- Displays to be relevant to the hazards in the area
- Proper installation to ensure boards don't obstruct activities and should not be prone to fall so as to pose danger
- In case of multiple elevations (eg. Boiler, Power-house etc.), each elevation to have displays for applicable hazards including Height-Work, Housekeeping
- For temporary work locations, posters/ boards may be erected and shifted after task is over
- Minimum size of displays should be A1 unless otherwise specified
- In case of damage, displays shall be reviewed and repaired/ replaced
- In areas where night work is envisaged, fluorescent displays shall be installed and these should comprise of at least 20-30% of total displays
- Total Number of displays to be not less than 1 per 10 workers and are to be dynamically updated based on number of workers

C. Area-wise Displays

Below is list of Area-wise displays that are to be installed at Sites (Numbers, locations may be adjusted for specific requirements)

SN	Area	Suggested Subjects	Minimum Size	Minimum Quantity	Locations
1	Walls/ Foundations/ Cement Structures etc. belonging to the package area	Safety Hazards Prevention and other HSE Awareness content	[Type 3]	As per BHEL assessment from time to time	
2	Site Interior Roads belonging to the package area	At least every 20 meters: 1. Speed Limit Indication, Safe Driving board 2. Boards for hazard awareness	1.As needed [Type 2] 2. A1 or equivalent each [Type 2]	As indicated	Sides of Roads; Height to ensure good visibility
3	Specific Package Areas	A. Common At entry to respective Package/ Work Area, each contractor to put up daily updated board with following for each shift: 1. Scope of work and start date 2. Emergency Contact Numbers 3. Emergency Assembly Location, Escape Plan 4. Locations and supervisors of various gangs in the area, 5. Current Work permit Details 6. Safety Supervisor Location assignments - Names, Mobile Nos., Assigned Locations 7. Details (Name, Contact No. etc.) of Package In-charge - Contractor & BHEL 8. Details (Name, Contact No. etc.) of Safety In-charge - Contractor & BHEL 9. LTI Free Man-days & details of last LTI also to be indicated In addition, Area-Specific Displays as indicated in Table 1	A0 [Type 2]	1 per Package Area	Entry/ Ground Level

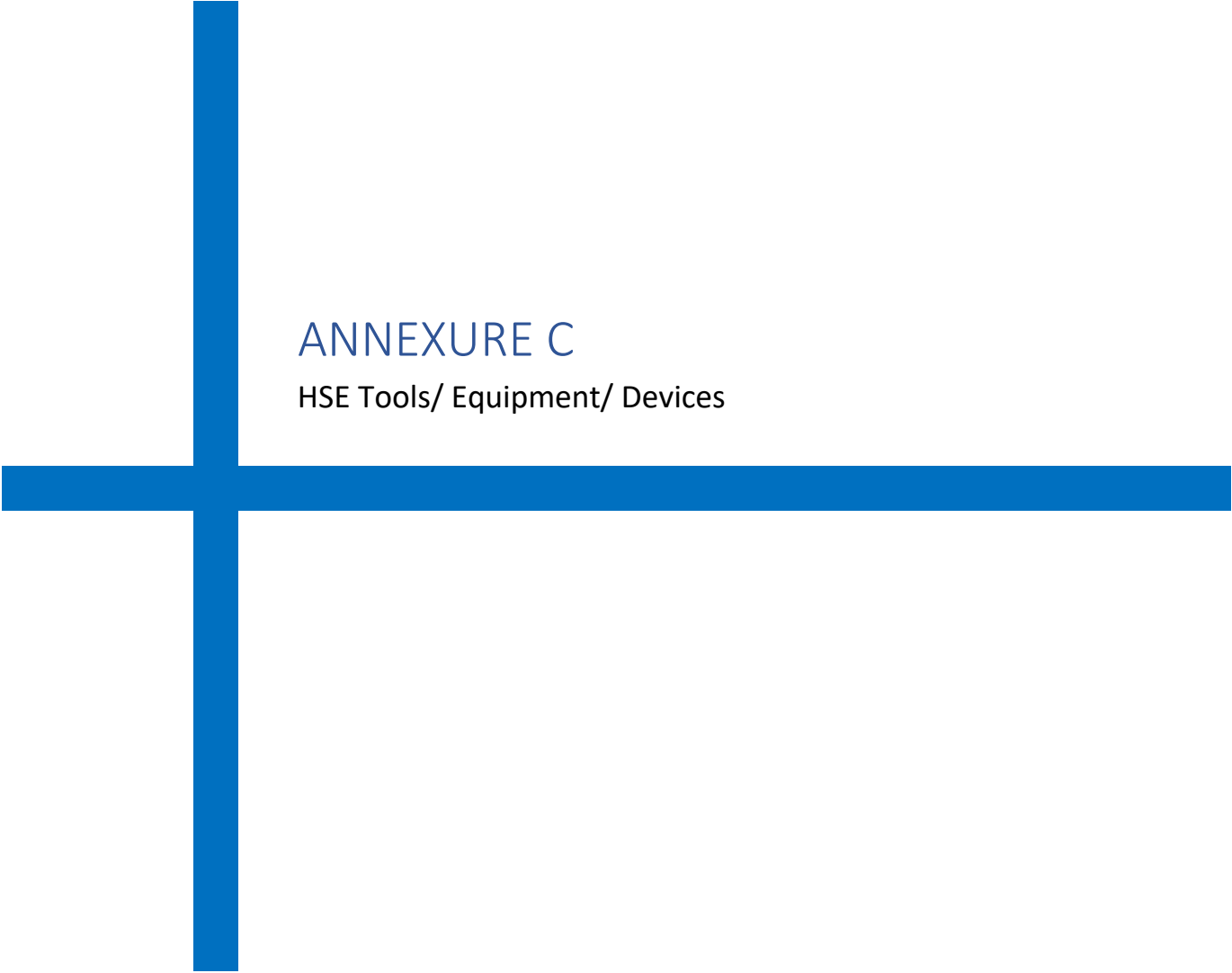
Table 1
(Area/ Package-wise HSE Display Plan – As applicable)

Prepared By (Subcontractor)				
S. No.	Area	Suggested Minimum No. of Displays & Types	Type	Numbers Installed
1	Boiler	3 per working elevation	[Type 1]	
2	Powerhouse	5 per elevation	[Type 1]	
3	ESP	5 Per Pass	[Type 1]	
4	Buildings	5 per elevation	[Type 1]	
5	Cooling Tower (NDCT/ IDCT/ ACC)	20 per Structure	[Type 1]	
6	Chimney	20 per Structure	[Type 1]	
7	Fabrication Yard	10 per Yard	[Type 2]	
8	Batching Plant	5 per Plant	[Type 1]	
9	Material Storage Yard – Open	20 per Yard	[Type 2]	
10	Material Storage Shed – Semi-Closed/ Closed	10 per Shed	[Type 1]	
11	Electrical Booths	2 per booth + Line diagram, Emergency contact details	[Type 1]	
12	Medical & First Aid Centre	2 per Centre	[Type 1]	
13	Rest Shed	2 per Shed	[Type 1]	
14	Canteen	2 per Canteen	[Type 1]	
15	Drinking Water Area	1 Per Outlet	[Type 1]	
16	Washing Water Area	1 Per Outlet	[Type 1]	
17	Training Centre	10 per room	[Type 1/2]	
18	Assembly Area	5	[Type 1/2]	
19	Stairs	1 per landing elevation	[Type 1]	
20	Cylinder Storage Area	5 + Signage: Type of Gas, Empty, Filled etc.	[Type 1/2]	
21	Labor Colony	Electrical Safety with Distribution Plan/ Line Diagram - 1 COVID Precautions Posters – 5 Safety Awareness Posters – 10 Hygiene awareness posters - 2	[Type 1]	
22	Others	As per requirement	[Type 1/2]	

Date:

Sign (Contractor)

Sign (BHEL)



ANNEXURE C

HSE Tools/ Equipment/ Devices

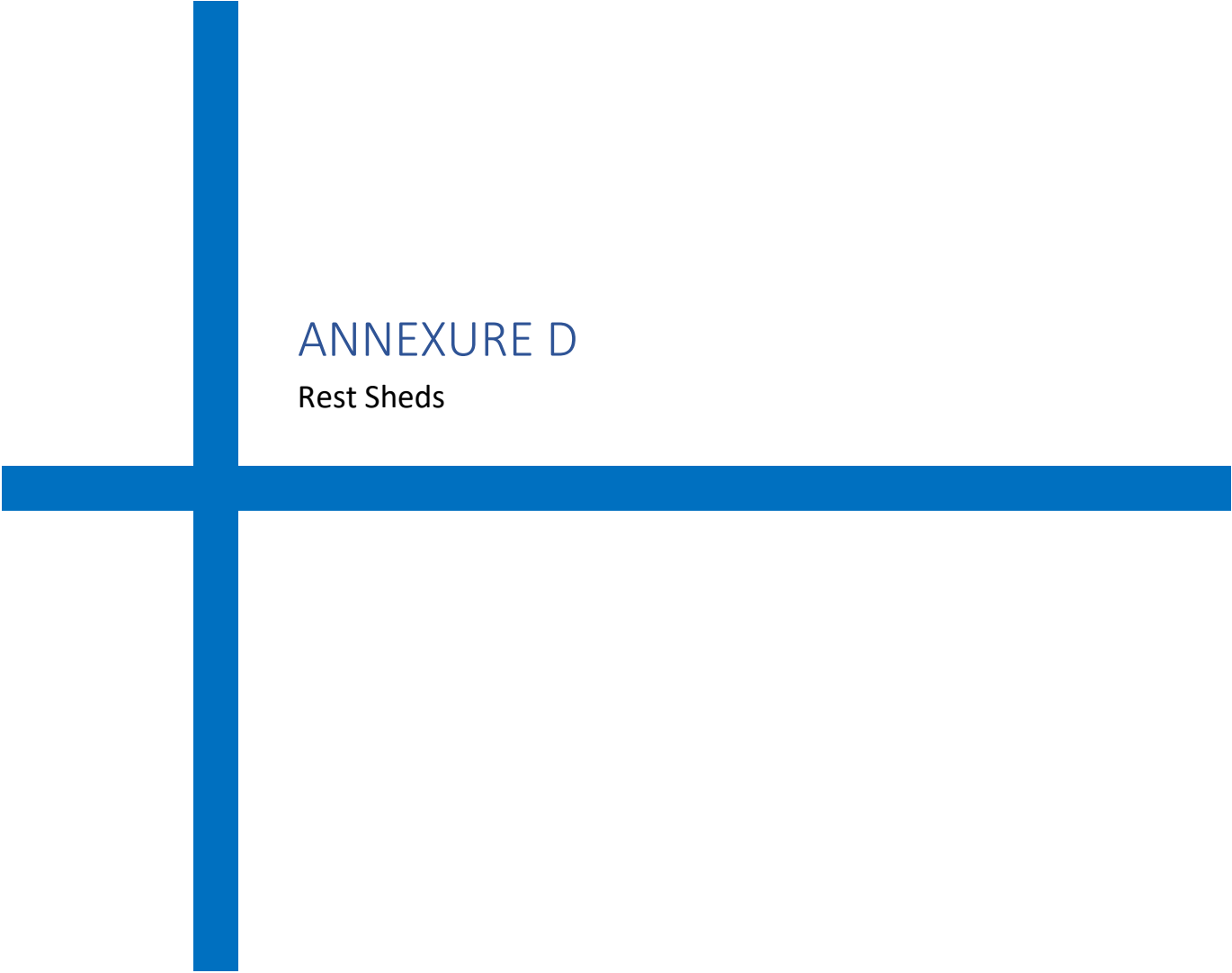
Following equipment conforming to relevant IS/ISO/BS Codes/ Standards in indicated quantities shall be ensured by subcontractor. This list is tentative, not exhaustive. Quantity and date/ period of deployment shall be as per site requirement.

A. HSE Tools/ Equipment/ Devices

SN	Item
1	Lifelines
2	Retractable Fall Arrestors
3	Safety Nets (10m X 5m) fire proof double mesh
4	Sky Climbers
5	Fire Blanket
6	Honey Bee Removal Suit & Kit
7	Scaffolding Pipes
8	Flashback Arrestors
9	Barricading Tape
10	Binoculars
11	Walkie-Talkies
12	LOTO kit
13	24-Volt light
14	Sand Buckets
15	Hard barricading Pipes
16	Standby Fire kits
17	Hand-held Megaphone
18	Small Public Address System
19	Foldable Stretcher
20	Height Rescue Kit (Non-Motorized)
	(Others:)

B. Test & Measurement Devices

SN	Device
1	ELCB Tester
2	Multi meter (Light cables)
3	Earth Resistance Meter
4	Lux Meter
5	Sound Meter
6	Anemometer
7	Breath Analyzer (Alcohol)
8	Multi-gas dozi-meter/ detector
9	Gas leakage detector / alarm
10	Gas monitor (confined space)
11	Radiation meter & Badges
12	Blood Pressure Monitor
13	Fire detectors
14	Hand held signaling light
	(Others:)



ANNEXURE D

Rest Sheds

1. Determining the Number, Sizes and Locations of Rest Shelters

i. **Numbers:**

The number of rest shelters shall be determined based on maximum number of workers at any one time (across all shifts). Formula is:

W_{max} = Maximum number of workers at any time in the Site

Space per worker = 1.1 sq meter

Total space required, T_{space} = $W_{max} \times 1.1$

Based on total space requirement calculated above, the number of rest sheds can be decided according to availability of locations and concentration of workers – so as to ensure the required space.

ii. **Locations:**

The rest sheds should be so located so as to minimize the distance to be travelled by the workers from their locations of work considering all the practical constraints

iii. **Other:**

The Rest shelter should be fenced so that it cannot be used as parking area.

2. Design & Construction of Rest Sheds

a. **Permanent/ Long duration Rest Sheds**

- i. For locations where, permanent rest sheds can be constructed without possibility of removal for relatively long period of time, a semi-closed shed can be constructed covered with tin roof and supported with well-grouted beams. The floor of the shed to be preferably cemented/ solidified.
- ii. Adequate structural requirements suitable to the local weather (wind/ rain etc.) to be ensured.
- iii. The design of the rest shed to be approved by Civil Engineering Department of BHEL Site before commencing work

b. **Temporary/ Movable/ Portable Rest Sheds**

- i. For locations where, permanent rest sheds cannot be constructed either due to non-availability of permanent location or other reasons, temporary rest shed shall be constructed.
- ii. Temporary rest sheds shall comprise of Tent arrangement carried out by professional agencies

3. Amenities in Rest Sheds

a. **Essential Amenities**

Following amenities shall be essentially ensured in a rest shed:

- i. Hygienic environment with regular cleaning and housekeeping (with records)
- ii. Adequate illumination
- iii. Adequate ventilation/ heating as per weather conditions
- iv. Clean Drinking water source
- v. Hand Washing area
- vi. Toilets & Urinals
- vii. Benches/ mats for sitting/ lying
- viii. Any other essential requirement deemed necessary by the Site
- ix. Dust bins of sufficient quantity/ size that are vacated each day/ as per requirement

b. **Additional/ Optional Amenities**

Following amenities are optional but are recommended to enhance the level of satisfaction of work force:

- i. Hot/ Cold drinks (Tea, Coffee, Glucose etc.) as per requirement
- ii. Snacks
- iii. Fans/ Coolers/ Heating arrangements as per requirement and weather conditions
- iv. A nice, welcoming interior design, music etc.
- v. Water cooler

4. Health & Safety Requirements of Rest Sheds

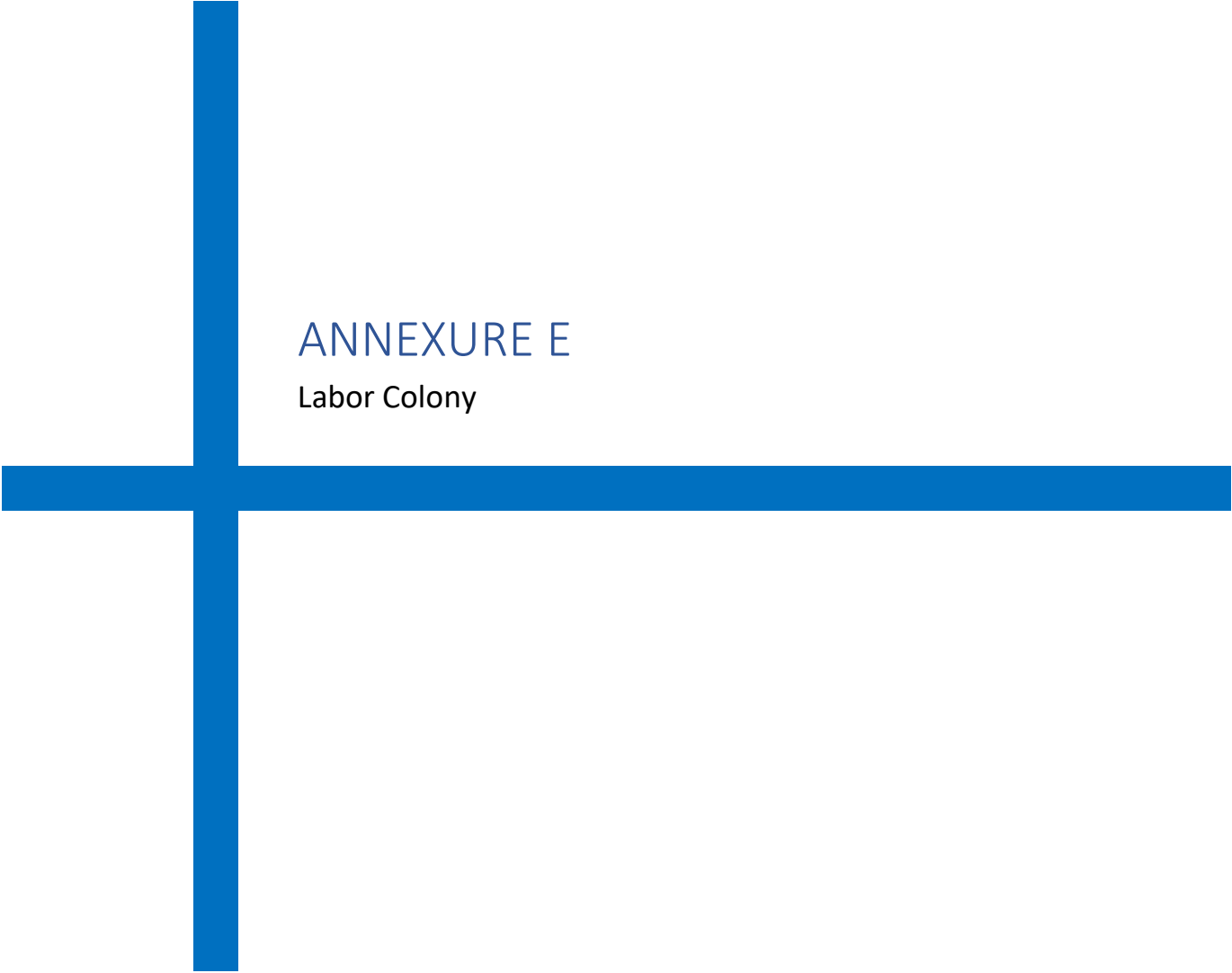
Use of asbestos in construction is banned and shall not be used.

In addition, following essential Safety features shall be ensured in Rest sheds:

- i. Availability of Fire extinguishers (preferably CO2 type)
- ii. Display of Safety Posters
- iii. Pest/ reptile protection
- iv. Mosquito prevention measures

5. Note:

Any suitable closed spaces/ newly constructed buildings etc. available at project may also be used for the purpose of rest shed with due concurrence of BHEL



ANNEXURE E

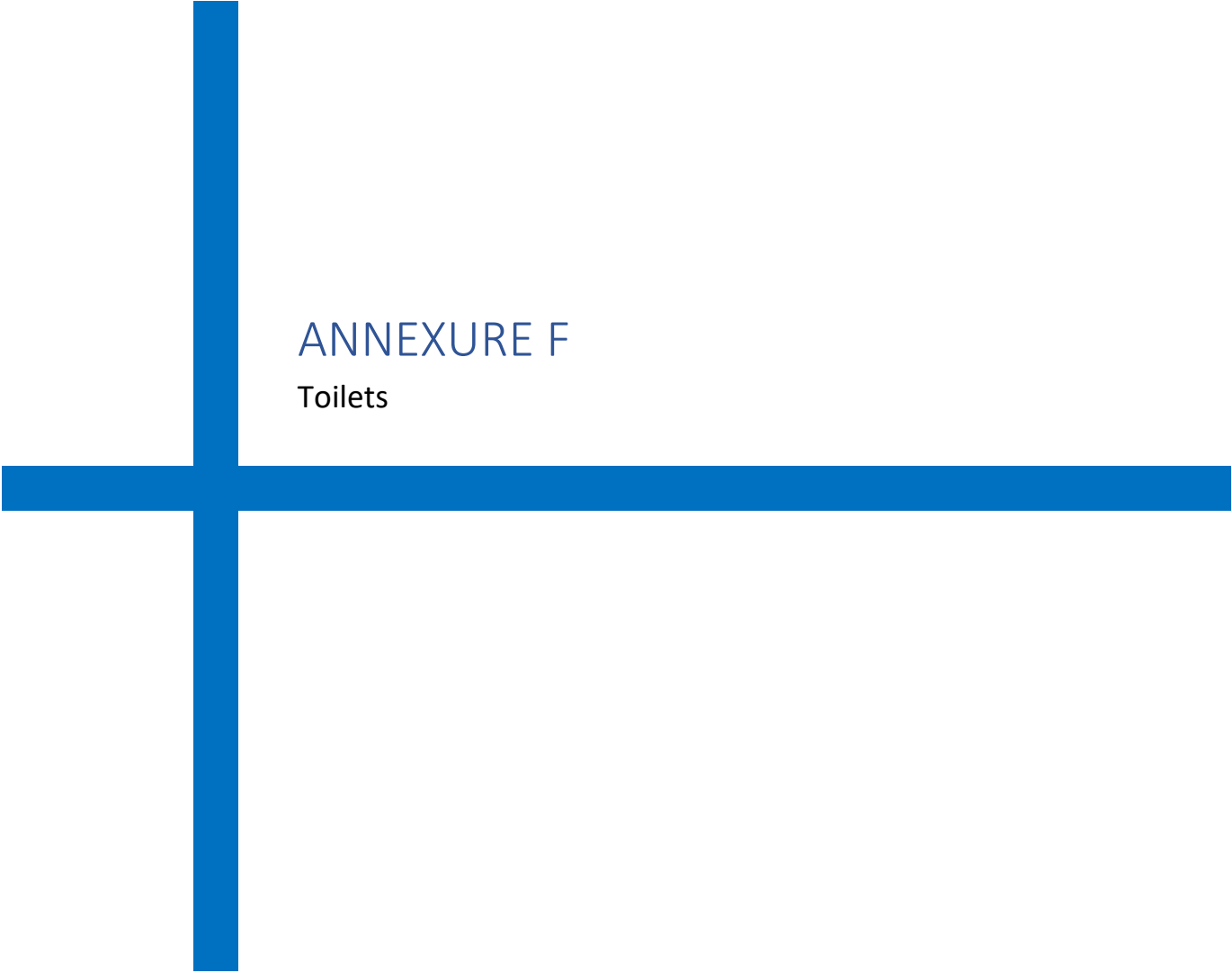
Labor Colony

1. These Guidelines suggest minimum requirements. However, additional requirements based on feasibility and circumstances, while adhering to directions of GOI/District Administration/Local Authority guidelines to be considered
2. Norms for social distancing, training/ awareness, face masks, disinfection, sanitization, gate entry, quarantine, medical, action in case of suspect cases of COVID and other communicable diseases etc. to be followed as per Govt. and BHEL guidelines issued from time to time
3. Labor colony to be developed as close to the Site as possible to avoid lengthy commute
4. A "Suggestion Register" shall be made available at the labor colony for residents. The feedback shall be reviewed on weekly basis and acted upon by concerned Contractor. Same shall be reviewed periodically by authorized BHEL Site Official.
5. **Canteens, Latrines & Urinals, Washing Facilities, Creches, Residential Accommodation and other infrastructure/ facilities:**
Numbers/ Quantities and Features of these facilities shall be in line with the following as applicable:
 - a. BOCW Act & State Rules
 - b. The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act & State Rules
 - c. Factories Act & State Rules
 - d. Other Relevant Acts & Rules
6. **Cleanliness & Hygiene/ Housekeeping:**
 - a. Regular cleaning of the labor colony to be ensured.
 - b. Daily cleaning of Sanitary facilities.
 - c. Proper drainage system to prevent water-logging
 - d. Regular fogging to prevent spread of mosquitoes
 - e. Prevention of foul smell through necessary interventions
 - f. Dust suppression as per requirement
 - g. Cutting of Grass at regular intervals and other necessary measures to prevent pests & reptiles
 - h. Stray animals to be banned from labor colony.
 - i. Outside every common facility, eg. Toilet, washroom, food hall/ canteen etc., provision of washbasin with flowing water and soap (preferably liquid soap) to be ensured
7. **Power Supply Layout:**
Electrical supply Layout of Labor Colony shall have the provision of Safety devices like MCBs, ELCBs etc. and to be clearly displayed
8. **Washing & Drinking Water Availability**
 - a. Adequate water to be provided in line with: "Estimation of Water Requirements for Drinking and Domestic Use (Source: National Building Code 2016, BIS)"
 - b. Drinking water tank to be cleaned every week and sticker for the same pasted on the tank
 - c. Drinking water source should be tested as per IS 10500
9. **Waste Disposal:** Separate bins for dry, wet and biomedical waste to be installed. These bins to be evacuated regularly
10. **Training & Awareness/ Displays**
 - a. **HSE Awareness Displays:** Posters/ banners/ boards to be displayed in labor colony. Subjects of displays shall be precautions for applicable hazards at work site.
 - b. **Emergency Contact Numbers** including that of Doctor, Hospital, Labor Colony Supervisor, HSE Officials to be displayed prominently

11. Doctor Visits:

Regular and need-based visits by Doctors to be ensured through tie-ups etc.

12. Inspection & Review: Regular inspection of labor accommodation to be carried out by the Contractor as per prescribed format. Last inspection date, inspector and next due date to be prominently indicated near main gate**13.** Provision of a Fair Price shop in the premises to be ensured as per requirement**14.** Adequate arrangements to be ensured in case of children/ families



ANNEXURE F

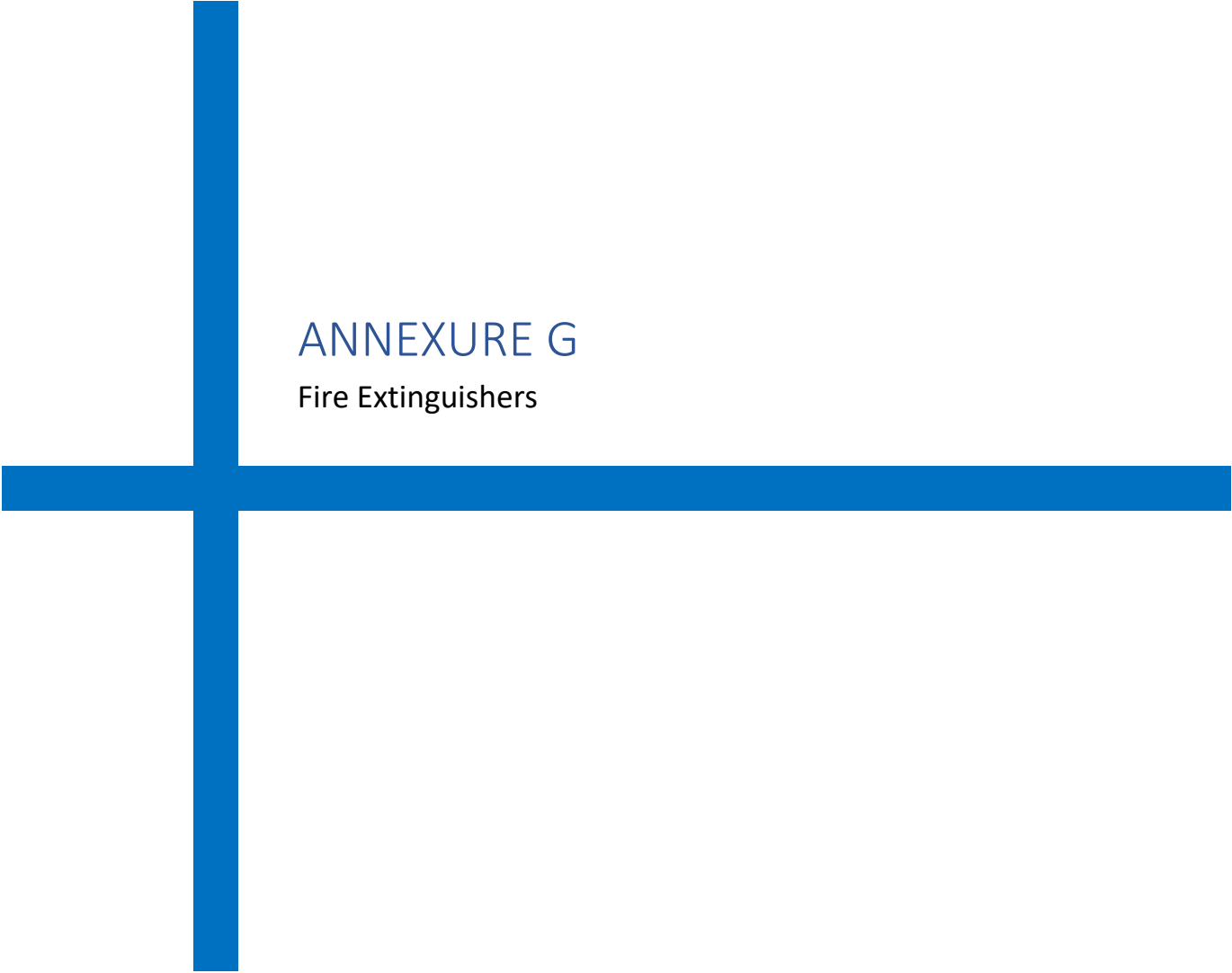
Toilets

Toilets (Latrines and urinals shall be ensured at Site and Labor Colony in accordance with the Inter-State Migrant Workmen Act, 1979 as given below:

LATRINES	URINALS
1. Latrines shall be provided in every establishment on the following scale, namely: - a. Where females are employed, there shall be at least one latrine for every 25 females; b. Where males are employed, there shall be at least one latrine for every 25 males: Provided that where the number of males or females exceeds 190, it shall be sufficient if there is one latrine for 25 males or females, as the case may be, up to the first 100, and one for every 30 thereafter 2. Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings.	1. There shall be at least one urinal for male workers up to fifty and one for female up to fifty employed at a time: Provided that where the number of male or female workmen, as the case may be, exceeds 500 it shall be sufficient if there is one urinal for every fifty females up to the first 500 and one for every 100 or part thereof thereafter. 2. The urinals shall be designed and located so as to ensure privacy.

Important:

- Where workers of both sexes are employed there shall be displayed outside each block of latrine and urinal a notice in the language understood by the majority of the workers '**For Men Only**', or '**For Women Only**', as the case may be.
- The notice shall also bear the figure of a man or of a woman, as the case may be.
- The latrines and urinals shall be conveniently situated and accessible to workers at all times at the establishment.
- The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.
- Latrines and urinals other than those connected with a flush sewage system shall comply with the requirements of the public health authorities.
- Water shall be provided by the means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.
- At Site, on ground, **Modular Bio-toilets** as per industry standard specifications and regular professional cleaning shall be ensured. The toilets should be sufficient in number and easily accessible to workers from every work area
- At Site, in various elevations, suitable urinals with proper drainage to be ensured at each elevation in line with IS 2064 (1993). Same to be cleaned regularly



ANNEXURE G

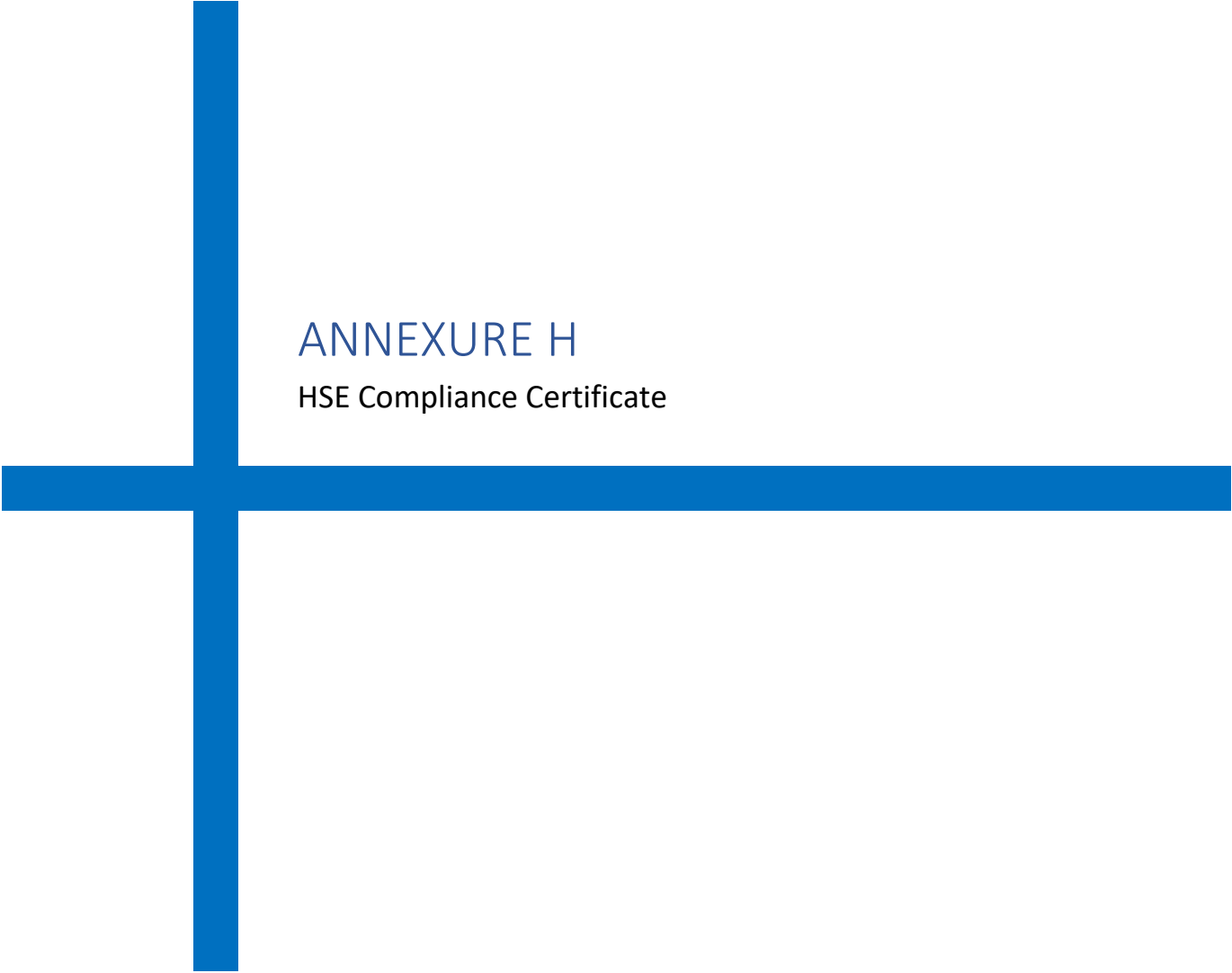
Fire Extinguishers

SN	Type of Fire Risk (Class of Fire)	Extinguishing Medium & Relevant INDIAN STANDARD	Scale of Equipment (Minimum recommended)
1.	CLASS 'A' Fires involving ordinary combustible materials like wood, paper, textiles, rubber etc. (Ordinary hazard or low fire load)	WATER Soda acid type, water type (gas pressure) and water type (constant air pressure) IS: 934 -1976; IS: 940 -1976; IS: 6234 -1971	For every 600 square meter floor area or part, one 9-litre capacity. Minimum 4 numbers per floor or room; should not be required to travel more than 15 meter to reach any extinguisher.
2.	CLASS 'A' (Extra hazard & high fire load)	-do	-do – (Also, consult local fire authority).
3.	CLASS 'A' (Special hazards)	-do	-do – Extra provision For every 100 square meter floor area or part, one 4.5 Kg. CO ₂ ; minimum 2 numbers per room; should not be required to travel more than 10 meter to reach any extinguisher.
4.	CLASS 'B' (Fires in flammable liquids like oils, solvents, petroleum, products, varnishes, paints, etc. where blanketing effect is essential) (Storage and handling in small quantities)	FOAM / CARBON DIOXIDE / DRY CHEMICAL POWDER IS: 933 -1976; IS: 2878 1976; IS: 2171 1976; IS: 4308 -1982	For every 50 square meter floor area or part, 2 numbers 9 -liters foam or 5 kg dry powder; should not be required to travel more than 10 m in the area of storage to reach any extinguisher.
5.	CLASS 'B' (Bulk storage other than in tank form))	-do -	-do- (but minimum 3 numbers per room)
6.	CLASS 'C' (Fires involving gaseous substances under pressure where it is necessary to dilute the burning gas at a very fast rate with an inert gas or powder) (storage and handling of gas cylinders)	CARBON DIOXIDE / DRY CHEM. POWDER. The best way to extinguish such fire is by stopping the flow of fuel gas to the fire. Container is kept cool with water spray. IS: 2878 1976; IS: 2171 -1976; IS: 4308 -1982	For every 100 square meter floor area or part; 2 numbers, 10 kg powder extinguisher or 6 kg CO ₂ ; minimum 3 nos. per room; should not be required to travel more than 10 meter to reach any extinguisher.
7.	CLASS 'D' Fires involving metals like magnesium, aluminum, zinc, potassium etc. where the burning metal is reactive to water and which require special extinguishing media or technique	SPECIAL DRY POWDER IS: 2171 -1976 IS: 4861 -1968	For every 50 square meter floor area or part, 2 nos. 5 kg special dry powder; minimum 3 nos. per room; should not be required to travel more than 10 meter to reach any extinguisher.
8.	MIXED OCCUPANCY (electrical); Generators; Transformers; etc.	CARBON DIOXIDE DRY POWDER, IS: 2878 1976; IS: 2171 -1976	For every 100 square meter floor area or part one 10 kg CO ₂ . Minimum 2 numbers for every location should not be required to travel more than 10 meter to reach an extinguisher.

Note: Due to peculiarities of the power plant construction sites, there would be locations in the construction areas of Boiler, Turbine, Generator, Transformer, etc. where different types of fire risk (classes of fire) may co-exist. Special care shall be taken while selecting and installing portable fire extinguishers for such locations so that all types of fire risk that may co-exist, are adequately covered. Similar special care shall be taken for storage areas.

a. All Electrical welding booths shall be equipped with appropriate Fire Extinguisher

- b. Appropriate Fire Extinguishers shall be made within easy reach of all welding operations
- c. Fire extinguishers shall be regularly tested and last checked date to be indicated on each. Master list shall be prepared with location and details
- d. Providing appropriate fire-fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
- e. Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labour colony etc. Such fire protection equipment shall be easy and kept open at all times.
- f. 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.
- g. 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.
- h. 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.
- i. Emergency contacts nos. must be displayed at prominent locations
- j. 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.



ANNEXURE H

HSE Compliance Certificate

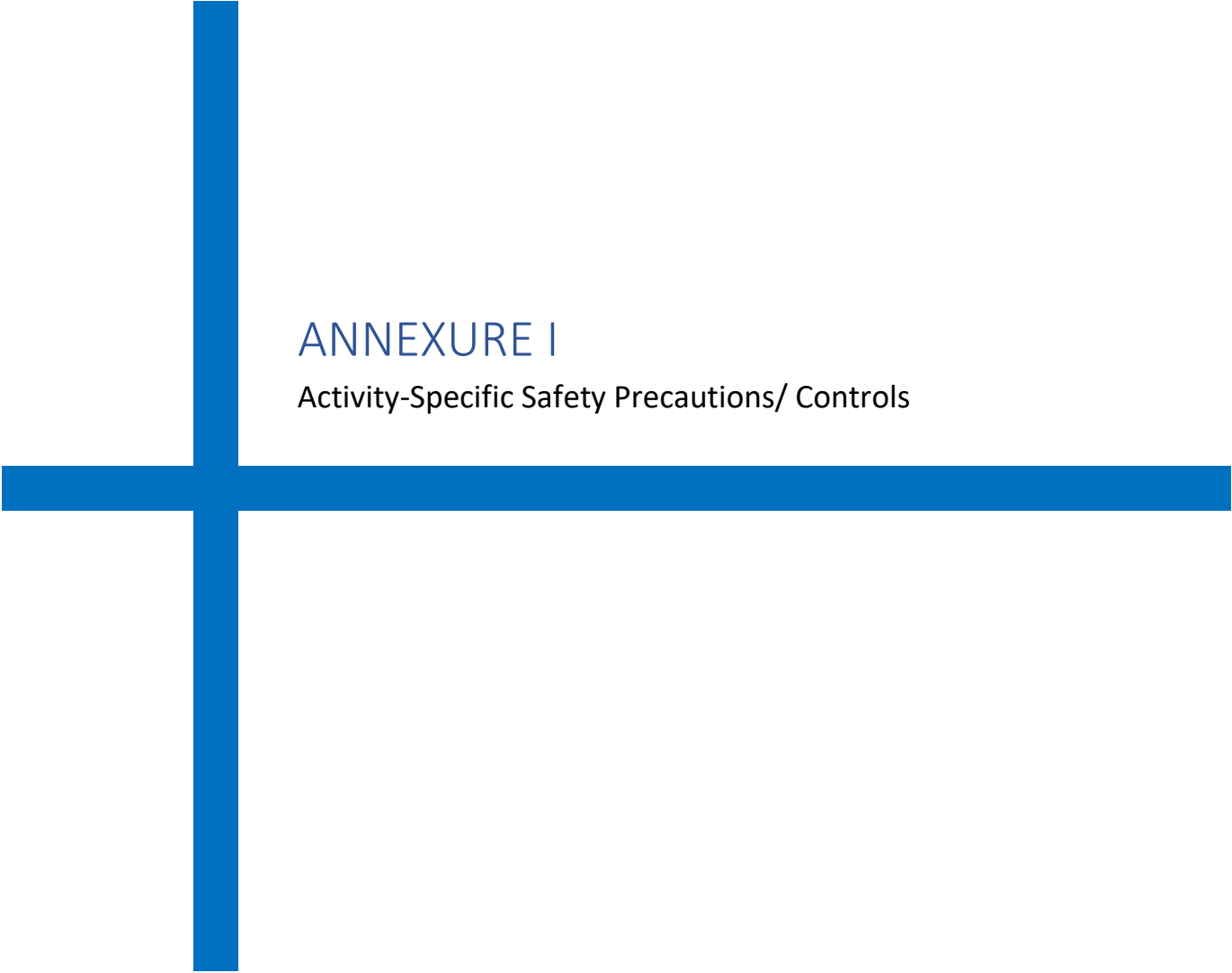
Bill Ref no: _____ Date: _____

NAME OF THE AGENCY: _____ Work-Area/Package: _____

Sl. No.	Description	Remarks
1	<u>HOUSE KEEPING:</u>	
1.1	All working areas at site (specific to the agency) are free from garbage's, scraps & any other undesired non-plant materials. There is no encroachment in safe passage of man, material & T&P to carry out activities safely	
1.2	All the plant materials under the custody of the agency are stacked & stored properly.	
2	<u>GENERAL ILLUMINATION:</u>	
2.1	ALL the working areas at site & office of the agency including passages are having proper & sufficient illumination.	
3	<u>STATUTORY & REGULATORY REQUIREMENT:</u>	
3.1	Sufficient water for drinking & other purposes and sanitation in work area and labour colony are available.	
3.2	Periodical Medical check-up of workers & staff done regularly & report submitted to BHEL	
3.3	Regular EYE testing is done for Crane operators/Welders and data's are available with agency	
3.4	All the T&P, Cranes etc used by the agency are having proper T.Cs & Fitness certificate available from competent authority.	
4	<u>SAFETY COMPLIANCE:</u>	
4.1	Number of Tool box meetings between Safety officers, erection staff & workers of the agency held in this month with location mentioned	
4.2	All precautions & Safety measures including PPE compliances are taken before working at HEIGHT	
4.3	Permit for working at Height is taken & complied accordingly	
4.4	ELCB is used in Construction Power Supply source by the agency & Proper Distribution board and electrical cabling has been used by the agency and regularly checked by electrician & safety officer of the agency	
4.5	Unsafe areas barricaded properly & unsafe opening closed properly	
4.6	Proper Platforms & Hand-rails used In areas earmarked earlier	
4.7	Proper safety signage's, Slogans & Emergency contact phone numbers including FIRE contact nos. are made available by the agency in locations mentioned	
5	Whether any penalty imposed by BHEL towards non-compliance of above points.	

<u>VENDOR'S SIGNATURE</u>	
Erection Engineer	
HSE Officer	
Site-in-Charge	

<u>BHEL'S SIGNATURE</u>	
Erection Engineer	
HSE Officer	
Package-in-Charge	



ANNEXURE I

Activity-Specific Safety Precautions/ Controls

INDEX OF CONTENTS

S. No.	Description	Page No.
1.	General	2
2.	Work at height	2
2.1	Personnel fall protection system must include	3
2.2	Working Platform	4
2.3	Scaffolding	5
2.4	Ladder Safety	7
3.	Excavation & Civil Works	8
3.1	Excavation	8
3.2	Piling	9
3.3	Batching Plant Operation	9
3.4	Mobile Plant	10
3.5	Concrete Vibrators	11
3.6	Concrete Mixers	11
4.	Welding & Gas Cutting Safety (Hot Work)	11
5.	Lifting & Rigging Safety	13
5.1	Cranes & Hoisting Equipment	15
6.	Demolition Work	20
7.	T&Ps General	21
8.	Chemical Handling	21
9.	Electrical Safety	21
10.	Use Of Hand Tools And Power-Operated Tools	25
11.	Start Up, Commissioning And Testing:	27
12.	Fire Safety	27
13.	Painting	28
14.	Hazardous Energy” Control Procedure/ Lockout/Tagout (LOTO)	30
15.	Risk Assessment	37
16.	HSE Preparedness For Adverse Climates And Weather	38
16.1	Summer	38
16.2	Monsoon	39
16.3	Emergency Weather Conditions	41
16.4	Prevention Of Covid-19 At Project Site & Labor Colony	42
16.5	Noise Mitigation	44

General

The philosophy of hierarchy of controls as below shall be followed

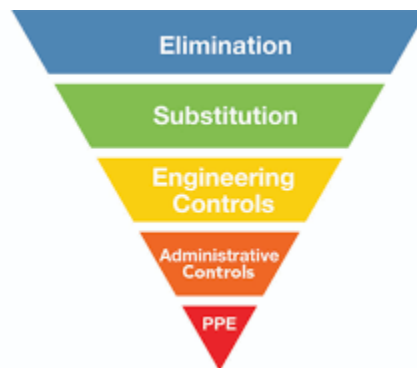


Fig. 1.1

It shall be ensured that there are multiple protections against any accident/ incident. For example, for height work there shall be safe platforms and walkways, Safety Nets and Lifelines for hooking double lanyard Safety harness by workers.

Monitoring and modifying worker behavior shall be part of ensuring safety. All personnel should be competent and trained for the job

Brief Safety guidelines for various hazardous activities are indicated below, besides the mandatory requirements based on Hazard Identification studies, HSE Procedures, Operational Control Procedures, Work Permits, applicable Indian Standard Codes and other provisions detailed in this document. Constant supervision at all times to be maintained by Execution & Safety Team to ensure implementation of these provisions.

1. WORK AT HEIGHT:

- a. All work at height above 2 meter above ground level without complete platforms, handrails and other related fall protection shall require a work permit in the prescribed form. This shall require approval by the competent authority. The HSE officer of sub-contractors shall follow the checklist religiously by physically verifying the condition of the work area before recommending for approval.
- b. Prior to the start of work at elevation, the HSE Officer involved with the work must meet the work supervisor to review the scope of work, and must review all the possible fall hazards and effective safety responses. The evaluation / analysis must be documented and kept on file and on site by the HSE Officer.
- c. Whenever a fall hazard or other exposure exists for working at heights more than 2.0m/6ft, the nature and scope of work will be evaluated for conditions and environmental factors before selecting the appropriate fall protection system (active, passive or a combination of measures, as appropriate).
- d. All Engineering and Administrative Controls including barricading, safe platform, Safety Nets etc. shall be made available at work location. Under no circumstances, there shall be total reliance on PPEs only
- e. **Safety Nets**
 - i. Contractor shall maintain sufficient stock of Safety Nets for deployment
 - ii. Safety Nets as per IS: 11057:1984 should be used extensively for prevention / arrest men and materials falling from height.
 - iii. The safety nets shall be fire resistant, duly tested and shall be of ISI marked.

- iv. Safety Nets shall be deployed below all platforms where height work is envisaged. Duration of work, delay shall be no excuses for non-installation of Safety Net
- f. 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.
- g. Monkey Ladder shall be fitted with cages. Rope ladder should be discouraged.
- h. In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
- i. In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
- j. For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure along with separate fall arrestor.
- k. The procedures for the safety response to identified fall hazards developed and rescue plans must be reviewed with all individuals exposed to the hazards.
- l. The HSE Officer must establish an inspection process of fall protection systems. Some equipment requires documented inspections by its manufacture on a regular schedule. Such equipment must have evidence of the inspection and re-certification process on it. This information must be reviewed before the equipment is actually used. Individuals must visually inspect the fall protection equipment before each use. Failure to complete this inspection process could result in serious injury or death.
- m. Immediately remove from service any fall protection equipment that is identified as defective, damaged, or has been subjected to an impact. Damaged fall protective equipment must be destroyed to prevent re-use and not be discarded into trash containers, as the worn or damaged equipment could be unintentionally re-used.
- n. Aerial lifting devices, excluding scissor lifts require the use of full body harnesses and lanyards in any elevated position.
- o. Where Height related works are applicable then rescue team (consist of 5- 10 person) shall be identified and trained for potential rescue.

1.1 Personnel fall protection system must include:

a. Safety Harness

All height workers must use Full Body Safety harness with double lanyards with shock absorber (only). The primary lanyard is never unhooked until the secondary lanyard is secure. The design of the working platform should be such that under no circumstances, worker should have both lanyards unhooked while at height.

b. Lanyard

- i. The type of work and the environment conditions determine lanyard and lifeline selection. If welding, chemical cleaning that may damage lanyards, connectors or lifelines, sandblasting, etc., either protect the components or use more appropriate type of system.
- ii. Lanyards and lifelines must incorporate, or be used with, an appropriate deceleration (shock absorbing) device. Deceleration devices include rope grabs, rip-stitch lanyards, specially woven lanyards, tearing, or deforming lanyards, automatic self-retracting lifelines and lanyards which dissipate or limit the energy imposed on the employee during fall arrest.
- iii. Once in use, the system's effectiveness is to be monitored. In some cases, a program for cleaning and maintaining the system may be necessary. Lanyard and lifelines must use locking snap hooks only and under

no circumstances must two lanyard snap hooks be connected.

c. Lifeline

All lifelines in general are to be made of min 12mm dia. steel rope (plastic coated) and tied to columns with 3 clamps at each end. Wherever columns are not available to tie the lifelines, the vertical posts as per the design below are to be provided after carrying out drop load test initially. A load of 240kg to be dropped off the mid-point of lifeline in this test.

d. Lifeline Post

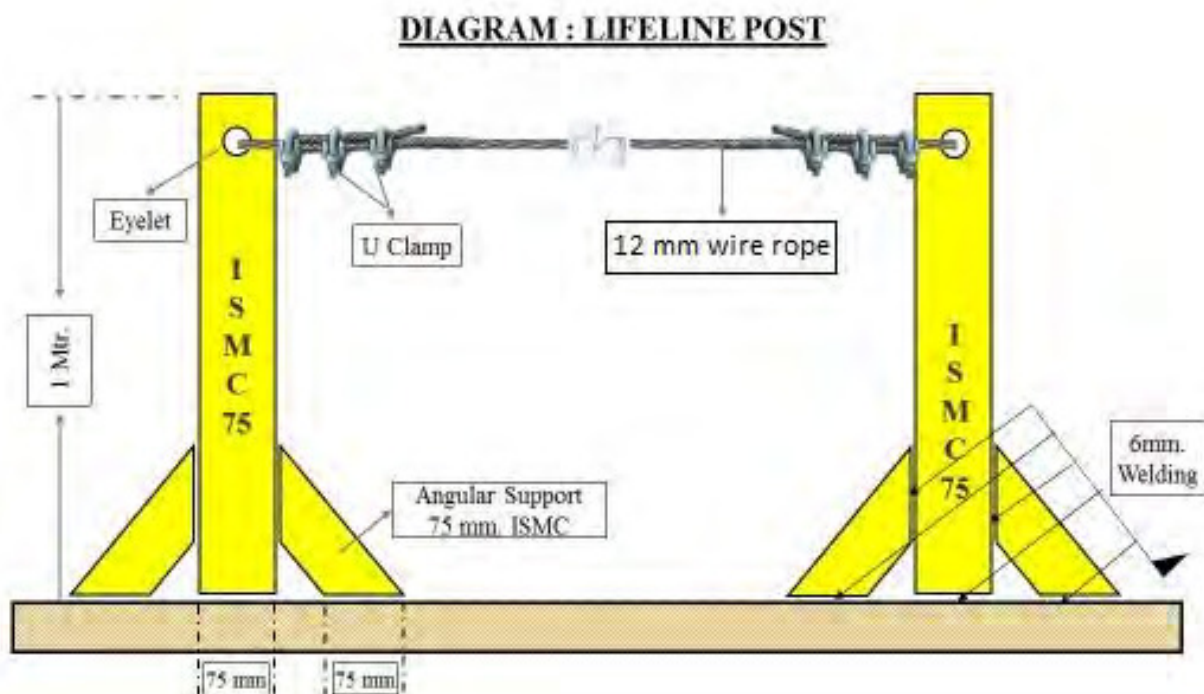


Fig. 2.1 Lifeline Post

- i. The support at vertical post shall be fixed at end-to-end (welded/ bolted). The maximum length of one end to another end shall be 6 meters
- ii. If the length of a lifeline is more than 6 meters, then intermediate vertical post(s) are to be used. Such intermediate post(s) will act as supports and the lifeline rope should simply pass through the eyelets (holes) of such supports without being anchored
- iii. The lifeline need not be wrapped / clamped to any intermediate post
- iv. Such intermediate posts must be used at an interval of every 6 meters
- v. The post(s) in which the original lifeline is to be installed should be capable of sustaining a tensile stress of 2268 Kgs.
- vi. In a horizontal lifeline installation, maximum allowable sagging is 500-600 mm
- vii. For a single spun lifeline, no more than 3(Three Nos.) persons are allowed to work; for more than two workers, another lifeline should be installed
- viii. Horizontal lifeline should be so installed that it does not impede safe movement of workers
- ix. All the installation work must be carried out by competent person with adequate knowledge

1.2 Working Platform

- a. 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.

b. Precautions against the fall of Materials, Persons and Collapse of Structures:

- i. Every opening in the floor or a building or in a working platform shall be suitably barricaded to prevent the fall of persons by providing suitable fencing or railing whose minimum height shall be 90 cm.
- ii. Adequate precautions should be taken such as the provision of fencing, or barriers to protect any person who might be injured by the fall of materials, or tools or equipment being raised or lowered. Hard barricading shall be made at such places made of scaffolding pipe & clamps covered with reflective net. Cradle may be used for lifting materials - however this shall be made of MS angles and flats only and duly certified by the HSE officer. Operators may also use designed containers for lifting small tools.
- iii. Guardrails (including scaffolding) erected over/adjacent working areas must have the guardrails screened (opening < 0.5), to prevent material from falling outside the platform/decking.
- iv. Guardrails must be able to withstand a 200-pound force exerted in any one direction.
- v. Where necessary to prevent danger, guys, stays or supports should be used or other effective precautions should be taken to prevent the collapse of structures or parts of structures that are being erected, maintained, repaired, dismantled or demolished.
- vi. All openings through which workers are liable to fall should be kept effectively covered or fenced and indicated in the most appropriate manner.
- vii. Guardrails and toe-board/barricades and sound platform conforming to IS: 4912-1978 and other Indian laws and r

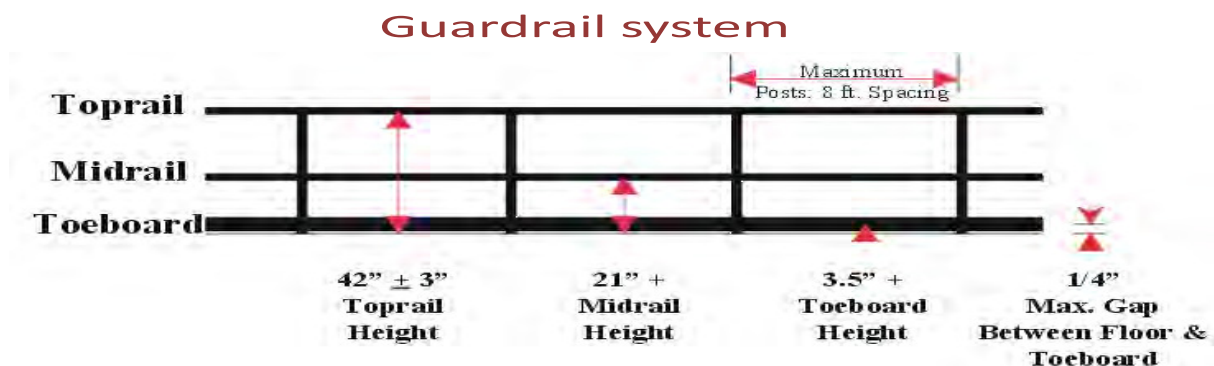


Fig. 2.2 Guard Rail System

- viii. Guardrails shall be provided to protect workers from falling from elevated work places. The rails are generally made of MS pipes of suitable dia. Rebar shall not be used for any handrails, ladder or cover purpose. Wherever the guard-rails and toe-boards cannot be provided:
 - a. adequate safety nets or safety sheets shall be erected and maintained; or
 - b. adequate safety harnesses shall be provided and used and / or
 - c. adequate fall arrestor shall be provided and used.

As mentioned under PPE clause, all these PPEs shall be defect free and regularly inspected for any defect. The full body safety harness shall have double lanyard only with max 1.8m length.

- ix. The monkey ladders shall have sufficient fall arrestors. Adequate lifelines of 8mm steel wire rope shall be provided across the work area.
- x. The HSE officer shall recommend appropriate PPEs after analyzing hazards and risks involved.

1.3 Scaffolding

All scaffolds shall be conformant to the relevant standards including IS 3696 and IS 4014 as applicable. A sketch of the scaffolds proposed to be used shall be prepared and approval of the BHEL Engineer obtained prior to construction / use. Only cup lock type scaffoldings will be allowed in site. Where cup lock type scaffolding arrangement is not feasible by the virtue of the location, in that case only pipe and clamp type scaffolding will be allowed.

- a. The scaffolding work must be carried out by a competent person, who shall train the scaffold users on safety aspects
- b. All scaffolds shall be erected / dismantled by scaffolding crew under direct supervision of competent scaffolding supervisors.
- c. All scaffolds shall be capable of supporting 4 times maximum intended load and erected on sound, rigid footing, capable of carrying the maximum intended load without settling or displacement. Bamboo scaffolding is not permitted for use on site.
- d. Each employee on the scaffold shall use an approved safety harness attached to an independent lifeline. The lifeline is to be securely attached to substantial members of the structure (not the scaffold itself) or to securely rigged lines, which shall safely suspend a worker in event of a fall.
- e. Guard rails and toe boards shall be installed on all open sides and ends of platforms more than (2) meters above ground or floor
- f. Scaffold planks must be at least 5 cm x 25 cm (2" x 10") full thickness lumber scaffold grade or better.
- g. Scaffold planks shall not span distances greater than 2.5 meters (8 feet).
- h. Scaffold planks shall extend over end supports not less than 6 inches nor more than 12 inches and be secured to the scaffold. Scaffolding and accessories with defective parts shall be immediately repaired or replaced.
- i. All scaffolding must be a minimum of two planks wide. No one may work from a single plank.
- j. Scaffold planks must be inspected before use. Planks that have been damaged must be removed from the site.
- k. Access ladders must be provided for each scaffold. Climbing the end frames is prohibited unless the design incorporates an approved ladder.
- l. Adequate mudsills or other rigid footing capable of withstanding the maximum intended load must be provided.
- m. Scaffolds more the 6 meters (20 feet) in height must be tied to the building or structure at intervals which do not exceed 4 meters (13 feet) vertically and 6 meters (20 feet) horizontally.
- n. Do not overload scaffolds. Material should be brought up as needed. Scaffolding must not be loaded in excess of its rated capacity.
- o. Barrels, boxes, kegs, blocks or similar unstable object must never be used as work platforms or to support scaffold.
- p. Where persons must work under or pass under a scaffold then a 18 gauge wire mesh screen must be installed between the toe board and guard rail.
- q. Employees exposed to overhead hazards while working on a scaffold will be protected by 5 cm (2") thick planks.
- r. Wooden/bamboo ladders shall not be allowed at any cost. Ladder's rungs shall be fitted /welded

properly. Before every use the rungs should be checked for safe use.

- s. Wooden scaffolds shall not be used in areas where fire / fire products are expected
- t. Ropes made of jute / Plastic and other fire prone material shall not be used to tie up scaffolding components together
- u. The platform should have permanent hand rail and mid rail with Toe board without fail.
- v. All platforms are to be tightly planked for the full width of the scaffold, except as may be necessary for entrance openings. Platforms shall be secured in place.
- w. On suspension scaffolds designed for a working load of 500 pounds, no more than two workers are permitted to work on the scaffold simultaneously. On suspension scaffolds with a working load of 750 pounds, no more than three workers are permitted on the scaffold simultaneously.

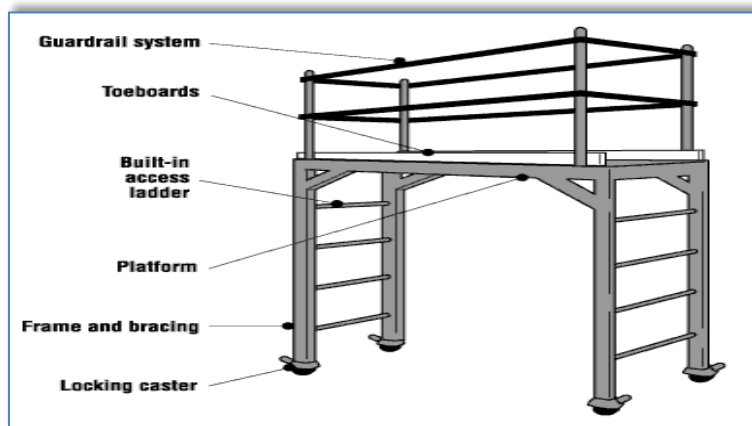
x. Requirements for different types of Scaffolds:

A. Suspended Scaffold

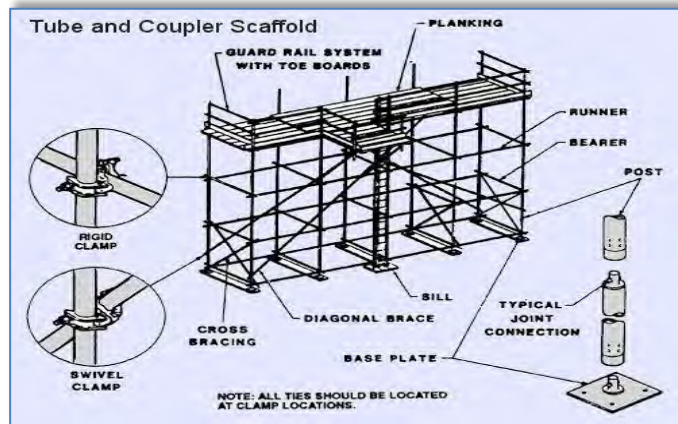
- i. Suspended scaffolds are platforms suspended by ropes, or other non-rigid means, from an overhead structure.
- ii. Requirements for use are to be preapproved by HSE Head, under a specific Permit to Work.

B. Rolling Scaffolds

- i. The height of rolling scaffolds shall not exceed three times the minimum base dimension.
- ii. The minimum base dimension of rolling scaffold will be 1.25 meters (4 feet).
- iii. Adequate help must be provided when moving a rolling scaffold.
- iv. Secure or remove all loose materials, equipment and tools before moving a rolling scaffold.
- v. No one is permitted to ride a rolling scaffold when it is being moved. Castor brakes must be locked-on when the scaffold is not being moved.



Rolling Scaffold



Tube & Coupler Scaffold

Fig. 2.3 Types of Scaffolds

1.4 Ladder Safety

A sketch of the ladders proposed to be used shall be prepared and approval of the BHEL Engineer obtained prior to construction / use

a. Safe Use of Ladders:

- i. Fall protection is required when working on a ladder above 2 meters and when climbing above nearby guardrails.

- ii. Ladders must be inspected prior to use and by a competent person quarterly, with documentation.
- iii. Use portable ladders for height up to 4 M only
- iv. Provide fixed ladders for height above 4 M
- v. Place the ladder at an angle of 75 degrees (approx.) from the horizontal (1:4)
- vi. Extend ladder at least 1 M above the top landing
- vii. Secure top and bottom of the ladder firmly to prevent displacement- anti skid lining at the bottom
- viii. Ensure that the width of the ladder is not less than 300 mm and distance between rungs is not more than 300 mm
- ix. Provide landings of minimum size 600 x 600 mm at intervals not more than 6 M for fixed ladders. Check the ladders daily for any defects
- x. Ensure that the areas around base and top of the ladder are clear. Getting on and off the ladder is more hazardous than using it. Use a mudsill if the ladder is to rest on soft, loose or rough soil
- xi. Do not use ladders of conducting material near power lines, and only use ladders near power line or other energized system with exposed parts if they are confirmed locked-out and de-energized.
- xii. Stand no higher than the fourth rung from the top for carrying out any job standing on a ladder.
- xiii. Never reach out from a ladder to perform work where your belt buckle protrudes past the ladder rung.
- xiv. Always face the ladder while climbing up or down
- xv. Maintain three-point contact while climbing up or down a ladder i.e. two hands and one foot or two feet and one hand on the ladder at all the times.
- xvi. Avoid climbing up or down a ladder while carrying anything in hands. Lift tools, equipment and materials with a rope.
- xvii. Work from portable and extension ladders near guardrail where fall exposure exists over the guardrail regardless of height, and above 2.0 mtr. heights from the working/walking surface will require the use of personal fall arrest equipment

2. EXCAVATION & CIVIL WORKS

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

2.1 Excavation

The following safety measures are to be ensured before and during excavation:

- a. All Excavation activities more than with depth of 1.22 meter or more shall require an Excavation Work Permit
- b. Check for underground utilities like electrical / telephone cables, sewage, water lines and proper care has to be exercised to protect and prevent damage to it.
- c. Electrical cables and service lines to be identified using cable detector/locator device before carrying out the excavation work
- d. Proper and adequate slope is maintained while excavating
- e. Adequate shoring or sheeting is done wherever required to prevent soil sliding
- f. Safe access through ladder or steps for exit & entry to excavation
- g. No material /excavated soil is kept within one meter from the edge
- h. Safe way is planned and provided for movement of HEM /transport equipment near excavation
- i. Safety helmet and shoes/gum boots are provided and worn by the workmen at excavation works

- j. Dewatering arrangement is made where water seepage is prevailed.
- k. Stop blocks are provided to avoid vehicles reversing into the excavated trenches
- l. Danger signs /Caution boards are displayed at work spot
- m. Hard Barricading is provided at excavated pits. It should be made of scaffolding pipe and clamp with reflective nets.
- n. All Excavated area of depth 3mtr or more is to be hard barricaded with pipe.

Soil Type	Height/Depth ratio	Slope Angle
Stable Rock	Vertical	90 deg.
Type A	$\frac{3}{4} : 1$	53 deg.
Type B	1 : 1	45 deg.
Type C	$1\frac{1}{2} : 1$	34 deg.

Determining Soil Type		
Type	Description	Examples
A	Cohesive soils with an unconfined compressive strength of 1.5 tons per square foot or greater.	Clay, silty clay, sandy clay, clay loam and in some cases: silty clay loam and sandy clay loam.
B	Cohesive soils with unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf.	Angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases silty clay loam and sandy clay loam.
C	Cohesive soils with unconfined compressive strength greater than 0.5 tsf or less.	Granular soils such as gravel, sand and loamy sand; submerged soil or soil from which water is freely seeping; submerged rock that is not stable.

Fig. 3.1 Excavation Reference

2.2 Piling

Ensure the following precautionary measures before starting piling works:

- a. Inspection of piling equipment by responsible person for its condition before initiating piling operation.
- b. Checklist and OCP for piling to be prepared using manufacturer's instructions and used
- c. Testing and its certification wire rope, slings, D-shackles, chain pulley blocks using in the process of piling work by competent person
- d. Adequate support and secured foundation of the piling equipment to avoid toppling
- e. Hoses should be lashed and adequately secured
- f. Proper work platform is to be provided on piling frame
- g. Safe work procedures and close supervision to prevent unsafe acts of operators/any unsafe conditions that may arise
- h. Only experienced and trained operators are engaged for the piling operation
- i. Provision of Personal Protective Equipment (PPE) like safety shoes/gumshoes/safety helmet/safety belt etc. and its use by their workmen.
- j. Special care and precautions If work is near electrical live cables/ electrical equipment
- k. Cordoning of work area to prevent un authorized entry
- l. Guarding of revolving parts
- m. Specific measures to prevent over turning of pile driver/missing of hammer/ hammer movement out of range

2.3 Batching Plant Operation

Following Safety considerations for batching plant are to be ensured:

- 1. Modern type batching plant should be used in which all the moving parts are protected and emergency

and safety features are incorporated.

2. Installation of external Electric moto-vibrators in the feeding hopper of all batching plants to reduce human intervention.
3. Installation of safety devices like pull-chord on both the sides of conveyor for stopping the conveyor in emergency
4. Workers carrying cement / sand to be given appropriate PPEs like respiratory masks & gloves.
5. Conveyor belt/rotating parts must be guarded properly.
6. Safety awareness shall be inculcated in workmen about the risk involved in rotating parts.
7. The agency shall ensure to erect the batching plant as per drawing including installation of all safety devices as provided by manufacturer and witnessed by BHEL Engineer in charge before starting of machine in future.
8. Safety audit to also focus on Batching plant.
9. The site shall impose penalty on the agency who has violated the safety norms as per contract.

2.4 Mobile Plant

Mobile plant includes tractors, trailers, dumpers, excavators, bulldozers, road rollers etc. for earthmoving purpose and concrete mixers, concrete transit mixtures, concrete pumps etc for concreting purpose. Due to the very nature of their function and movement in difficult terrains, congested areas, working in tandem with manual work and other operations the danger is inherent.

Automatic reverse camera with reverse horn connected with reverse gear is compulsory for all moving machineries.

Following Safety measures to be ensured for Mobile Plant:

- a. Where movement around site is involved, routes should be planned, obstruction free and well maintained
- b. Observe specified speed limits
- c. Operating personnel should be aware of associated risks and its preventive measures
- d. Only experienced, trained and authorized persons with valid license (wherever applicable) should operate the mobile equipment/vehicles
- e. Provide and use Warning lights and reverse horn for cautioning the people around
- f. Operation should be on level and stable ground with adequate working clearance.
- g. Loading of out riggers/stabilizers should be well within safe ground bearing capacity
- h. No person should be on equipment or vehicle during loading and unloading of material
- i. Operators should be protected by warning barriers or switching off power when working in close proximity of overhead power lines
- j. The equipment /vehicles should be well maintained and provided with effective brake system and other safety devices (wherever require)
- k. Rotating parts of equipment should be adequately guarded
- l. Provide necessary personal protective appliances and ensure its use by the operating personnel Ensure effective measures at source to control harmful emissions, dust, fumes contaminating atmosphere and cause health hazards to the operators and people in the vicinity.
- m. No overloading/over stressing of vehicles/plant is allowed
- n. Hoses, pipes, receivers, gauges and valves involved in carrying out hydraulic fluid/ compressed air should be checked for leaks and tested prior to operation.

- o. Adequate safe clearance for swing and movement is to be judged during operation of Concrete mixer
- p. Setting of machines on firm and level ground with wheel locked to prevent movement of machine
- q. Proper instructions and Special precautions are to be ensured to prevent entry in to the danger zone of projectile of bucket while dropping bucket
- r. Operator leaving work spot should ensure that the equipment/vehicle is kept in neutral position and place on firm and level ground.
- s. The hand brake should be kept in position and block road wheels as additional safety measure
- t. Blades/buckets should be kept low while moving
- u. The dozer blades should not be used as brakes except in emergency
- v. The ground should be examined for its bearing capacity and general safety especially when operating road roller at the edges of slopes, embankments.
- w. The roller should not be moved downhill with the engine out of gear
- x. If operating near excavations the following precautionary measures are to be ensured
- y. Barricading, edge protection to prevent fall of persons/vehicles over running while reversing etc.
- z. Suitable support system and adequate allowance to avoid the danger of side collapsing
- aa. Experienced signaller /attendant should be always accompanied with operator/driver for proper direction /signal and also to caution others in the working Zone during operation of mobile plant

2.5 Concrete Vibrators

- a. Revolving parts/belt drives should be adequately guarded and Vibrating unit shall be completely enclosed and have suitable overload relays and effectively earthed
- b. Ensure sufficient length of cable to the Vibrator.
- c. Ensure electric starters and other accessories are firmly fixed adequately supported
- d. Ensure locking of needle load while inserting needle in to the vibrator,
- e. Ensure periodical lubrication and maintenance

2.6 Concrete Mixers

- a. Setting of machines on firm and level ground with wheel locked to prevent movement of machine
- b. Proper instructions and Special precautions are to be ensured to prevent entry in to the danger zone of projectile of bucket while dropping bucket

3. WELDING & GAS CUTTING SAFETY (HOT WORK)

- a. All Hot Work shall require a Hot Work Permit
- b. Inbuilt Voltage Reduction Device (VRD) equipped arc welding machine will only be allowed for work.
- c. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced.
- d. All safety precautions shall be taken for welding and cutting operations as per IS-818.
- e. When possible, items to be welded, cut, heated, etc. shall be moved to a safe location free of combustible or flammable material. If this is not possible, then all combustibles/ flammables that can be removed from the area shall be removed within a 35-foot circumference and a positive means of confining arcs and sparks generated by the process shall be ensured and additional person(s) shall be stationed as fire-watch for the area(s) still exposed, along with obtaining the Hot Work Permit as applicable.
- f. Appropriate fire-fighting equipment is to be available in close proximity of any welding and gas cutting operations at all times suitable for the type of Fire.

- g. Drums, tanks, and similar containers that have contained flammable or toxic material shall not be welded, cut, or heated until they have been made safe by water filling, thorough cleansing or similar accepted practices. The container shall also be ventilated during the welding, cutting, or heating process.
- h. Proper ventilation is required for any welding or torch operations performed in a confined space.
- i. Any welding or gas cutting operations performed on metals of toxic compounds or coating such as zinc, stainless steel, lead, cadmium, chromium, and beryllium shall be properly ventilated and/or proper respiratory protection shall be worn by any person that could be exposed to fumes, vapors, and gasses created by the welding and gas cutting processes.
- j. Wherever it is practical, all arc welding operations shall be shielded to prevent direct light rays or sparks from contacting persons in the vicinity or from reaching areas normally used to travel through or into the vicinity. Where this is not practical, persons who shall be in the area are to use proper eye and skin protection. Other persons who are not participating in the welding or gas cutting operations are not to be allowed into the hazard zone.
- k. Welders and other employees who are exposed to arc welding radiation shall wear suitable clothing and protective apparel to prevent burns and other types of ultraviolet radiation damage to the skin.
- l. Arc welding machines shall be shut down when being moved or when they are not in continuous use. Electrode holders left unattended shall have electrodes removed and shall not be left where they might contact employees or conducting objects.
- m. Arc welding power supply cable shall be of proper rating and material, e.g. copper.
- n. Welders shall guard against allowing materials adjacent to or behind them to reflect radiation back toward them or towards others in the area. Reflected radiation can cause skin burns and eye flash burns.
- o. Valve caps shall be in place when cylinders are not in use. Valve caps shall never be used for lifting the cylinder vertically.
- p. Torches shall only be lit by approved strikers; never with matches, cigarette lighters, or hot-work.
- q. **Splatter / Slag Collector:**

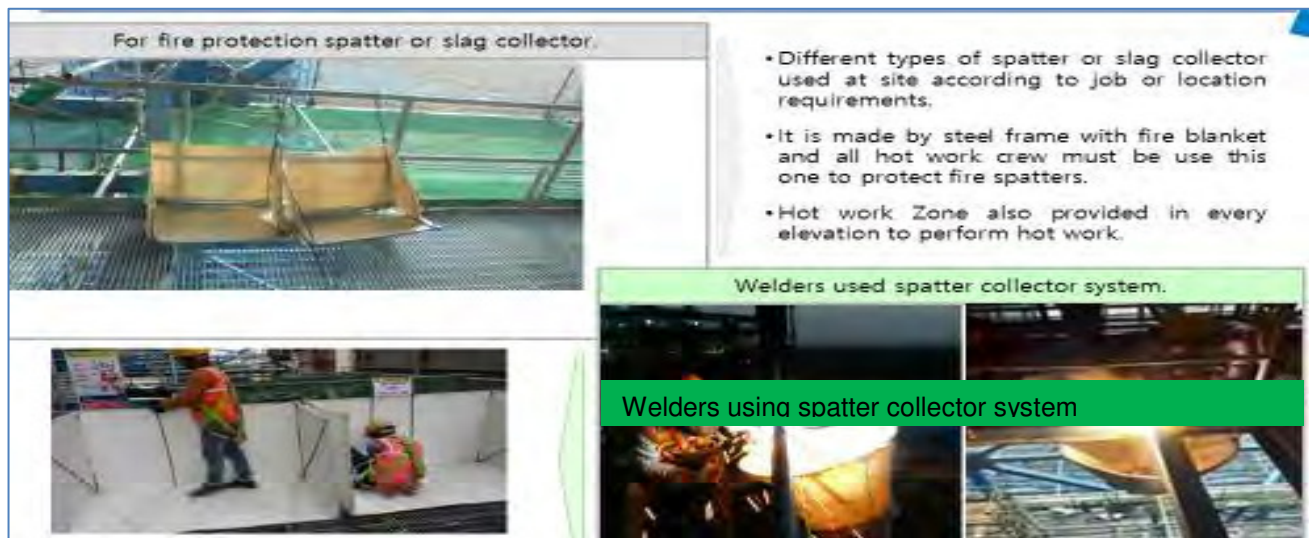


Fig. 4.1 Splatter / Slag Collector

While carrying out job at height, the sparks or molten slag shall be prevented from falling down by putting a fire-resistant (non-asbestos) sheet or patter/ slag collector or even MS Sheet. The passage of falling sparks

or molten slag shall be barricaded till ground floor and any cable/ tubes/ any other objects interfering in the passages shall either be removed or covered with Fire-resistant sheet or MS Sheet.

r. COMPRESSED GAS

- i. All cylinder valves shall be closed when any work is finished and when any Cylinders are empty or being moved. Valve protection caps shall be placed and secured properly before gas cylinders are transported, moved or stored.
- ii. Compressed gas cylinders shall be secured in an upright position with chain or appropriate means during storage & use. However, a trolley shall be used for transportation.
- iii. Compressed gas cylinders shall always be secured from tipping or falling, whether in use, in storage or in transit. The cylinders shall always be secured upright, except during times when actually being hoisted or carried.
- iv. When cylinders are transported by powered vehicle they shall be secured in a vertical position.
- v. Regulators shall be removed when cylinders are not in use or are in transit, unless the cylinder is firmly secured on a special carrier designed for this purpose.
- vi. Gas cylinders are not allowed to be used in man-basket when occupied.
- vii. Cylinders containing oxygen or fuel gasses shall not be taken into confined spaces.
- viii. Oxygen cylinders shall be stored a minimum of 6 meters from fuel gas cylinders or shall have an approved firewall between them.
- ix. All cylinders shall be kept at a safe distance from welding or cutting operations or shielded from arc/sparks / slag.
- x. All cylinders shall be placed where they cannot become part of the electrical circuit.
- xi. Oxygen and acetylene shall not be stored together. Oxygen must be separated from acetylene (or ANY fuel gas) or combustible material by at least 20ft or a barrier with a 30-minute fire resistance rating.
- xii. All Cylinders should be stored upright in a designated area with labels for the type of gas. All applicable precautions to be ensured during storage
- xiii. Oxygen and fuel gas regulators, hoses and associated equipment shall not be altered and shall be in proper working order while in use.
- xiv. Compressed air can be extremely dangerous if allowed to penetrate the skin. As such, the use of compressed air to clean off yourself or other workers shall be strictly prohibited.
- xv. All gas cylinders shall be stored in upright position. Suitable trolley shall be used for cylinder movement, the design of which shall be submitted to BHEL Engineer for approval.
- xvi. No of cylinders shall not exceed the specified quantity as per OCP
- xvii. 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.
- xviii. All cylinder should be kept only in cylinder trolley.
- xix. Cylinder shall be transported in upright vertical position by suitable mean.

4. LIFTING & RIGGING SAFETY

- a. All Heavy / Complex Lifting operations as defined in Clause 6.12 shall require a Lifting Work Permit. A written rigging procedure and plan must be prepared for all individual heavy/ complex lifting operations.

- b. All the cranes and lifting tools & tackles shall be inspected on daily / weekly basis as well as monthly by expert as per applicable formats.
- c. In addition, inspection / certification as mandated by law shall be carried out wherein these shall be tested and certificates of fitness shall be obtained from 3rd party State Govt. approved competent agency before deploying at site and later periodically. BHEL shall be given advance intimation of any such inspections
- d. The last date of Third-Party Inspection and the next Due date shall be conspicuously displayed on all cranes. A copy of certificate shall be pasted on operator's cabin of all the lifting equipment.
- e. Specifically designed heavy steel plates lifting clamps shall be used for lifting heavy metal sheets. Manmade lifting clamp chapa shall not be used for lifting/shifting of plates.
- f. Following requirements shall be mandatorily followed, wherever applicable:
 - i. The manufacturer's instruction for maintenance shall also be followed. All safety measures shall be followed.
 - ii. All tools tackles, lifting appliances; material-handling equipment etc. used by the subcontractor shall be of safe design and construction.
 - iii. The operators, slingers and signalers shall be qualified as per IS 13367 (part-1):2003 "Safe use of cranes- code of practices".
 - iv. There shall be a person responsible for co-ordination among cranes where multiple cranes are used, and lifting over load chart of the crane to be avoided.
 - v. Mobile phone should be banned for crane operator and lifting operation. Only walkie talkie shall be allowed in rigging/Lifting purpose.
- g. Lifts/Movements between 5 Tons and 20 Tons:
 - i. Shall include a rigging plan, detailing schematic representation of the handling/lifting operations that must be included on the Method Statement.
 - ii. When performing similar lifts of identical items, only one rigging plan need be prepared, provided each of the lifts can be performed in accordance with the rigging plan.
- h. Lifts/Movements Less Than 5 Tons:
 - i. An equipment rigging plan is not required for lifts less than 5 tons, safety measures are covered in the JSA. This could change as per BHEL requirement

i. Personnel Lifts (Man-Basket / Jhoola):

The design of personnel man basket shall be submitted to BHEL Engineer for approval before use. Relevant permit (Height work & others as applicable) shall be completed prior to lifting any people, along with a rigging plan.

- i. A separate Lifeline / fall arrestor anchored to a fixed structure outside of Jhoola shall be provided for the workers inside the basket. All occupants of the basket shall have Safety Harnesses equipped with rope grabs, which are to be hooked to the vertical lifeline.
- ii. Man-basket shall be used where access through ladders or scaffolding is not feasible.
- iii. Man-baskets shall be designed and engineered by a manufacturer (job made man-baskets are not allowed, unless designed and tested by a certified engineer), and built robust with MS Angles and flats or plates or channels only.
- iv. Guard rails top and mid, must be in place and screened-in to avoid material from falling out of

basket. The factor of safety shall be 200%.

- v. It shall have a door with double latches and shall open inside. Anchor points shall be identified within the man-basket.
- vi. The man-basket shall be thoroughly inspected and load tested and a trial run performed without personnel before being put to job.
- vii. It shall be treated as a lifting tool (T&P Item) and shall undergo same certification cycle and inspection as other lifting equipment.
- viii. An additional sling of required lifting capacity shall be fixed the man-basket main lifting point and attached to the crane above the ball or block.
- ix. While lifting man-basket, the crane shall maintain a uniform speed of lift without any swing.
- x. Once man-basket reaches the destination, the lift brakes shall be locked as long as the basket
 - a. remains at that point. The same care shall be taken in its descent.
- xi. As for hanging man-basket, the same shall be hung off a rigid structure with help U-shaped handle welded to man-basket. This shall be tested once in a year by a competent person.
- xii. Use of Rebar steel for making and monkey-ladder must be avoided.

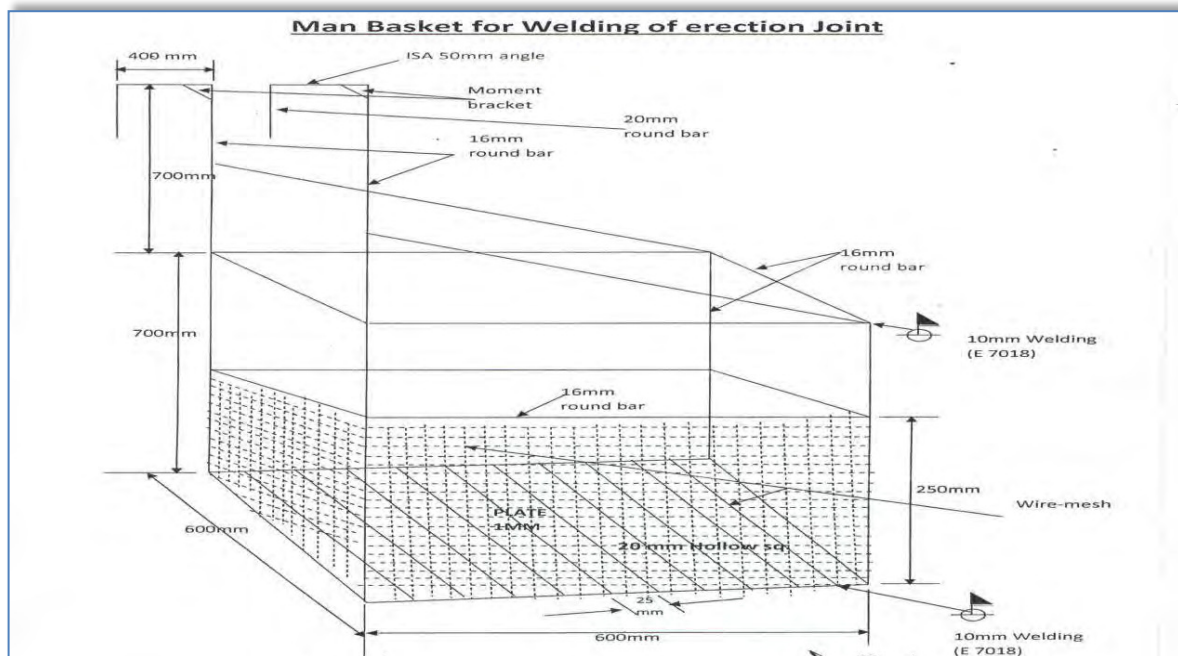


Fig. 5.1 Man Basket for Welding Erection Joint

4.1 Cranes & Hoisting Equipment:

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

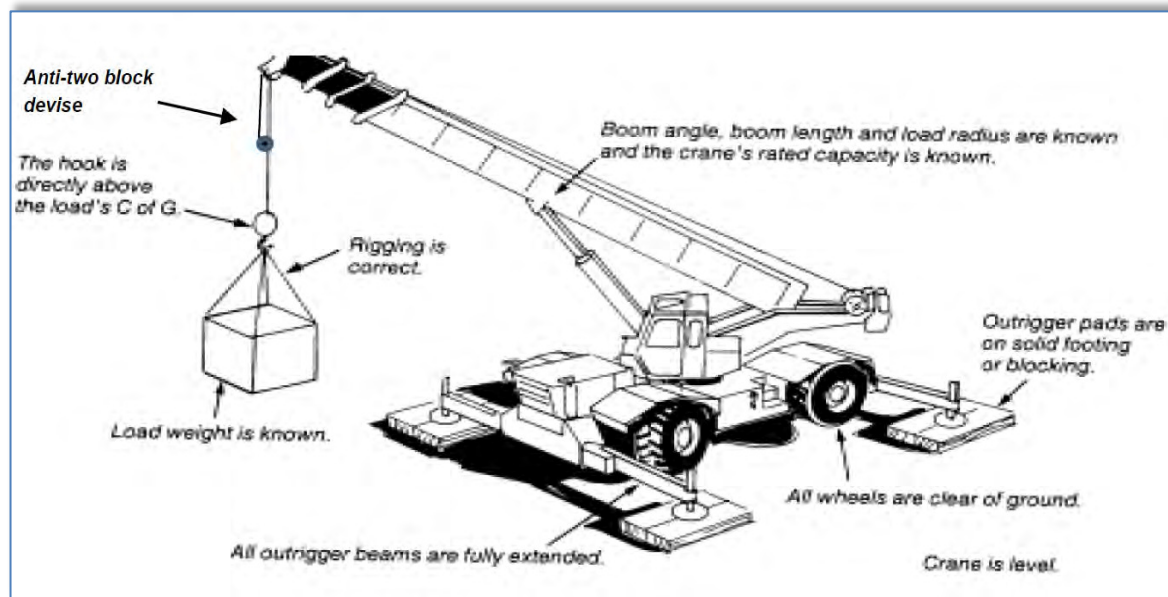


Fig. 5.2 Proper Crane Setup

- a. On every crane or piece of hoisting equipment notices of all rated load capacities, recommended operating speeds, and any hazard warnings or special instructions shall be conspicuously posted. All instructions and warning shall be visible from the equipment operator's station.
- b. Cranes shall have an Anti-Two-block safety device installed
- c. All mobile cranes shall have overload and backup alarms, load angle indicators and limit switches
- d. All areas within swing radius of cranes that are potentially accessible by pedestrian, vehicular, or equipment movement shall be barricaded to prevent anyone or any vehicle or equipment from being struck by the crane or hoisting equipment, or its load(s).
- e. No part of the lifting equipment or its load shall be within the distance as specified in the Indian Electricity Act from an energized power line
- f. Cranes shall have annual certified third-party inspection and be inspected before use by the operator. Any defects shall be corrected before use. Logs of crane inspection shall be kept with the crane.
- g. Make certain that the rigging personnel, material, and equipment have the necessary capabilities for the job and are in safe condition.
- h. Communicate with person(s) directly responsible for accomplishing the work and / or work area to establish requirements/responsibilities and make certain that all preparatory work is complete.
- i. Mats/Pads must be used on all lifting equipment, equipped with out riggers.
- j. Pick and carry must have the load secured to the rig in front.
- k. Only BHEL Approved Plate Lifting Spreader Beam configuration shall be used (Sample in Fig. 11.3.5.3)
- l. Crane operators must follow the following:
 - i. Pass an annual Operator's Physical examination
 - ii. Carry a valid training certification card at all time while operating issued by the Govt. or other recognized institute.



- i. Review the planned operation and requirements with the operator and rigging crew.
- ii. Ensure a pre-lift meeting is conducted with crane operator, tagline operator, signal personnel, and Safety Manager.
- iii. Designate a qualified person from the rigging crew to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means.
- iv. Clear the lift area of all unnecessary personnel.
- v. Hydras shall only be allowed for loading & unloading works & shall not be allowed to move with load

- i. Use loops, thimbles and corner pads to prevent damage to slings when used around corners or on cutting edges.
- ii. Never allow wire rope to lie on the ground for any length of time or on rusty steel or near solvents, chemicals or corrosive substances.
- iii. Slings must not be pulled from between or under loads with load resting on the sling.
- iv. Keep all rope away from flame cutting or welding operations.
- v. Never use rope as sling material.
- vi. Never wrap a wire rope completely around a hook.

- vii. Do not bend wire rope near any attached fitting.
- viii. The sling must be selected to suite the most heavily loaded leg rather than the total weight when using multi-legged sling to lift loads in which one end is heavier than the other.
- ix. When using 3 and 4-legged sling configurations, any two legs must be capable of supporting the entire load.
- x. Where possible, wire rope choker hitches must include a shackle with the eye around the shackle pin to prevent breaking wires of the choke. The choker hitch must be “snugged down” prior to lifting, not after tension is applied.
- xi. Unless authorized by the hook manufacturer when more than two rope eyes are placed over a hook, install a shackle, pin resting in the hook, and place the rope eyes in the bowl of the shackle.
- xii. Properly rig all loads to prevent dislodgment of any part.
- xiii. Use guide ropes or tag lines to prevent the rotation or uncontrolled motion of the load when necessary.
- xiv. Loads must be safely landed and properly blocked before being unhooked and unslung. Tag lines must not be used in situations that jeopardize the safety of the lift.
- xv. Lifting beams must be plainly marked with their weight and designed working load and must only be used in the manner for which they were designed.
- xvi. The hoist rope or chain must never be wrapped around the load. The load must be attached to the hook by slings or other rigging devices that are adequate for the load being lifted.
- xvii. Multiple part lines must not be twisted around each other.
- xviii. The hook must be brought over the center of gravity of load before the lift is started.
- xix. If there has been a slack rope condition, determine that the rope is properly seated on the drum and in the sheaves prior to lifting.
- xx. Keep hands away from pinch points as the slack is being taken up.
- xxi. Leather gloves are recommended when handling wire rope.
- xxii. Avoid impact loading caused by sudden jerking when lifting or lowering. Lift the load gradually until the slack is eliminated.
- xxiii. Never ride on a load that is suspended.
- xxiv. Avoid allowing the load to be carried over the heads of any personnel.
- xxv. Never work under a suspended load until the load has been adequately supported from the floor and all conditions have been approved by the supervisor in charge of the operation.
- xxvi. Never leave a load suspended unless emergency evacuation is required.
- xxvii. Never make temporary repairs to sling.
- xxviii. The capacity of a sling is determined by its angle, construction, type of hitch and size.
- xxix. Never lift loads with one leg of a multi-leg sling until the unused legs are made secure.
- xxx. Never point load a hook unless it is especially designed and rated for such use.
- xxxi. Make certain that the load is broken free before lifting and that all legs are taking the load.
- xxxii. When using two or more slings on a load make certain all slings are made from the same materials.
- xxxiii. Lower the loads on to adequate blocking to prevent damage to the slings.
- xxxiv. Materials and equipment being hoisted must be loaded and secured to prevent any movement which could create a hazard in transit.

- xxxv. The weight of the hook, load block and any material handling devices must be included when determining crane capacity.
- xxxvi. Calculated weights cannot exceed load chart without written approval.
- xxxvii. Personnel must be completely clear of loads being picked up or set down by crane. Tag lines will be used to control the loads. Loads must not be touched by hand while placing/ moving.

o. Slings

The following are rules for safe use of synthetic slings:

- i. Synthetic slings must be marked to show the rated capacity for each type of hitch and type of web material.
- ii. Nylon web slings must not be used where fumes, vapors, sprays or mists or liquids of acids or phenolic are present. Web slings with aluminum fittings must apply in this category.
- iii. **Synthetic web slings must be removed from service and destroyed if any of the following conditions are present:**
 - a. Acid or caustic burns
 - b. Melting or charring of any part of the sling surface
 - c. Snags, punctures, tears or cuts
 - d. Broken stitches
 - e. Distortion of fittings
 - f. Synthetic web slings of polyester or nylon must not be used at or come in contact with temperatures in excess of 82°C
 - g. Polypropylene web slings must not be used at or come in contact with temperatures in excess of 93°C
 - h. Insulated hooks must be tested yearly to ensure insulation integrity to at least manufacturer's specifications.

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

- i. In (10) randomly distributed wires broken in one (1) rope lay, or five (5) broken wires in one (1) strand in one (1) rope lay.
- ii. Wear or scraping of one-third the original diameter of outside wires.
- iii. Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure such as:
- iv. Evidence of heat damage.
- v. End attachments that are cracked, deformed worn.
- vi. Corrosion of the rope or end attachments.

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

- i. A broken weld or broken brazed joint along the sling edge.
- ii. Reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion.
- iii. Lack of flexibility due to distortion or corrosion.

r. Requirements of Plate Clamps:

- i. The rated load of the plate clamp must be marked on the main structure.

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

s. Signaling Practices:

- The "slinger" is responsible for attaching and detaching the load to and from the crane. He shall:
 - have received appropriate training on general safe lifting operations;
 - be capable of selecting lifting gears suitable for the loads;
 - liaise with the operator and direct the movement of the crane safely.
- The "signaller" is responsible for relaying the signal from the slinger to the crane operator. He shall:
 - have received appropriate training on general safe lifting operations;
 - be able to direct the movement of the crane and loads.

Suggested hand signals



Note: During the lifting operation, either the slinger or signaller shall communicate with the operator. Other communication methods (e.g., wireless walkie-talkies, telephones, etc.) may also be used.

Fig. 5.4 Recommended Signaling Practices

5. DEMOLITION WORK

Before any demolition work is commenced and also during the process of the work the following shall be ensured, besides using the Work Permit:

- a. All roads and open areas adjacent to the work site shall either be closed, suitably protected or restricted for movement
- b. 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.

- c. 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.

6. T&PS GENERAL

- a. All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test /calibration certificates bearing endorsement from competent authority of BHEL.
- b. 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.
- c. Tagging and punching in all lifting tool is compulsory with SWL, sr. no. and due date.
- d. All T&Ps shall be inspected by authorized Third Party agency as per applicable frequency. BHEL shall be kept informed of any such scheduled inspection
- e. All T&Ps shall be internally inspected in each quarter and colour coded.

7. CHEMICAL HANDLING

- a. Displaying safe handling procedures & MSDS for all chemicals such as lube oil, acid, alkali, sealing compounds etc. at work place.
- b. 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.
- c. The used containers of chemicals shall be segregated and disposed of suitably
- d. In case the used containers need to be re-used, all traces of the chemical to be removed by thorough cleaning with detergents etc. under trained supervision

8. ELECTRICAL SAFETY

- a. Only electricians licensed by appropriate statutory authority shall be employed by the subcontractor to carry out all types of electrical works. The subcontractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
- b. No PDB or any other distribution board shall be more than 03 (three) years of purchase. Only modern PDB with industrial sockets as shown in layout below to be allowed to use at site.
- c. Power supply to all equipment at site to be routed through MCBs of appropriate rating. A 'Power Supply Distribution Plan' shall be prepared and submitted to BHEL Engineer for approval
- d. All power supplies through cables shall be underground or overhead with height > 3mtrs.
- e. All power distribution boxes shall be locked and the key controlled by site management of concerned subcontractor.
- f. All individual equipment & tools at site shall be powered through Earth Leakage Circuit Breakers of 30 mA sensitivity.
- g. These MCBs and ELCBs shall be regularly tested as per Clause 14
- h. All fuses and fuse wires shall be of standard size and rating.
- i. All electrical appliances used in the work shall be in good working condition and shall be properly double earthed other than armour earthing.

- j. All extension boards shall have separate switches for all sockets / connections.
- k. All portable electric tools used by the subcontractor shall have safe plugging system (industrial top & socket) to source of power and be appropriately earthed.
- l. Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts especially in confined spaces like inside water boxes, turbine casings, condensers etc.
- m. Electrical appliance shall have proper earthing and for appliances equal to & more than 415V shall have two separate earthing (as per IS-3043-1987)

n. Portable Electric Lights

- i. Portable electric lights used in wet or potentially wet locations must be either low voltage type (24 volts or less) or protected by a GFI (ground fault interrupter).
- ii. They must be visually checked before each use and periodically while in use to assure their original integrity is maintained.
- iii. Cords with cuts, breaks, deep abrasions, etc. shall be taken out of service immediately.
- iv. Repairs to extension cords shall only be performed by qualified/ licensed electricians.
- v. Must not be allowed to lie in wet or potentially wet areas.

o. Underground Cables:

- i. Every electric line or cable of unknown origin that is discovered or exposed during a digging, drilling, probing, or similar operation is to be considered as energized and life threatening.
 - ii. The senior company employee on the site will ensure that all necessary safety precautions are taken in order to isolate the line from all workers and the public.
 - iii. Such precautions may include halting the operation if appropriate.
 - iv. The senior company employee on the site is to then contact the proper authorities to have the line identified and either confirmed to be abandoned and/or made safe for continuing the work.
 - v. Any and all underground lines that are discovered or become severed must be considered energized on both sides, and be treated accordingly.
- p. Details of earth resource and their test date to be given to BHEL safety officer as per the prescribed formats of BHEL
- q. The subcontractor shall use only properly insulated and armoured cables and conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site.
- r. BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the risk & cost of the subcontractor.
- s. No maintenance work shall be carried out on live equipment
- t. 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
- u. The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.
- v. Wiring and Branch Circuits Must be protected by a proper amperage over-current device such as a HRC fuse or circuit breaker. Such installations must be located so as to prevent physical damage to the wire conductors & panels.

- w. The sub-contractor shall supply modern power distribution board of different combination (1-phase & 3-phase). All the distribution of power should be through modern PDB. Equipment drawing is mentioned below.

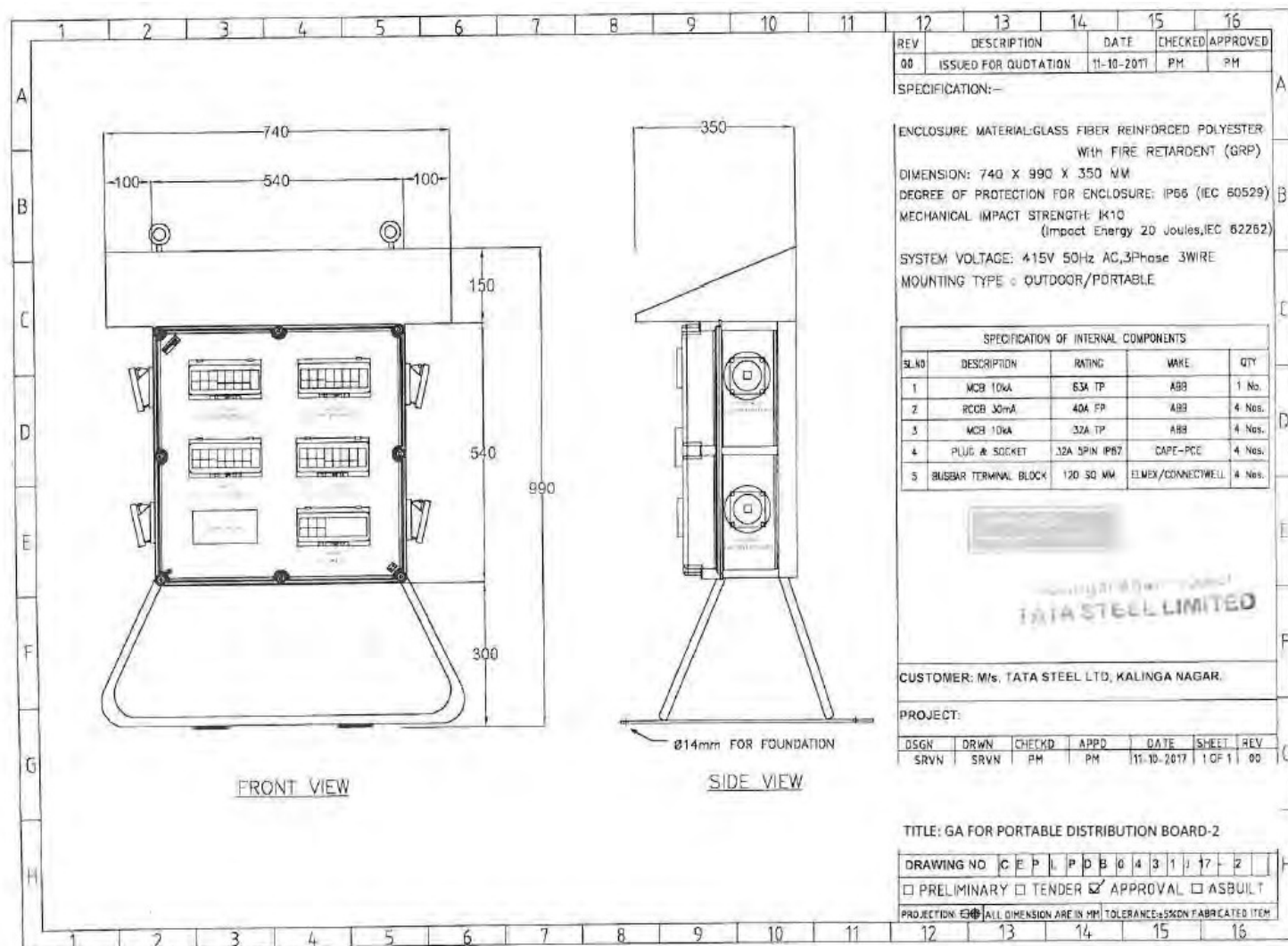


Fig. 9.1 Layout of a modern Power Distribution Board

x. General Electrical Safety

- In general, equipment or machinery being moved or transported must maintain minimum clearances of 25 ft. to all power lines.
- TAG IN/ TAG OUT must be in force in Switch Room and all Distribution Boxes for live power line. The authorized person's name and contact no shall be displayed
- Ensure "double insulated" three - core cables and three pin connectors are used and are properly ground "all insulated" types, all electrical tools and appliances must be manufactured for industrial use.
- All connections shall be electrically and mechanically sound and properly insulated. Taped joints are not permitted. Connections to socket outlets must be made with proper plugs (industrial top and socket).
- Splices in electrical cords are not permitted. Repairs must be made at the socket connection and retain the same mechanical and dielectric condition of the original connection.

- vi. Damaged or defective electric tools, equipment and extension cords, etc. must not be used and shall be tagged out of service, removed from the work area and taken back to stores.
- vii. Only licensed electricians are authorized to repair and work on electrical equipment. Tampering with electric tools or equipment by others could result in termination.
- viii. Temporary electric cabling should be elevated 2.2 meters above the floor/ground or covered for protection. It must be kept clear of walkways and other locations where it may be exposed to damage or create a tripping hazard.
- ix. Energized wiring in junction boxes, circuit breaker panels and similar places must be covered and locked at all times.
- x. Areas with live high voltage wires or terminals must be barricaded against entry and warning signs posted Danger – High Voltage and Authorized Personnel Only.
- xi. Personnel should never work on energized equipment, de-energizing (lockout/tag out) the equipment is always the first requirement.
- xii. The lockout and tag out procedure will be used when testing or working on, or around, energized installation.
- xiii. Working around energized equipment should never be done alone. A second electrician must always be available for assistance.
- xiv. If lockout/tag out of the work is infeasible (must be demonstrated), work on energized electrical circuits must be approved by the Site In-charge. All safety precautions necessary must be taken, PPE use must be evaluated per the exposure and used, i.e high/low voltage gloves, insulated shoes, overcoats/aprons, face shields, and other protective equipment like insulated tools, blankets, mats, etc. must be used.
- xv. The welding machines earth leads shall be properly fixed without loose contacts. The earth cable only has to be used. No steel members shall be used as earth leads.
- xvi. Electrical crews must be qualified for the equipment and tools they work on, including being trained in Cardio-Pulmonary Resuscitation (CPR) methods and First Aid for rendering help in the event of electric shock.

y. Qualified Persons for Electrical Works

(One who is trained and wiremen licensed to Govt. of Respective State and familiar with the construction, operation and safety hazards of the equipment upon which they are permitted to work.)

- i. Qualified persons are intended to be only those who are well acquainted/experienced with and thoroughly conversant in the electric equipment and electrical hazards involved with work being performed.
- ii. Only qualified persons may be permitted to work on or near exposed energized parts. Such persons are required to have been trained in three specific areas:
- iii. Qualified persons must be capable of working safely on energized circuits;
- iv. Must be familiar with the proper use of special precautionary techniques and procedures bases on equipment and exposure; and
- v. Must be familiar with required personal protective equipment, insulating and shielding materials, and insulated tools.

- vi. Qualified persons are expected to be able to evaluate unknown situations and adjust their activities in such a way that only safe work practices are used. Such behavior is the responsibility of the qualified person.
- vii. It is possible and likely for an individual to be 'qualified' with regard to certain equipment in the work place, and unqualified on other equipment they must know their limitation and stop work if not qualified on what equipment they were to work on.
- viii. An employee who is undergoing on-the-job training, who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training, and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties. The process must be documented as proof.

z. Mandatory PPEs of electrical work on LV & HV

- i. HV arc flash suit with protective hood (for protection of face and head) as specified for hazard risk category-4 in NFPA-70E or similar IS specification for working on HT switch gear (for all voltage >690 V) to the concerned licensed electrician or competent person.
- ii. LV arc flash jacket/FR as specified for hazard risk category-4 in NFPA-70E or similar IS specification having ATPV rating of 8.5 to 9 cal/cm² for working on LV (>260V and ≤690V) to the concerned licensed electrician or competent person.



- iii. The LV arc flash jacket as shown above shall be worn continuously while working on LV (>260V and ≤690V). The color specification of LV arc flash jacket should be blue.
- iv. Electrical hand gloves should have following specification: Flame resistance, arc flash and cut protection of voltage rating (>260V and ≤690V).
- v. Electrical safety over shoe of relevant IS make for foot protection of licensed electrician or competent person while working in HV & LV line or equipment.

9. USE OF HAND TOOLS AND POWER-OPERATED TOOLS

a. General Provisions

- i. All hands and power tools and similar equipment, shall be maintained in safe condition.
- ii. When power operated tools are designed to accommodate guards, they shall be equipped
- iii. with such guards, when in use;
- iv. Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains and other reciprocating, rotating or moving parts of the equipment shall be similarly guarded;
- v. Personnel using hand and power tools and exposed to the hazard of falling, flying, abrasive, and splashing objects, or exposed to harmful dusts, fumes, mists, vapors, or gases shall be provided with the particular personal protective equipment necessary to protect them from the hazards;

- vi. All hand-held powered platen sanders, grinders, grinders with wheels of 5 cm or less, routers, planers, laminate trimmers, nibblers, shears, scroll saws and jigsaws with blade shanks of 0.5 cm wide or less shall be equipped with only a positive on-off control.
- vii. All hand-held powered drills, tappers, fastener drivers, horizontal, vertical or angle grinders with wheels greater than 5 cm in diameter, disc sanders, belt sanders, reciprocating saws, saber saws and other operating powered tools shall be equipped with a momentary contact on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on.

b. Hand Tools

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

c. Power Operated Tools

- i. Electric power operated tools shall be either of the approved double-insulated type or shall be grounded;
- ii. The use of electric cords for hoisting or lowering loads shall not be permitted;
- iii. Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming incidentally disconnected;
- iv. Safety clips or retainers shall be securely installed or maintained on pneumatic impact (percussion) tools to prevent attachments from being incidentally expelled;
- v. All pneumatically riveting machine staplers and other similar equipment provided with automatic fastener feed, which operate at more than 7 kg/cm² pressure at the tool a safety device on the muzzle to prevent the tool from ejecting the fasteners unless the muzzle is in contact with the work surface;
- vi. Compressed air shall not be used for cleaning purposes except when the pressure is reduced to less than 2 kg/cm² and that too with effective chip guarding. The 2 kg/cm² pressure requirement does not apply to concrete form, mill scale and similar cleaning purposes;
- vii. The manufacturer's safe operating for hoses, pipes, valves, filters and other fittings shall not be exceeded;
- viii. Only personnel who has been trained in the operation of the particular tool shall be allowed to operate power-actuated tools;
- ix. The tool shall be tested each day before loading to see that the safety devices are in proper working condition. The method of testing shall be accordance with the manufacturer's recommended procedure;
- x. Any tool found not in proper working order, or that which develops a defect during use, shall be immediately removed from service and not used until properly repaired;
- xi. Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools are to be pointed at any other person. Hands shall be kept clear of the open barrel end;
- xii. Loaded tools shall not be left unattended;
- xiii. Fasteners shall not be driven into very hard or brittle materials including, but not limited to, cast iron, glazed tiles, surface hardened steel, glass block, live rock, face brick or hollow tiles;

- xiv. Driving into materials that can be easily penetrated shall be avoided unless backed by a
- xv. substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side;
- xvi. No fastener shall be driven into a palled area caused by an unsatisfactory fastening;
- xvii. Only non-sparking tools shall be used in an explosive or flammable atmosphere;
- xviii. All tools shall be used with the correct shield, guard or attachment as recommended by the manufacturer.

d. Abrasive Wheels and Tools

- i. All grinding wheel must be ISO certified only.
- ii. All grinding machines shall be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation;
- iii. Grinding machines shall be equipped with suitable safety guards;
- iv. The maximum angular exposure of the grinding wheel periphery and sides shall not be more than 900, except that when the work requires contact with the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 1200. In either case, the exposure shall begin not more than 8.650 above the horizontal plane of the spindle. Safety guards shall be strong enough to withstand the bursting of the wheel;
- v. Floor and bench-mounted grinders shall be work-rests, which shall be rigidly supported and readily adjustable. Such work-rests shall be kept at a distance not to exceed 5 mm from the surface of the wheel;
- vi. Cup type wheels used for external grinding shall be protected by either revolving cup guard or a band type guard;
- vii. When safety guards are required, they shall be mounted as to maintain proper alignment with the wheel and the guard and the guard and its fastening shall be adequate strength to retain the fragments of the wheel in case of incidental breakage. The maximum angular exposure of the grinding wheel periphery and sides shall not exceed 1800;
- viii. Portable abrasive wheel used for internal grinding shall be provided with suitable safety flanges;
- ix. When safety flanges are required, they shall be used only with wheels designed to fit the flanges. Only safety flanges, of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of incidental breakage, shall be used;
- x. All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that they are free from cracks or defects;
- xi. Grinding wheels shall fit freely on the spindle and shall not be forced on. The spindle nut shall be tightened only enough to hold the wheel in place;
- xii. All employees using abrasive wheels shall be protected by suitable eye protection equipment.

e. Wood Working Tools

- i. All fixed power-driven woodworking tools shall be provided with a disconnect switch that can either be locked or tagged in the off-position;
- ii. The operating speed shall be attached or otherwise permanently marked on all circular saws over 0.5 m in diameter or operating at over 3000 peripheral rpm. Any saw so marked shall not be operated at a speed other than that marked on the blade. When a marked saw is re-tensioned for a different speed,

the marking shall be corrected to show the new speed;

- iii. Automatic feeding devices shall be installed on machines wherever the nature of the work will permit. Feeder attachments shall have the feed rolls or other moving parts covered or guarded so as to protect the operator from hazardous points;
- iv. All portable power-driven circular saws shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. When the tool is withdrawn from the work, the lower guard shall automatically and instantly return to the covering position.

10. START UP, COMMISSIONING AND TESTING:

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

- a. These activities shall be personally supervised by the site executive along with the commissioning engineer.
- b. Appropriate Work Permits shall be taken as applicable
- c. The readiness of upstream and downstream system shall be ensured before taking up.
- d. These shall be handled strictly by the authorized persons only and the team shall be suitably briefed about the activity including hazards & risks involved and control plan by the concerned executive-in-charge before start.
- e. Entry of persons to the area of activity shall be suitably restricted and the emergency functions like Ambulance, first aid center and Fire station shall be intimated about the plan well in advance.
- f. Tag-in/ Tag-out shall be in place while charging transformer and whenever necessary.
- g. Electricians with valid wiremen license only shall be permitted to work on power lines.
- h. The area and the passage shall be adequately illuminated.

11. FIRE SAFETY

- a. The Fire Prevention, Protection and Preparedness Program is an integral part of the overall HSE Program. Effort and consideration must be given to safety, life and potential for delays in construction schedules and plant startup, as well as protection of property on a given project. The purpose of which is to prevent
 - i. Inception of fire
 - ii. Loss of life or personal injury
 - iii. Loss of Property
 - iv. Interruption of operations
- b. Site-in-charge / Safety Officer will make periodical review of the site Fire Protection, Prevention Preparedness Programme, Site conditions and available fire protection equipment. It is very imperative that the Sub-contractors along with BHEL to establish good contact with Local fire station for availability of Fire tender in case of emergencies, in addition to their own fire equipment.
- c. Fire Protection, Prevention and Preparedness Inspections - The Contractor /Sub-Contractor will be required to make frequent fire prevention inspections of his work site and operating facilities. Deficiencies will be corrected at once.
- d. Area where Hot work activities are carried out (Gas cutting / Welding/ any other spark producing work)

above a working spot, a GI / fire-resistant non-asbestos sheet or suitable material shall be placed to prevent the fall of hot sparks. A bucket of water shall be kept nearby while doing hot work

- e. Hot work shall be preferably carried out in a designated area with a standing Hot Work Permit, to be renewed monthly. The designated area shall have fire extinguishers.
- f. Any hot work outside designated area shall require a Hot Work permit and fire watch. No flammable material shall be stored within 35 feet from any fire load.

12. PAINTING:

- a. Requirements provide a detailed procedure to be implemented by all concerned employees and sub-contractors involved in painting activities.
- b. Significant Environmental Hazards:
 - i. Chemical hazard due to inhalation of lead fumes (lead containing paint)
 - ii. Chemical hazard due to inhalation of VOC's from painting operations
 - iii. VOC's from painting and coating operation
 - iv. Disposal of paints and coats drums
- c. Control Procedure for Painting:
 - i. Chemical products used in painting and coating operation shall have proper MSDS sheet in place. Whenever any doubt arises with respect to handling and safety point of view it should be accessed to all concerned.
 - ii. Toxic substances and hazards relate the toxic chemicals shall be identified.
 - iii. Proper PPE shall be used including plastic gloves appropriate overall etc.,
 - iv. Arrangement for cleaning of spillage shall be ensured
- d. Only trained workers shall be allowed and proper training should be imparted to the works.
- e. Exposure limits of the toxic substances shall be checked before starting the work and nobody shall be allowed to carry the work beyond the permissible limit.
- f. Ventilation or exhaust facility shall be provided at place where painting and coating operations are carried out.
- g. Overalls shall be supplied by the contractors/subcontractors to the workmen and adequate facilities shall be provided to enable the painters to wash at the cessation of work.
- h. Smoking, open flames or sources of ignition shall not be allowed in places where paints and other flammable substances are stored.
- i. A caution board in national /regional language "**smoking strictly prohibited**" shall be displayed in the vicinity.
- j. Suitable fire extinguishers/sand buckets shall be kept available at places where flammable paints are stored, handled or used.
- k. In case of indoor painting or painting in confined spaces, exhaust ventilating shall be provided. If adequate ventilation is not provided a proper respirator shall be provided and used by persons who are trained and fit tested.
- l. The VOC's from painting and coating operations shall not exceed the permissible level of CPCB/ SPCB norms. The paints and coats must be selected as per the guidelines.
- m. Workers shall thoroughly wash their hands and feet before leaving the work.

13. “HAZARDOUS ENERGY” CONTROL PROCEDURE/ LOCKOUT/TAGOUT (LOTO)

Hazardous Energy Control Procedures, known as "Lockout/Tagout (LOTO)" refers to specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities.

Contractors must develop and submit a written LOTO program. This requires that a designated qualified individual turns off and disconnects the machinery or equipment from its energy source(s) before performing service or maintenance and that the authorized employee(s) either lock and tag the energy-isolating device(s) to prevent the release of hazardous energy and test the machine or equipment to verify that the energy has been isolated effectively.

a. Minimum Requirements:

The following are minimum requirements that must be included in the Contractor's LOTO program:

- i. Inspection of equipment by a trained individual who is thoroughly familiar with the equipment operation and associated hazards.
- ii. Identification and labeling of lockout devices. Purchase of locks, tags, and blocks. Development of a standard written operating procedure, permitted through a controlling authority that is followed by all workers.

b. General Requirements

The following steps must be taken to protect workers that install or service equipment and systems:

Follow the hazardous energy procedures and statutory regulations. Follow the manufacturer's service/repair instructions. Identify and label all sources of hazardous energy. Before beginning work, accomplish the following:

- i. De-energize all sources of hazardous energy:
 - ii. Disconnect or shut down engines or motors.
 - iii. De-energize electrical circuits.
 - iv. Block fluid (gas or liquid) flow in hydraulic or pneumatic systems.
 - v. Block or secure machine parts against motion.
 - vi. Block or dissipate stored energy.
 - vii. Discharge capacitors.
 - viii. Release or block springs that are under compression or tension.
 - ix. Vent fluids from pressure vessels, tanks, or accumulators—but never vent toxic, flammable, or explosive substances directly into the atmosphere.
- c. Lockout and tag out all forms of hazardous energy including electrical breaker panels, control valves, etc. Make sure that only one key exists for each of your assigned locks and that access to the key is controlled. Verify by test and/or observation that all energy sources are de-energized.
- d. After completion of the work, accomplish the following:
- i. Inspect repair work before removing the lock and activating the equipment.
 - ii. Make sure that only the worker that installed the lock removes his/her assigned lock.
 - iii. Make sure that all workers are clear of danger points before re-energizing the system.

e. LOTO Procedure**PURPOSE AND SUMMARY**

This procedure provides the requirements and responsibilities of Hazardous Energy Control and the process for Lockout / Tag out (LOTO) of energy isolating devices (valves, circuit breakers, disconnect, etc.). Its use

shall ensure that machinery, equipment, or systems are isolated from all potentially hazardous energy to prevent unexpected energization, startup, or release of stored energy which may cause personnel injury or property damage.

This procedure applies to all BHEL personnel and subcontractors working on the WBPDC (1X660MW) STAGE-III projects where equipment must be taken out of service for the performance of work activities such as installation, maintenance, repair, construction, or equipment removal. The procedure may also be used to isolate equipment of which the energization or operation may present danger to personnel or property. Lockout / tag out are not required for electrical equipment that can be unplugged from the source and the person performing the work has control of the plug.

This procedure shall be applied to prevent injury or damage caused by the unexpected release of active or stored energy. Hazardous energy sources could be in the form of the following:

- Electrical
- Hydraulic
- Chemical
- Thermal
- Mechanical
- Pneumatic

Preplanning of work activities includes the identification of all potential hazardous energy sources so that they may be properly controlled and isolated, locked, and tagged out.

Prior to initiating work activities on or around locked out / tagged out equipment, the equipment must be tested and tried by or in the presence of the person(s) performing the work activities.

RESPONSIBILITIES

- The Engineers in Charge is responsible for implementing and enforcing this procedure and approving lockouts /tag outs that impact the operation of the project.
- The Engineer in Charges responsible for authorizing Lockout /Tag out Requests.
- The Lockout / Tag out Coordinator is responsible for maintaining the Lockout / Tag out Log. Each shift should have a designated Lockout / Tag out Coordinator.
- The Isolator is responsible for determining the proper isolation devices and device positions required to isolate all potential energy sources so that the work stated on the Lockout /Tag out Request Permit may be safely performed. The Isolator must be familiar with the equipment and energy type(s) that require isolation. For this reason, in some cases the Isolator may be more than one person (i.e. Engineer, System Operator and/or Electrician). The Isolator shall position the specified device points, and apply locks and tags, and sign the tags and the LOTO Permit isolation point blocks.
- The Safety Manager is responsible for conducting an annual audit that is documented to ensure all procedures and requirements are current and being followed as written.

DEFINITIONS

Affected Employee: -

An employee whose job requires him/her to operate or use machinery or equipment on which servicing or maintenance is being performed under a lock out/tag out procedure or whose job requires him/her to work in an area in which servicing or maintenance is being performed under a lockout/tag out procedure

Authorized Employee: -

An employee who implements a lockout/tag out procedure on machinery, equipment, or systems in order that servicing or maintenance may be performed. Often an authorized employee and an affected employee may be the same person.

Danger “Do Not Operate” Tag

A tag used to identify energy isolation devices and specify the required position of the device. The tag should be affixed to the isolation device such that it is in plain view of anyone attempting to operate the device. The tags shall be sequentially numbered and shall specify the lockout/ tag out request number. The tag shall also state the purpose, and the expected duration of the lockout /tag out

Isolation Device

A device that is designed and intended to prevent the passage of energy. These devices, usually located at the energy source, are typically valves, circuit breakers, etc. Isolation devices should have a means of being locked in position

Lockout Device

A device that uses a positive physical means such as a lock, either key or combination type to maintain an energy isolation device in the safe position and prevent the inadvertent energization of machinery, equipment, or systems. Device locks should serve no other purpose other than hazardous energy control isolation

Lockout Tag out Request Permit

A pre-numbered form used to request that machinery, equipment or systems be taken out of service. A Lockout/Tagout Request Permit may be initiated by any one requiring energy isolation for work activities or for taking faulty equipment out of service

Lockout / Tag out Request Log

A record of all Lockout /Tag out Request Permits shall be maintained by the Lockout /Tag out Coordinator.

PROCEDURE**1. REQUESTING A LOCKOUT / TAGOUT PERMIT**

When machinery, equipment, or systems are partially or completely taken out of service for work activities or equipment protection, a lockout / tag out shall be requested. The requestor shall be familiar with scope of work required and shall provide a brief description of the work on the Lockout / Tag out Request Permit. The requestor shall also provide the proposed start time and estimated duration of lockout / tag out. If familiar with the machinery, equipment, or system to be taken out of service, the requestor may identify the devices that are required to be isolated. The LOTO Request Permit shall be forwarded to the Authorized Lockout / Tag out Coordinator for reviewed and signature, along with Permit to Work number to be entered on the LOTO Request Permit.

- a. The Lockout / Tag out Coordinator shall record the necessary information on the Lockout / Tag out Request Log and forward the request to the Engineer in Charge for approval.
- b. The Safety Manager or Engineer in Charge shall review the Lockout / Tagout Request Permit for impact on project operations. Project operations could be impacted by the equipment being taken out of service or by the required isolation to take the equipment out of service. If project operations are impacted by the Lockout / Tagout, the request shall be forwarded to the Engineer in Charge for approval.
- c. The Engineer in Charge shall provide the lockout / tag out isolation points necessary to perform the task stated on the request. The device identification, device location, device position, and locking mechanism

shall be entered into the appropriate blocks on the Lockout / Tag out Request Permit.

- d. The Engineer in Charge indicates approval of the Lockout / Tagout Request Permit by signing in the appropriate space on the request. If the Lockout /Tag out Request Permit is rejected, the Engineer in Charge shall return it to the requestor, via the Lockout / Tagout Coordinator with a written explanation of the rejection.
- e. Once approved, the Lockout / Tag out Request Permit shall be forwarded to the Lockout / Tag out Coordinator to assign tags and locks.
- f. The log shall show current status of all Lockout / Tag out Request Permits from submittal to approval, through lifting of locks and tags to final closeout. The log shall be maintained by the Lockout / Tag out Coordinator in their office.

2. PLACEMENT OF LOCKS AND TAGS

- a. The tags shall be filled out to match the information on the LOTO Request Permit. Appropriate locks for the types of isolation devices specified shall be collected and placed with the tags and the Lockout / Tag out Request Permit.
- b. The isolator(s) shall take the device locks, tags, and the Lockout / Tagout Request Permit to position the specified isolation devices, sign and hang the tags, and place the locks. If the isolator does not agree with or understand the Lockout / Tagout Request Permit, or has a problem performing the isolation, the problem should be brought to the attention of the Safety Representative or Area Supervisor immediately and the lockout / tag out should be postponed until the situation is resolved.
- c. Once the Isolator has placed all “locks” on isolation points, they will “test ”and “try” the machinery, equipment, or system to ensure all hazardous energy has been completely removed and the isolation is one totally accomplished, and has initialed and signed the Lockout /Tag out Request Permit indicating all isolation points have been confirmed. Examples of “lock”, “test” and “try”:
 - by checking that all locks on the LOTO Request Permit have been applied and are in the specified position open/closed, on/off, etc.; metering test of electrical circuits, opening of drain valves, checking pressure gauges or indicators; and try by pushing start buttons and on/off switches, etc.
 - Testing shall be performed by person(s) knowledgeable of the energy source(s) being isolated (e.g., an electrician should meter electrical circuits).
- d. A copy of the completed Lockout /Tag out Request Permit shall remain with the Work Package and used as part of the daily Pre-Job Briefings

3. WORKING UNDER A LOCKOUT / TAGOUT REQUEST

- a. Prior to starting the work activity, the person(s) performing the work shall review the Lockout / Tag out Request Permit and place the necessary tags and personal locks on the identified isolation devices. Personal locks may be placed only on devices that have already been locked and tagged in accordance with the Lockout / Tag out Request Permit.
 - All personal locks shall be accompanied by a tag that is signed and dated by the worker(s) and specifies the work activity being performed.
 - Personal locks should be of a different color than device locks for ready identification.
- b. Verification of the effectiveness of the isolation by the Isolator shall be performed for Worker’s working under the lockout / tag out, by demonstrating the checks on “lock”, “test” and “try”,
- c. When the work activity is finished, personal locks and tags shall be removed and the Safety Representative

shall be notified that the Lockout / Tagout is no longer required. If work under a lockout / tag out is to be delayed or interrupted for a period in excess of 24 hours, personal locks shall be removed until the work restarts. Personal locks shall be removed prior to the worker(s) leaving the project at the end of shift unless the key(s) are maintained at the project.

4. REMOVAL OF LOCKS AND TAGS

- a. When the lockout / tag out is no longer required, the Safety Representative or Area Supervisor shall obtain the Lockout / Tagout Request Permit from the work package for LOTO removal. Prior to removing locks or tags that may allow equipment to be energized, a check shall be made to verify that the equipment is free to safely operate (i.e., will not cause damage or injury). The locks and tags shall be removed and returned to the Lockout / Tagout Coordinator. Isolation devices may be repositioned at the discretion of the Engineer in Charge according to operational requirements. The Isolator shall complete the Lockout / Tagout Request Permit indicating each lock and tag has been removed and the Safety Representative or Area Supervisor forward to the Lockout / Tagout Coordinator.
- b. The Lockout / Tagout Coordinator shall discard the tags and maintain the completed Lockout / Tagout Request Permit for future reference.
- c. In the event that an employee leaves the job site without removing the personal lock I tag, the following measures shall be taken and documented. The measures listed below are a minimum set of guidelines and under all circumstances, refer to the site-specific safe work plan for detailed procedures:
 - Attempt calling / contacting the employee to return to the site for removal.
 - In the event an employee cannot be contacted, the Site Manager and Safety Manager shall sign an Emergency Lockout/Tagout Removal Form, which has been completed by the Area Supervisor.
 - Employee shall be notified upon returning to the site, prior to beginning any work.

5. INTERRUPTION OF A LOCKOUT / TAGOUT

Operational Emergency

The Engineer in Charge / Safety Manager /Area Supervisor may deem it necessary to temporarily remove the locks and tags from isolation devices, prior to the end of the work activity. The standard procedure for removal of locks and tags shall be followed. Extreme caution shall be taken by the Isolator removing the locks and tags to prevent personnel injury.

Testing

When the performance of a work activity requires the functional testing of a machine, component, or system, the locks and tags may be temporarily removed in accordance with the tag removal, to perform the test. As a result of the testing, if it is determined that the equipment needs further work, the locks and tags shall be positioned back on to the device. If it is not necessary to replace all the locks and tags, then the unnecessary locks and tags may be returned to the Lockout / Tagout Coordinator. The Engineer in Charge shall initial the Lockout / Tag out Request Permit in the removal block to indicate that these locks and tags have been removed. When testing has been satisfactorily completed, the locks and tags shall be removed.

ISOLATION DEVICES

- In most industrial applications, there are isolation devices that were not designed to accommodate a locking device. In these instances, an acceptable alternative that physically obstructs or prevents the use of the isolation device shall be found. Chains shall be placed on valves or electrical panels. Wires shall be determinate, pulled back, taped, and secured.

- If an isolation device does not accept a lock, a tag only is acceptable; however, all possible precautions shall be undertaken to provide a level of safety for the workers. The tag shall be readily visible to anyone attempting to operate the device.
- If more than one Lockout / Tagout Request Permit requires that a single isolation device be locked and tagged, a lock and tag for each request shall be placed. Each lock in itself prevents the inadvertent operation of the device.

GROUP / COMPLEX LOCKOUT

In a multiple lockout / tag out procedure, each person working on the machinery or equipment must place a lock or tag on the energy isolating device. If the energy isolating device will not accept multiple locks or tags, a hasp (a multiple lockout device, may be used. The locks or tags must be placed in such a way that energy cannot be restored to the machinery or equipment until every lock or tag is removed. As each employee involved no longer needs to maintain lockout / tag out protection that employee removes his - her lock and/or tag. The employee attaching the lock or tag is the only person authorized to remove the lock or tag.

6. TRAINING

The training must include recognition of hazardous energy source, type and magnitude of energy available, methods and means necessary for energy isolation and control. Each authorized employee shall receive adequate training. The training should address that all affected employees are instructed in the purpose and use of the energy control procedure. There should be training provisions included for any other employee whose work operations are or may be in an area where energy control procedures may be utilized. The employee training should also address when tag out systems are used including the limitations of a tag (tags are warning devices and do not provide physical restraint). The training should also include that a tag is not to be removed without authorization. The tag is never to be ignored or defeated in any way. Retraining is required when there is a change in job assignments, in machines, a change in the energy control procedures, or a new hazard is introduced. All training and I or retraining must be documented with employee's name and dates of training.

7. PROGRAM REVIEW

The lockout / tag out program must be reviewed at least annually. The review must ensure that procedures are being followed and that they are effective. A documented review of the inspection must include the date, the equipment, employees involved & the inspector. The inspector must be someone other than those actually using the lockout / tag out in progress.

ATTACHMENTS

#1. Danger (DO NOT OPERATE) Tags



#2. Device & Personal Locks and Multi Lock Hasp:



#3. Lockout / Tagout Request Permit

		LOCKOUT / TAGOUT REQUEST PERMIT			LOTO Request Permit No.: Work Permit No.:	
Equip. Out of Service:	LOTO Date Required by: ____ / ____ / ____	Estimated Duration:		LOTO Requested Date:		
Scope of Work:				LOTO Authorization Signed by: Date:		
				LOTO Removal Authorization Signed by: Date: Time:		
Tag No.	Device to be Tagged / Locked I.D. No.	Device Location	Device Position OPEN / CLOSE D -	Lock No.	Tag/Lock Placed by Print/Sign - Date/Time	Tag /Lock Removed by Print/Sign - Date/Time
Comments Instructions: Attachment 3.Lockout / Tag out Request Permit:						

#4. Lockout / Tag out Request Log

LOTO Permit No.	Request or Name	Equipment & Location	Est. Work Completed Date	Approval Date	LOTO Placed Date	LOTO Removed Date	Comments

14. RISK ASSESSMENT

Risk and Hazard Analysis

In order to produce an overall Project EHS Plan, a project must be assessed for its risks. There are two components to the risk and hazard analysis. The procedure used to examine and plan for the identified risks and hazards is called a General Hazard and Risk Assessment.

JSA/HIRA review

Prior to commence the following activities Method statement and JSA/HIRA to be prepared by the concern engineer in coordination with EHS officer and submit to the client for review and approval. After getting approval the work will be started under PTW after clearance. For HIRA and criteria for the defining the high, medium & low risk the relevant annexure be referred. In case any deviations required in the approved method statement the concerned engineer/supervisor has to prepare additional HIRA/JSA to cover the new activities and associated risk. Following activities to be covered,

- Deep excavation (more than 5 feet)
- Significant concrete pouring (like heavy foundation, TG deck, Slab casting etc.)
- Confined entry
- Blasting
- Working on electrical/ energized equipment's
- Steel erection more than 5-Ton weight
- Working at height prior to completion of stairs/ladders/hand railing etc.

Definition:

HAZARD - Any potential or present danger to persons or property within the project site, e.g., oil on the floor is a hazard.

INCIDENT - An unintended happening that may result in injury, loss or damage, e.g., Slipping on the oil is an Incident.

INJURY – Physical harm, the result of an Incident, e.g., a sprained wrist from the fall would be an injury.

Hazard Analysis Document

- For high risk and dangerous work identified, the Applicant shall complete and submit a Hazard Analysis Document together with the PTW request. It will be a JSA (Job Safety Analysis) or Preliminary Hazard Analysis Checklist. And it shall be reviewed and approved by respective Construction and HSE Representatives.
- Issues such as work interface, coordination, drawings, toolbox meetings and work type/duration shall be detailed and included with supporting documentation for the Applicant's request for PTW.
- If applicable, Hazard Analysis Document shall be used as the foundation for development of Safe Work Method Statement. Each hazard identified shall be addressed in the Safe Work Method Statement and be submitted as part of the Applicant's submittal package.

Evaluation of Sub-contractor Risk Assessments includes

- Experience and expertise in performing similar type work.
- Duration of work performed
- Location of the work to be performed.

- Nature of the work to be performed.
- Potential for a subcontractor performing the work to expose themselves, other persons or employees, to hazards.
- Potential for exposure to work site hazards.

Review of Subcontractor specific issues

Preventive and protective measures must be introduced according to the following order of priority

- Eliminating the hazard by removing the activity from the work process. Examples include substitution with less hazardous chemicals, using different manufacturing processes, etc.
- Controlling the hazard at its source through use of engineering controls. Examples include local exhaust ventilation, isolation rooms, machine guarding, acoustic insulating, etc.
- Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc.
- Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE.

15. HSE PREPAREDNESS FOR ADVERSE CLIMATES AND WEATHER

All Preventive and Precautionary measures to ensure Health & Safety of workers in all possible adverse weather conditions based on the analysis of the local area conditions to be taken by the subcontractor

15.1 SUMMER

1. The Working Time and Lunch Hour will be as per instruction of Statutory Authorities (no work between 11am to 3:30pm). However, in case temp comes down due to rain/cloudy weather work will continue as per normal routine.
2. During long lunch break, worker will be allowed to go back home for rest. Those who will like to stay back will avail at the facility of rest shed or other designed area.
3. They will be allowed to take small break during work as per their need.
4. Water sprinkling will be done on roads to reduce dust concentration.
5. Workers will be provided with adequate cool drinking water and Butter milk/Lemon water etc.
6. Adequate ORS stock will be made available at the work location in the First-Aid Box for use as needed and at First-aid Centre for emergency need.
7. Fire prevention shall be on high alert, with removal of dry grass and bushes, etc, inside and outside the surrounding work areas. No smoking, and control of open flame/sparks shall be maintained and monitored.
8. Worker will be informed about the Do's and Don'ts to be followed during summer in the Pre Job Brief.

Dos & Don'ts

1. Drink plenty of cool water and other non-alcoholic fluid and keep body well hydrated.
2. Eat salt in food to replenish loss of salt through sweating.
3. Avoid over physical exercise.
4. Have adequate sleep at night.
5. Eat light and less spicy food
6. Avoid eating food which was cooked long time ago.

7. Nobody should use small water bodies such as pits, running rain water through crevices etc. for drinking and cleaning purpose as it may be unhygienic.

Emergency Handling

In case of emergency due to heat disorder:

1. Rescue the victim from workplace and place under shed.
2. If to be rescued from height, use stoke basket or rescue kit.
3. Inform Ambulance immediately.
4. If nearby any air conditioned room/shed is available, place him inside the room/shed.
5. Administer First aid by trained First aider for Heat Disorder
6. If conscious, give him ORS solution to drink.
7. If required send the victim hospital immediately.

15.2 MONSOON**A. Height Work & Structural Safety:**

1. Ensure that all height work platforms are barricaded and avoid any highly hazardous
2. Height work.
3. Ensure that all personnel have good quality and intact safety shoes
4. Stop all dangerous height work during rain
5. Explain Do's and Don'ts to workers during Tool Box Meetings
6. Ensure that there are no weak structures, boards etc. that can fall during high winds
7. Do not allow any loose material (e.g. GI sheet, Ply board, empty cement bag, aluminium foil, foam sheets etc.) on roof sheds or top of structures.
8. Do not permit any one to ride up or come down scaffolds frame work during heavy wind or rain.
9. Provide "anchor" of adequate strength to scaffolds and other high-rise structures.
10. All rest sheds and GI sheds will be anchored into the round and wall and roof panels will be secured with J hook to prevent shed from blowing over or parts/pieces becoming airborne. Proper earthing per IS standard is also to be installed.
11. Do not go alone nor permit anyone to stay at tower-tops, roof-tops, high structures or on electrical poles during the course of stormy weather or heavy rain.

B. Electrical:

1. All electrical connections / loads have to be routed through ELCB / RCCB (residual current circuit breaker) whose rating should be 30mA.
2. RCCB operational checks need to be done DAILY / WEEKLY during monsoon season.
3. Avoid joints on power cables which need to be laid over-head or under-ground, better not to have any joint at all. In case joints become essential, such cables must be housed rigidly and insulation must be provided as per approved standard. The joint shall be suitable for outdoor use.
4. All electrical distribution board shall be properly covered at top and sides to protect from rain water. Extension boards shall be protected from rain water.
5. Ensure proper "earthing" for each and every electrical appliance.
6. Double earthing need to be provided for 3-phase power supply and for voltage more than 220V.

7. Provide lightening arrestors at the top of Boiler 3 and boiler 4 and rest sheds which are not covered by existing lightening arrestor of other installation.

C. Others:

1. Maintain smooth flow on open drains. i.e. no obstruction or blockade shall be made on storm water drains. If required, make temporary drains.
2. Arrange back-filling of excavated pits on war-footing basis.
3. Arrange bringing down booms of all cranes, hydra machines during stormy weather (wind speed 40-50 km/hr)
4. Confirm that all gantry cranes are effectively choked to prevent rolling and toppling.
5. Do not forget to deep ready a dew battery operated lights at site-offices during rainy season.
6. Avoid using wet damp clothes.
7. Hard Barricade excavated zone filled with water with scaffolding pipe & clamp with reflective net
8. Engage diesel operated water pump to dewater work area. For electrically operated water pump, the starter shall be protected from rain water. All rotating parts shall be guarded. Ensure availability of sufficient water pumps.

D. Health and hygiene:

1. Monsoon reduces the immunity of our body and makes us vulnerable to many diseases which are commonly associated with this season. It is time for us to keep our body challenging against disease by boosting our immunity and taking safety measures against these diseases.
2. The diseases associated with monsoon are Malaria, Jaundice, Gastro-intestinal infections, like typhoid, cholera etc. apart from these viral infections like cold and cough also make their presence felt. Majority of above said diseases are on account of:
3. Puddle of water formed due to rain become breeding grounds for mosquitoes which spread disease like, malaria and dengue fever. As a precautionary measure against mosquito-bite disease one can use mosquito net around the end which is better choice to mosquito repellents like mats and coils.
4. Pollution of drinking water during monsoon is very common. It is very necessary to drink clean and pure water when water-borne monsoon diseases like diarrhoea and gastro-intestinal infections threaten us.
5. Walking in dirty water during rainy season leads of numerous fungal infection which affect toes and nails. Diabetic patients have to take a special care about their feet. Keeping feet always dry and clean is very necessary. Avoid walking in dirty water. Keep shoes socks and raincoats dry and clean.

E. Workmen will be made aware of following Do's and Don'ts:

1. Do not sleep in daytime.
2. Avoid over physical exertion.
3. During lightning and thunder storm, do not take shelter under tree. Take shelter inside rest shed or store room.
4. Wash vegetables with clean water and steam them well to kill germs.
5. Avoid eating un-cooked foods and salads should be washed properly before consumption.
6. Drink plenty of water and keep body well-hydrated.
7. Always keep the surrounding area dry and clean. Don't allow to get water accumulated around.
8. Keep body warm as viruses attack immediately when body temperature goes down.

9. Do not enter air conditioned room with wet hair and damp cloths.
10. Dry your feet and webs with soft dry cloth whenever they are wet.
11. Eat light and less spicy food.
12. Avoid eating food which was cooked long time ago.
13. Eat salt in food to replenish loss of salt through sweating.

15.3 EMERGENCY WEATHER CONDITIONS

Cyclone/Severe thunder storm

In the event of Cyclone/Severe thunder storm, alert will be issued by subcontractor on notification received by Govt. authorities/Metrological departments Customer or BHEL.

The actions required during cyclone/rough weather:

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

Personnel Evacuation:

1. Personnel Evacuation will be required if predicted wind speed and storm surge heights are beyond acceptable limits as per the instructions from Govt. Authorities/ Metrological departments or Customer.
2. Once the warning is received for personnel evacuation, an emergency response team shall be formed. The team will work with local authorities and other agencies formed/deployed to evacuate and transport all personnel involved in the project to the cyclone shelter.
3. Cyclone may be followed by the calm "EYE", be aware of it. If the wind suddenly drops, don't assume the cyclone is over. Violent wind may resume from the opposite side direction. Wait for the official "All clear Signal".

4. After the cyclone, do not go outside until officially communicated about safe situation outside. Use recommended routes for returning. Do not panic or rush while returning.
5. Checking of gas leaks and well-being of electrical appliances is essential before leaving the site.
6. Follow local communications for official warning and advice. The construction Manager shall also obtain updates from customer/metrological departments and communicate to the personnel on project site.

15.4 PREVENTION OF COVID-19 (COVID-19 HERE TO BE READ AS COVID-19 AND OTHER PANDEMICS/ COMMUNICABLE DISEASES) AT PROJECT SITE & LABOUR COLONY:

Resumption of Construction Activities after Lock Down and Prevention of Coronavirus Infection during Site Operations and OCP 61A: Prevention of COVID-19 Infection in Labor Colony will be strictly followed.

A. Preventive measures at project site:

- BHEL and Agencies shall nominate COVID Marshalls, who will be responsible for monitoring the COVID prevention measures and apprising management on the same.
- Mandatory health check-up for every worker/ official joining the site
- All activities to be carried out using least amount of paperwork and physical proximity as far as possible.
- **HSE Observer App** to be used to monitor HSE Activities and follow up with agencies for closure of non-conformities.

a. Strict Control at the Gate/ Banning Entry to Anyone Not Wearing Masks

- i. Security personnel at the gate may erect a barricade preferably approx. 10 meters from the gate and only allow personnel who are wearing proper masks inside.
- ii. Public address system may be used to warn any non-compliant visitors
- iii. Near entry gate, round markers at minimum 1-meter distance to be ensured so that distancing is ensured
- iv. A hand-wash or hand sanitiser facility is preferable at the gate to allow entry after hand wash or hand sanitisation. These are also to be provided at key locations to enable hand wash / hand sanitisation before starting work, before eating, etc.
- v. Gutkha, Paan, tobacco etc. to be banned from the site. Spitting to be strictly prohibited.

b. Screening at Gate with Contactless Thermometer & Action on Suspected Cases

- i. Security Personnel at the Gate to screen each person entering the premises using a non-contact infrared thermometer, which is duly serial numbered and calibrated.
 - ii. In case any site worker/ official is found to have fever more than 99 Degrees Fahrenheit or found coughing/ sneezing, he/she may be advised rest till recovery and entry to be permitted after obtaining clearance from medical officer/assistance/attendants.
- Parcel to be collected from gate by concerned person preferably with provision of Special Box
 - Any construction material received at site, unless properly sanitized, to be kept undisturbed for at least 3 days and to be used only after that period.
 - During Toolbox Talks, minimum 1-meter distance between any two workers to be ensured

c. During site execution activities:

For all site execution activities, social distancing is to be maintained. In case this is not possible due to nature of work, speciality of work, etc, ensure sensitisation of the labour/staff involved and use of appropriate PPEs, especially mandatory face mask. In any case, close working to be allowed only in special

circumstances and ensuring these activities are preferably time staggered to the extent possible

d. In office premises:

- i. Sharing of items like pens, water bottles etc. in office premises to be avoided
- ii. Doors preferably to be in open condition to avoid contact
- iii. All common touch points to be frequently disinfected in a day.

e. Regular disinfection of all Areas, Equipment and facilities

- i. A dedicated disinfectant gang to be identified for the task by each agency. The disinfectant gang to be provided full body suits for the task.
- ii. All areas (including office premises, site areas, chairs, tables, furniture etc.), tools & equipment to preferably be disinfected by dedicated gang every day before resumption of work.
- iv. Common touch points like handrails, lift buttons, door/window knobs or handles, vehicle door handles, taps, conference room & dining hall tables/chairs, common sofas/chairs, visitor sofa/chairs, files & folders, etc to preferably be disinfected regularly at frequent intervals every day.
- v. Pool vehicles, to be disinfected after every use. Social distancing to be maintained inside the common pool vehicles as per Govt./ statutory body guidelines.

f. Disinfecting the operator/driver touch points of Vehicles/cranes, T&Ps etc.

Disinfection to also be carried out for all Cranes, Vehicles, Equipment, consoles, T&Ps etc. which come into contact with operating personnel.

g. Posters on COVID-19

Sufficient Posters on COVID-19 to be ensured across the site in languages understood by most workers.

h. Brief guidelines for hand washing are as below:

- i. Soap to be provided at each wash basin and replenished regularly.
- ii. Washing with soap for at least 20 seconds is recommended.
- iii. As a general guideline, for every 100 workers, 1 wash-basin may be provided at site areas.
- iv. Close queue to be avoided near wash-basins and 1-meter distance to be maintained. Round markers at 1-meter distance can be ensured as guidance

Composition of Disinfectant:

- i. Readily available 1% hypochlorite solution or 4%
- ii. Liquid chlorine-1% solution
- lii. Surgical spirit-95% alcohol content
- iv. Hand sanitizer should have: Isopropyl alcohol-75%, Glycerol-1.45%, Hydrogen Peroxide-0.125%

B. Prevention of COVID-19 Infection in Labor Colony:

- Spacing of minimum 2 meters between living areas of workers inside a room may be maintained. Preferably, the living area of each worker may be partitioned using sheet of cloth, plastic etc.
- Rooms to be properly ventilated as far as possible
- Sanitation to be given prime importance and personal hygiene to be promoted
- Face masks shall be worn by everyone inside the colony premises
- Spitting of Pan. Gutkha etc. inside the colony and urinating etc. outside the toilets to be strictly avoided
- Regular visits by Doctors to the labor colony can be arranged on non-working day for check-up of all workers
- **Identification of "COVID Wardens" (CWs) by each agency for maintaining the following:**
 - i. Keeping an eye on the health of workers and report any suspected cases of fever, coughing etc. to the

management

- ii. Keeping an eye on the social distancing measures in the labor colony and report any non-conformances to the management.
- iii. Educate the workers about social distancing and COVID prevention measures.
- Training/ Awareness regarding COVID-19 to be provided to workers regularly.
- Workers to be instructed to maintain social distancing of minimum 1 m at all time
- **Posters on COVID-19:** Sufficient Posters on COVID-19 to be ensured across the labor colony in languages understood by most workers.
- All workers to be instructed to inform any suspected cases of illness (individual or others) to an emergency contact number of CW, the emergency contact numbers and CW contact numbers to be displayed at prominent locations
- **Inspection & Review**
 - i. Daily Inspection by concerned COVID Wardens and reporting to Agency
 - ii. Regular inspection by Agency & BHEL

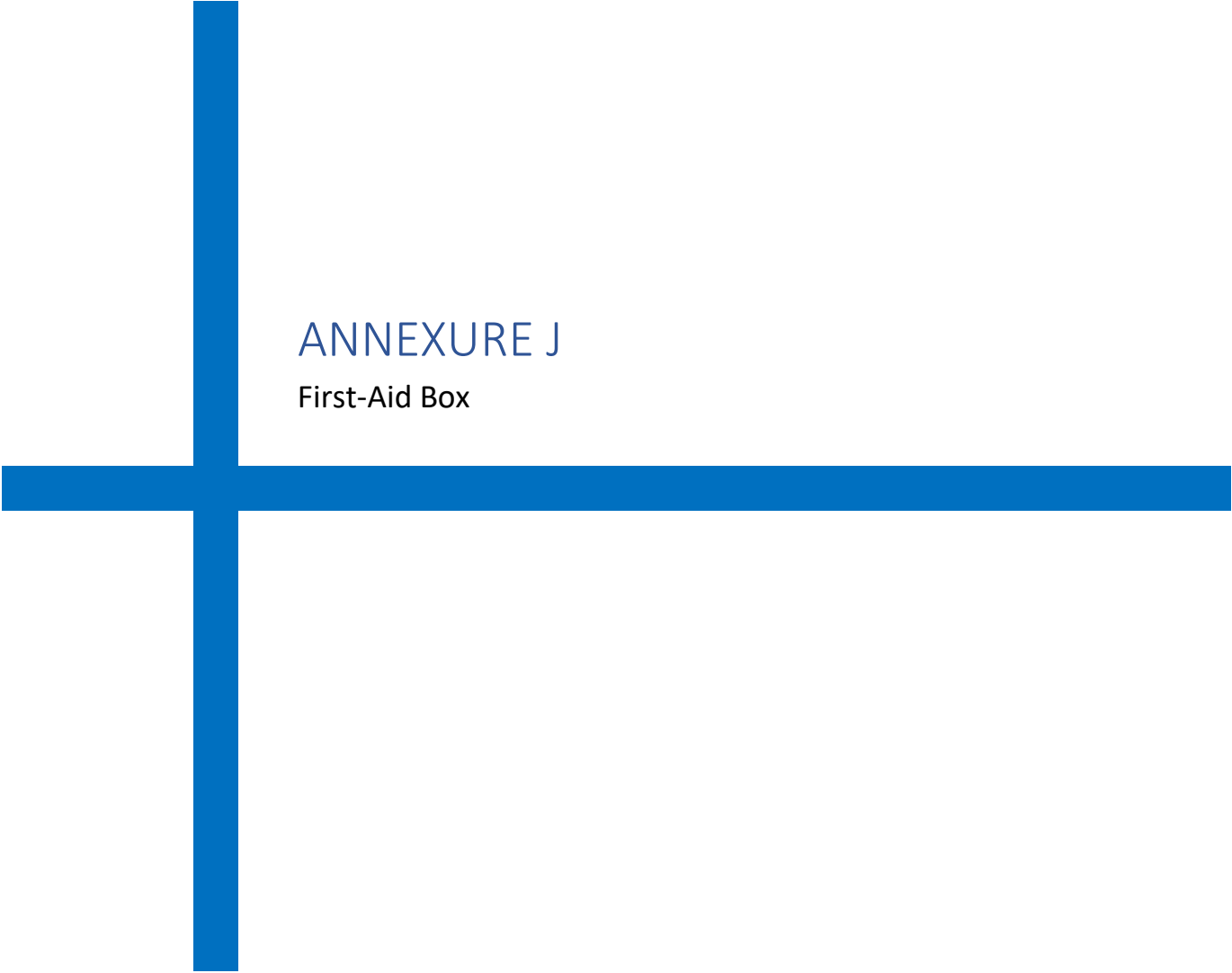
15.5 Noise Mitigation

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

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

Noise Level Chart

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



ANNEXURE J

First-Aid Box

Details & Contents of First Aid Box as per Contract Labor (Regulation & Abolition Act), Central Rules, 1971

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

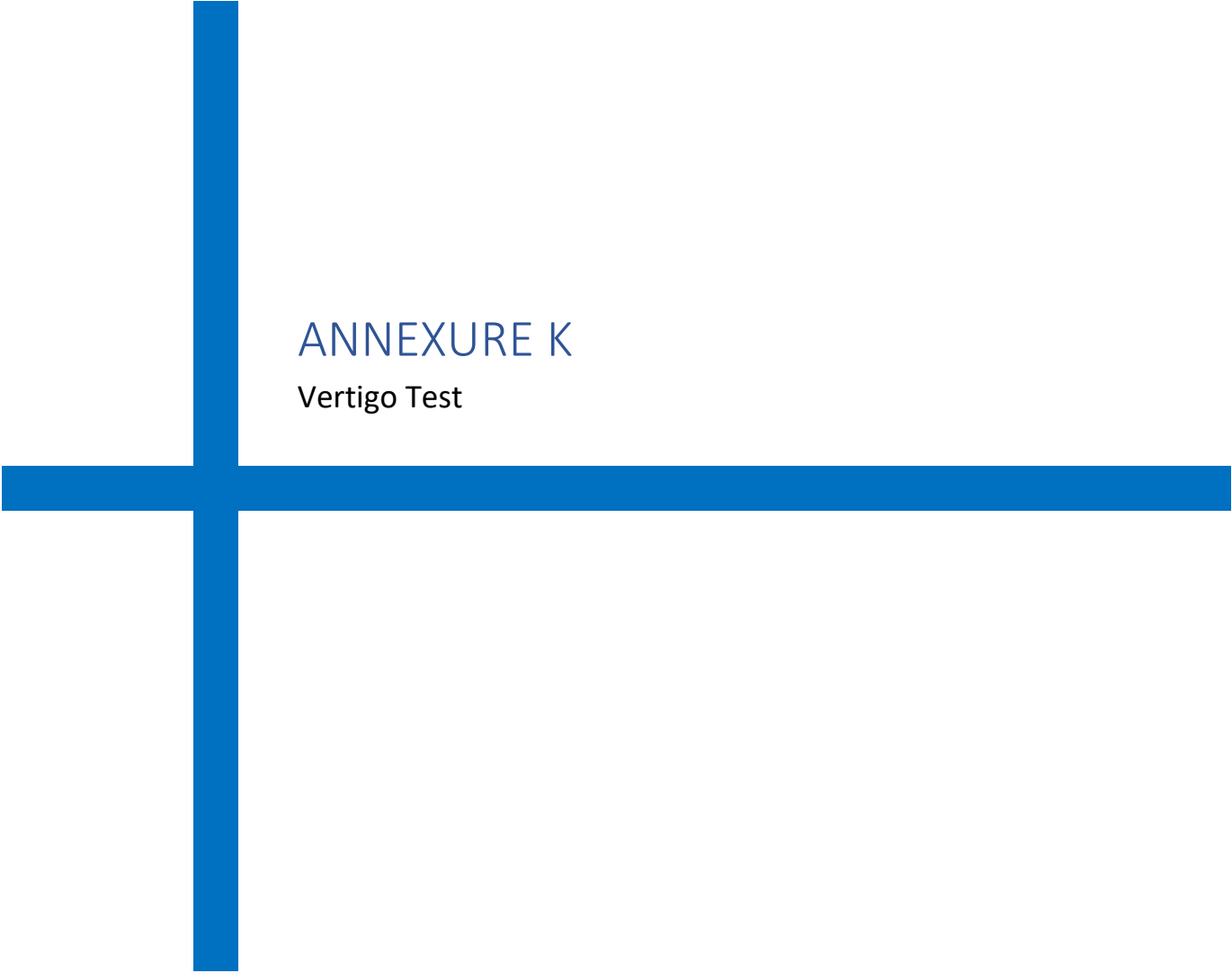
(a) For establishments in which the number of contract labor employed does not exceed fifty, each first aid box shall contain the following equipment:

(i)	6 small sterilized dressings
(ii)	3 medium size sterilized dressings
(iii)	3 large size sterilized dressings
(iv)	6 pieces of sterilized eye pads in separate sealed packets.
(v)	6 roller bandages 10 cm wide.
(vi)	6 roller bandages 5 cm wide.
(vii)	One tourniquet
(viii)	A supply of suitable splints
(ix)	Three packets of safety pins.
(x)	Kidney tray.
(xi)	3 large sterilized burn dressings.
(xii)	1 (30ml) bottle containing a two percent alcoholic solution of iodine
(xiii)	1 (30 ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label
(xiv)	1 snake bite lancet
(xv)	1 (30gms) bottle of potassium permanganate crystals.
(xvi)	1 pair scissors
(xvii)	1 copy of the First-Aid leaflet issued by the Director General, Factory Advice Service and Labor Institutes, Government of India.
(xviii)	A bottle containing 100 tablets (each of 5 grains) of aspirin
(xix)	Ointment for burns
(xx)	A bottle of suitable surgical anti-septic solution

(b) For establishment in which the number of contract labor exceeds fifty each first-aid box shall contain the following equipment:

(i)	12 small sterilized dressings
(ii)	6 medium size sterilized dressings
(iii)	6 large size sterilized dressings.
(iv)	6 large size sterilized burn dressings
(v)	6 (15 grams) packets sterilized cotton wool
(vi)	12 pieces of sterilized eye pads in separate sealed packets.
(vii)	12 roller bandages 10 cm wide.
(viii)	12 roller bandages 5 cm wide.
(ix)	One tourniquet.
(x)	A supply of suitable splints.
(xi)	Three packets of safety pins.
(xii)	Kidney tray.
(xiii)	Sufficient number of eye washes bottles filled with distilled water or suitable liquid clearly indicated by a distinctive sign which shall be visible at all times.
(xiv)	4 per cent Xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops.
(xv)	1 (60ml) bottle containing a two percent alcoholic solution of iodine
(xvi)	One (two hundred ml) bottle of mercurochrome (2 per cent) solution in water.
(xvii)	1 (120ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label.
(xviii)	1 roll of adhesive plaster (6 cmX1 meter)
(xix)	2 rolls of adhesive plaster (2 cmX1 meter)
(xx)	A snake bite lancet.
(xxi)	1 (30 grams) bottle of potassium permanganate crystals.
(xxii)	1 pair scissors
(xxiii)	1 copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labor Institutes, Government of India.
(xxiv)	a bottle containing 100 tablets (each of 5 grains) of aspirin
(xxv)	Ointment for burns
(xxvi)	A bottle of a suitable surgical anti septic solution.

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



ANNEXURE K

Vertigo Test

Vertigo Test Procedure/ Guidelines

This document specifies minimum requirements for vertigo test. These may be supplemented by any additional requirements deemed fit by the medical examiner/ HSE department)

Fear of height may be physiological or psychological. Therefore, to rule out any possibility of physiological factor, detailed medical check-up of workers is carried out before vertigo test. Medical check-up of workers includes the following:

history of past illnesses (like epilepsy, drug allergy, diabetics/ hypertension, unconsciousness etc.), general physical examination (like height, weight, BMI, build and nourishment etc.), measurement of pulse rate, Blood Pressure, respiratory rate.

After this check-up, those who are found suitable for height work by examining doctor, are allowed to undergo vertigo test.

During this health check-up, psychology of workers is also studied. If any worker finds it extremely difficult/ frightening to climb the monkey ladder & walk on the beam, during/after performing vertigo test or even before performing, then he is treated as disqualified.

As per standard, during vertigo test, worker is allowed to climb on a foundation through monkey ladder, walk on a beam, then steps down at the other end of beam, through monkey ladder. Height of the beam should be at least six feet from ground level. All necessary safety precautions are taken during this test. Worker has to wear full body harness with double lanyard. A horizontal lifeline is run parallel to the beam and worker has to put his lanyards into the lifeline. Additionally, a safety net is also put below the beam for rescue of the victim in case of a fall from beam.

Following activities are suggested to be carried out during testing:**1. Walking Bench Training:**

- a. Person should walk over the channel. He should maintain balance & walk without much problem.
- b. If the person has problem to balances himself on repeated chances, he may be having flat foot or some other problem. So, he may not be fit for height work.

2. Rope Climb Training:

Person should be able to climb the rope up to the top channel for ensuring that in case of fall, a person hanging on the safety harness, will be able to safely climb back to the platform within minimum time period before the safety harness start breaking down under the load.

3. Height Work Training:

Person should walk freely on the middle channel while holding the top channel with the help of safety harness.

4. Ladder for Vertical fall arrestor Training:

Vertical fall arrestor rope is fixed from top to bottom of the ladder. It will ensure:

- Usage of vertical fall arrestor.
- Usage of two lanyards of a safety harness.
- Ensure 3-point contact on the ladder while climb.

5. Chair for work at height Training:

- Climb though vertical ladder with two lanyard ropes.
- Hooking of two lanyard ropes to life line. With this safe arrangement, he can walk to chair.
- Sits in the chair safely, comes out & walks back to the vertical ladder & come down from vertical ladder. After completion of vertigo test, blood pressure of worker is again measured. If it is not within acceptable limits for any worker, concerned worker is denied height pass.

Only those who pass the above training are to be considered as fit for height work.