

TENDER SPECIFICATION BHEL: PSSR: SCT: 1891

FOR

**Construction of Single Steel Flue RCC Chimney of
275M height including all civil (excluding
foundation), electrical and elevator works for Unit 5
at 5x800MW Yadadri Power project, Veerlapalem
village, Dameracherla Mandal, Nalgonda District,
Telangana State**

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

Book- I Consists of

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

Book-II consists of

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

VOLUME – I BOOK – I

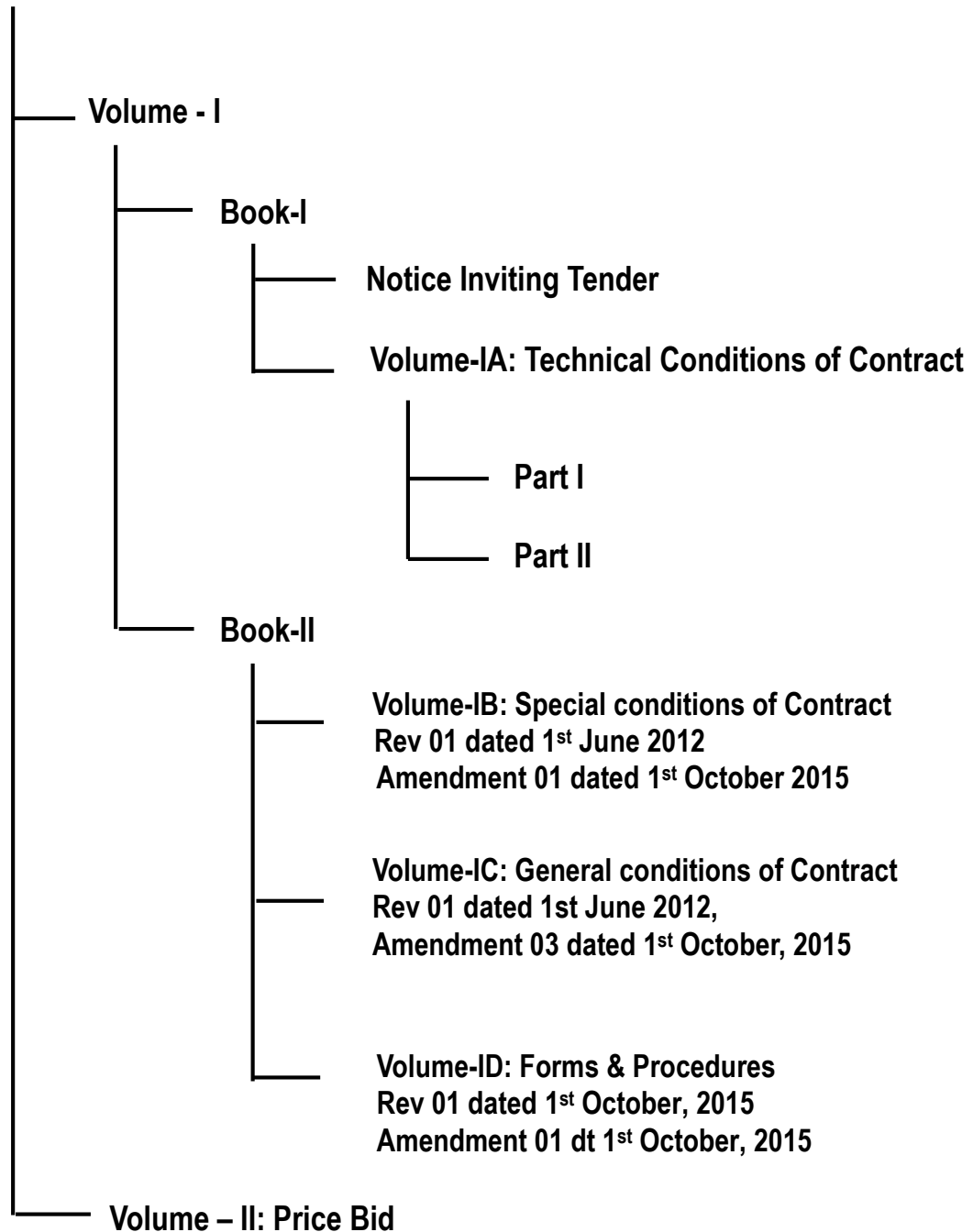


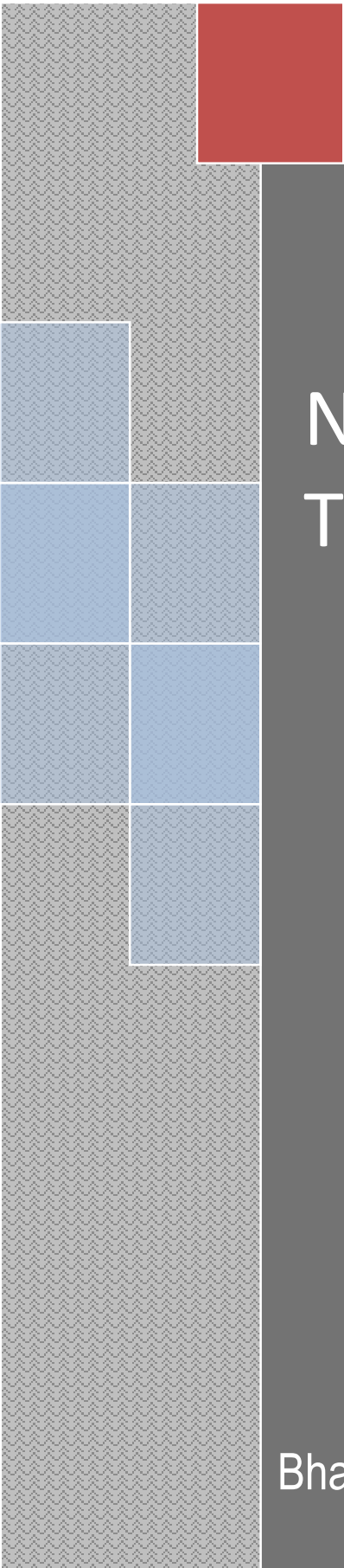
BHARAT HEAVY ELECTRICALS LIMITED

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

TENDER SPECIFICATION CONSISTS OF

Tender Specification





NOTICE INVITING TENDER

Bharat Heavy Electricals Limited



NOTICE INVITING TENDER

Ref: BHEL: PSSR: SCT: 1891

Date: 21 Feb 2020

NOTICE INVITING TENDER (NIT)

Submission only through E-Procurement Portal

<https://bhel.abcprocure.com>

Note: Bidder may download Tender Document from web sites

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To

Dear Sir/Madam

Sub: NOTICE INVITING TENDER

Online Sealed offers in two part bid system (National competitive bidding (NCB)) are invited from reputed & experienced bidders (meeting PRE QUALIFICATION CRITERIA as mentioned in Annexure-I) **through E-Procurement Portal** <https://bhel.abcprocure.com> only, for the subject job by the undersigned on the behalf of BHARAT HEAVY ELECTRICALS LIMITED as per the tender document. Following points relevant to the tender may please be noted and complied with.

1.0 Salient Features of NIT

Sl. No	ISSUE	DESCRIPTION
i)	TENDER NUMBER	BHEL: PSSR: SCT: 1891
ii)	Broad Scope of job	Construction of Single Steel Flue RCC Chimney of 275M height including all civil (excluding foundation), electrical and elevator works for Unit 5 at 5x800MW Yadadri Power project, Veerlapalem village, Dameracherla Mandal, Nalgonda District, Telangana State
iii)	DETAILS OF TENDER DOCUMENT	
A	Volume-IA	Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc
B	Volume-IB	Special conditions of Contract, Rev 01 dated 1st June 2012, Amendment 01 dated October 01, 2015
C	Volume-IC	General conditions of Contract Rev 01 dated 1st June 2012, Amendment 03 dated October 01, 2015
D	Volume-ID	Forms & Procedures Rev 01 dated 1st June 2012 Amendment 01 dated October 01, 2015
E	Volume-II	Price Schedule (Absolute value).

Tender Specification No.: BHEL: PSSR: SCT: 1891

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iv)	Issue of Tender Documents	1. This is an E-tender floated online through our E-Procurement Portal https://bhel.abcprocure.com 2. Sale Start: 22.02.2020 Close: Tender documents can be downloaded till closing time for offer submission. 3. From: BHEL website (www.bhel.com -> Tender Notifications). Tender documents for bidder's reference can be downloaded from this website till due date of submission.	Applicable
v)	Due Date & Time of Offer Submission	Date:07.03.2020, Time :15.00 Hrs The bidder should submit their offer online in e-Procurement portal at https://bhel.abcprocure.com. <u>Bidders are requested to upload their offer well in advance in order to avoid last minute congestion at this website.</u> Hard copy bid or bids through E-mail / fax shall not be accepted.	Applicable
vi)	Opening of Tender	Date: 07.03.2020, Time :15.30 Hrs Notes: (1) In case the due date of opening of tender becomes a non-working day, tenders shall be opened on next working day at the same time. (2) Bidder may record their presence online, during tender opening. However, this being an e-tender it shall be opened online.	Applicable
vii)	EMD Amount	Rs.2,00,000/- (Rupees Two Lakhs only). - Refer Vol-1A Part-II Chapter-1 of Technical Conditions of Contract (Volume-I, Book-I) for mode of payment of EMD. - Exemption of EMD for MSEs is not applicable for this tender. - One time EMD is not applicable for this tender.	Applicable
viii)	Cost of Tender	Rs. 2,000/- (Rupees Two Thousand Only) - Cost of tender shall be remitted through, Electronic Fund Transfer credited in BHEL account or Banker's cheque or Pay order or Demand draft, in favour of BHEL.	Applicable

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		- Exemption of Cost of Tender for MSEs is not applicable for this tender. - Originals shall be sent to "BHEL-PSSR, EVR Periyar Building, 690, Anna Salai, Nandanam, Chennai – 600035'.	
ix)	Last Date For Seeking Clarification	Bidders may submit their queries in https://bhel.abcprocure.com at least 7 days before the due date of offer submission or two days before the scheduled date of pre-bid meeting whichever is earlier along with soft version also, addressing to undersigned & to others as per contact address given above.	Applicable
x)	Schedule of Pre Bid Discussion (PBD)	Date:26.02.2020 Time 11.00AM at BHEL:PSSR:Chennai-35	Applicable
xi)	Integrity Pact & Details of Independent External Monitor (IEM)	a. Integrity Pact (IP) is a tool to ensure that activities and transactions between the company and its Bidders / Contractors are handled in a fair, transparent and corruption free manner. Following Independent External Monitors (IEMs) on the present panel have been appointed by BHEL with the approval of CVC to oversee implementation of IP in BHEL.: 1. Shri. Arun Chandra Verma, IPS(Retd.) Flat No. C-1204, C Tower, Amrapali, Platinum Complex, Sector 119, Noida (U.P.) E Mail: acverma1@gmail.com 2. Shri. Virendra Bahadur Singh, IPS (Retd.), H. No. B-5/64, Vineet Khand, Gomti Nagar, Lucknow-226010 E Mail: vbsinghips@gmail.com b. The IP as per format given at Volume IA Part II of this tender is to be submitted (duly signed by the authorized signatory) along with Techno Commercial Bid (Part-1, in case of two/ three part bid). Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In	Applicable

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		other words, entering into this pact would be a preliminary qualification. c. Please refer section- 8 of the IP (refer the format given at Volume IA Part II of this tender) for Role and Responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to any of the above IEMs. Note: No routine correspondence shall be addressed to the IEM (Phone / Post / E mail) regarding the clarifications, time extensions or any other administrative queries, etc. on the tender issued. All such clarification / issues shall be posted in https://www.bhel.abcprocure.com. Any other queries may be addressed directly to the tender issuing (Procurement) department as mentioned below:	
	Contact Details	For all clarifications /issues related to the tender, please contact: 1. Mr.R. Siva, Dy. Manager/SCT BHEL-PSSR 690 Anna Salai, Nandanam, Chennai-35 044-28286762/+91-9884184574 sivaramesh@bhel.in 2. Ms. Asha Alex, DGM/ SCT BHEL-PSSR 690 Anna Salai, Nandanam, Chennai-35 044-28286714/044-24330209 ashaalex@bhel.in 3. Mr. Sandipan Biswas, AGM/ SCT & Purchase BHEL-PSSR 690 Anna Salai, Nandanam, Chennai-35 044-28286757/044-24348943 bsandipan@bhel.in	
xii	Latest updates	Latest updates on the important dates, Amendments, Correspondences, Corrigenda, Clarifications, Changes, Errata, Modifications, Revisions, etc to	

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		Tender Specifications will be hosted in BHEL webpage (www.bhel.com → Tender Notifications), CPP Portal (https://eprocure.gov.in) & portal https://bhel.abcprocure.com . Bidders to keep themselves updated with all such information. This also form part of tender hence the same shall be enclosed with their offer.	

- 2.0 The offer shall be submitted as per the instructions of tender document and as detailed in this NIT. Bidders to note specifically that all pages of tender document, including these NIT pages of this particular tender together with subsequent correspondences shall be submitted by them, **duly signed & stamped on each page, as part of offer. Rates / Price including discounts / rebates, if any, mentioned anywhere / in any form in the techno-commercial offer other than the Price Bid, shall not be entertained.**
- 3.0 Unless specifically stated otherwise, Bidder shall remit cost of tender through, Electronic Fund Transfer credited in BHEL account or Banker's cheque or Pay order or Demand draft, in favour of BHEL.
- 4.0 Unless specifically stated otherwise, bidder shall deposit **Earnest Money Deposit (EMD) as mentioned in Volume IA, Part-II, Chapter-1** of Technical Conditions of Contract (Volume-I Book-I) under the heading 'Modes of Deposit of EMD'. Please note that 'One Time EMD' shall not be considered. **It is to be noted that proof of remittance for EMD shall be made available at BHEL PSSR Office prior to tender opening.**
- 5.0 **Procedure for Submission of Tenders:** This is an E-tender floated online through our E-Procurement portal <https://bhel.abcprocure.com>. The bidder should respond by submitting their offer online only in our e-Procurement portal at <https://bhel.abcprocure.com>. Hard copy bid or bids through email/ fax shall not be accepted.

I. Pre-requisite for Offer Submission: -

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

MINIMUM REQUIREMENT: (Mandatory)

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

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At first time login, to verify and approve your login profile & DSC, you are requested to contact e-Procurement Service Provider.

Also please Refer “Bidder Manual for BHEL Bidders” and “Minimum System Requirements and Settings Document for BHEL user & Bidders” available at <https://bhel.abcprocure.com> .

II. Digital Signing of e-Tender

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

i) The Requirement:

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

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

III. E-procurement service Provider:-

Address:

e-Procurement Technologies Limited (abcProcure),
Head Office: B-704/705, Wall Street - II, Opp. Orient Club,
Nr. Gujarat College, Ellis Bridge, Ahmedabad - 380 006, Gujarat (India)

Timing:

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

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

The contact details of the service provider are given below:

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

E-Mail: Bhel.Support@abcProcure.com

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

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

IV. Documents Comprising the e-Tender

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

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i) **Technical Tender (UN priced Tender)**

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

- i). Tender Cost and Earnest Money Deposit (EMD) furnished in accordance with **NIT Clause 3.0 & 4.0**.
- ii). All Technical details (eg. Eligibility Criteria requested, Technical Conditions of Contract) should be attached in e-tendering module (**As detailed in Clause 6.0 below**), failing which the tender stands invalid & may be REJECTED.

ii) **Price Bid:**

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

Note:

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

V. DO NOT“S

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

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

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

SI No	Description	Remarks
	Techno-Commercial Bid CONTAINING THE FOLLOWING:-	
i.	Covering letter / Offer forwarding letter of Tenderer.	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
ii.	Duly filled-in 'No Deviation Certificate' as per prescribed format to be placed after document under sl no (i) above. Note: 1. In case of any deviation, the same should be submitted separately for technical & commercial parts, indicating respective clauses of tender against which deviation is taken by bidder. The list of such deviation shall be attached along with document under sl no (i) above. It shall be specifically noted that deviation recorded elsewhere shall not be entertained. 2. BHEL reserves the right to accept / reject the deviations without assigning any reasons, and BHEL decision is final and binding. (i) In case of acceptance of the deviations, appropriate loading shall be done by BHEL (ii) In case of unacceptable deviations, BHEL reserves the right to reject the tender.	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
iii.	Supporting documents / annexure / schedules / drawing etc as required in line with Pre-Qualification criteria. (Technical & Financial)	Refer "Bidder Manual for BHEL Bidders" available at

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	As detailed in Clause No. 25 of NIT, It shall be specifically noted that all documents as per above shall be indexed properly and credential certificates issued by clients shall distinctly bear the name of organization, contact phone no, FAX no, E-mail ID, etc.	https://bhel.abcprocure.com
iv.	All Amendments / Correspondences / Corrigenda / Clarifications / Changes / Errata etc pertinent to this NIT.	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
v.	Integrity Pact Agreement (Duly signed by the authorized signatory)	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
vi.	Duly filled-in annexures, formats etc as required under this Tender Specification / NIT	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
vii.	Notice inviting Tender (NIT)	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
viii.	Volume – I A : Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
ix.	Volume – I B : Special Conditions of Contract (SCC)	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com
x.	Volume – I C : General Conditions of Contract (GCC)	
xi.	Volume – I D : Forms & Procedures	
xii.	Volume – II (UNPRICED – without disclosing rates/price, but mentioning only 'QUOTED' or 'UNQUOTED' against each item	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcprocure.com

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xiii.	Any other details preferred by bidder with proper indexing.	Refer "Bidder Manual for BHEL Bidders" available at https://bhel.abcpurchase.com

Caution to Bidders: -

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

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

SPECIAL NOTE:

- i. All documents / annexures submitted with the **offer shall be properly attached / entered / uploaded in the respective sections**. BHEL shall not be responsible for any missing documents.
- ii. **Your offer & documents submitted along with offer shall be signed & stamped in each page by your authorized representative.**

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

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

9.0 ASSESSMENT OF CAPACITY OF BIDDERS:

Bidder's capacity for executing the job under tender shall be assessed

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‘LOAD’ wise and ‘PERFORMANCE’ wise as per the following:

I. LOAD: Load takes into consideration ALL the contracts of the Bidder under execution with BHEL Regions, irrespective of whether they are similar to the tendered scope or not. The cut off month for reckoning ‘Load’ shall be the 3rd month preceding the month corresponding to the ‘latest date of bid submission’, in the following manner –

(Note: For example, if latest bid submission is in Jan 2017, then the ‘load’ shall be calculated up to and inclusive of Oct 2016)

Total number of Packages in hand = Load (P)

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

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

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

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

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

a) $P_1, P_2, P_3, P_4, P_5, \dots, P_N$ etc. be the packages (under execution / executed during the ‘Period of Assessment’ in all Regions of BHEL)

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SIMILAR to the packages covered under the tendered scope, excepting packages not commenced. Total number of similar packages for all Regions = P_T (i.e. $P_T = P_1 + P_2 + P_3 + P_4 + \dots + P_N$)

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

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

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

Aggregate of Performance scores for all similar packages in all the Regions

= -----

Aggregate of months for each of the similar packages for which performance should have been evaluated in all the Regions.

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

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

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

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Sl no	Item Description	Details for all Regions							Total
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
1	Similar Packages for all Regions → (under execution/ executed during period of assessment)	P ₁	P ₂	P ₃	P ₄	P ₅	...	P _N	Total No of similar packages for all Regions = P_T ie Sum (Σ) of columns (iii) to (ix)
2	Number of Months for which 'Monthly Performance Evaluation' as per relevant formats should have been done in the 'period of assessment for corresponding similar Package (as in row 1)	T ₁	T ₂	T ₃	T ₄	T ₅	...	T _N	Sum (Σ) of columns (iii) to (ix) = T_T
3	Monthly performance scores for the corresponding period (as in Row 2)	S ₁₋₁ , S ₁₋₂ , S ₁₋₃ , S ₁₋₄ , ... S _{1-T1}	S ₂₋₁ , S ₂₋₂ , S ₂₋₃ , S ₂₋₄ , ...	S ₃₋₁ , S ₃₋₂ , S ₃₋₃ , S ₃₋₄ , ...	S ₄₋₁ , S ₄₋₂ , S ₄₋₃ , S ₄₋₄ , ...	S ₅₋₁ , S ₅₋₂ , S ₅₋₃ , S ₅₋₄, ...	.. ... ...	S _{N-1} , S _{N-2} , S _{N-3} , S _{N-4} , ...	-----
4	Sum of Monthly Performance scores of the corresponding Package for the corresponding period (as in row-3)	S ₁	S ₂	S ₃	S ₄	S ₅	...	S _N	Sum (Σ) of columns (iii) to (ix) = S_T

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

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

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

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

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

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

III. Assessment of Capacity of Bidder':

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

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

Note:

- i. In case the value of P_{Max} results in a fraction, the value of P_{Max} is to be rounded off to next whole number
- ii. For $R_{BHEL} = 60$, $P_{Max} = '1'$
- iii. For $R_{BHEL} \geq 80$, there will be no upper limit on P_{Max}

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

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

Note: For the transition period of 1 year (i.e. for all the NITs floated between 11th May 2019 to 10th May 2020), in addition to above, 'Assessment of Capacity of Bidder' shall also be calculated considering 'performance scores' till 36 months

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as per Sl. no II ii). Higher of the results obtained out of both shall be considered for 'Assessment of Capacity of Bidder'.

IV. Explanatory note:

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

ii). Identified Packages (Unit wise)

Table-1

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

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

A ‘NEW VENDOR’ shall be considered qualified subject to satisfying all other tender conditions

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

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

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

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

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

a) All the bidders having Overall Performance Rating (R_{BHEL}) ≥ 60 shall be considered qualified against criteria of ‘Assessment of Capacity of Bidders’.

b) If even after using option “a”, the number of qualified bidders remains less than four, then in addition to bidders considered as per option “a”, “First timer” bidders having average of available performance scores ≥ 60 upto and including the Cut Off month shall also be considered qualified against criteria of ‘Assessment of Capacity of Bidders’.

c) If even after using option “a” and “b”, the number of qualified bidders remains less than four, then in addition to bidders considered as per

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option “a” and “b”, “First timer” bidders for whom no performance score is available in the system upto and including the Cut Off month, shall also be considered qualified against criteria of ‘Assessment of Capacity of Bidders’.

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

- v). ‘Under execution’ shall mean works in progress as per the following:
- a. Up to execution of 90% of anticipated Contract Value in case of Civil, MM, Structural and Turbo Blower Packages
 - b. Up to Steam Blowing in case of Boiler/ESP/Piping Packages
 - c. Up to Synchronization in all Balance Packages

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

- vi). Contractor shall provide the latest contact details i.e. mail-ID and Correspondence Address to SCT Department, so that same can be entered in the Contractor Performance Evaluation System, and in case of any change/discrepancy same shall be informed immediately. Login Details for viewing scores in Contractor Performance Evaluation System shall be provided to the Contractor by SCT Department.
- vii). Performance Evaluation for Activity Month shall be completed in Evaluation Month (i.e. month next to Activity Month) or in rare cases in Post Evaluation Month (i.e. month next to Evaluation Month) after approval from Competent Authority. In case scores are not acceptable, Contractor can submit Review Request to GM Site / GM Project latest by 25th of Evaluation Month or 3 days after approval of score, whichever is later. However, acceptance / rejection of ‘Review Request’ solely depends on the discretion of GM Site / GM Project. After acceptance of

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Review Request, evaluation score shall be reviewed at site and the score after completion of review process shall be acceptable and binding on the contractor.

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

- a. **Short hold:** Evaluation shall not be applicable for this period; however, loading will be considered.
- b. **Long hold:** Short hold for continuous six months and beyond or hold on account of Force Majeure shall be considered as Long Hold. Evaluation as well as Loading shall not be considered for this period.

- 10.0** Performance evaluation in Clause 9 above is applicable to Prime bidder and consortium partner (or Technical tie up partner) for their respective scope of work.
- 11.0** Since the job shall be executed at site, bidders must visit site/ work area and study the job content, facilities available, availability of materials, prevailing site conditions including law & order situation, applicable wage structure, wage rules, etc before quoting for this tender. They may also consult this office before submitting their offers, for any clarifications regarding scope of work, facilities available at sites or on terms and conditions.
- 12.0** For any clarification on the tender document, the bidder may seek the same in clarification provision available in procurement portal <https://bhel.abcprocure.com> or writing or through e-mail, as per specified format, within the scheduled date for seeking clarification, from the office of the undersigned. BHEL shall not be responsible for receipt of queries after due date of seeking clarification due to postal delay or any other delays. Any clarification / query received after last date for seeking clarification may not be normally entertained by BHEL and no time extension will be given.
- 13.0** BHEL may decide holding pre-bid discussion [PBD] with all intending bidders as per date indicated in the NIT. The bidder shall ensure participation for the same at the appointed time, date and place as may be decided by BHEL. Bidders shall plan their visit accordingly. The outcome of pre-bid discussion (PBD) shall also form part of tender.
- 14.0** In the event of any conflict between requirement of any clause of this specification / documents / drawings / data sheets etc or requirements of different codes / standards specified, the same to be brought to the knowledge of BHEL in writing for clarification before due date of seeking clarification (whichever is applicable), otherwise, interpretation by BHEL shall prevail. Any typing error/missing pages / other clerical errors in the tender documents,

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- noticed must be pointed out before pre-bid meeting / submission of offer, else BHEL's interpretation shall prevail.
- 15.0** Unless specifically mentioned otherwise, bidder's quoted price shall deem to be in compliance with tender including PBD.
- 16.0** Bidders shall submit Integrity Pact Agreement, (Duly signed by authorized signatory who signs in the offer), along with techno-commercial bid. This pact shall be considered as a preliminary qualification for further participation. **The Integrity pact is to be submitted by Prime Bidder & Consortium / Technical Tie up partner jointly in case Consortium bidding is permitted, otherwise by the sole bidder. The names and other details of Independent External Monitor (IEM) for the subject tender is as given at point (1) above.**
- 17.0** The Bidder has to satisfy the Pre-Qualifying Requirements stipulated for this Tender in order to be qualified. The Price Bids of only those bidders will be opened who will be qualified for the subject job on the basis of satisfying the pre-qualification criteria specified in this NIT as per Annexure-1(as applicable) past performance etc. and date of opening of price bids shall be intimated to only such bidders. BHEL reserves the right NOT to consider offers of parties under HOLD.
- 18.0** In case BHEL decides on a 'Public Opening', the date & time of opening of the sealed PRICE BID shall be intimated to the qualified bidders and in such a case, bidder may depute one authorized representative to witness the price bid opening. BHEL reserves the right to open 'in-camera' the 'PRICE BID' of any or all Unsuccessful / Disqualified bidders under intimation to the respective bidders.
- 19.0** Validity of the offer shall be for **six months** from the latest due date of offer submission (including extension, if any) unless specified otherwise.
- 20.0** Void
- 21.0** On submission of offer, further consideration will be subject to compliance to tender & qualifying requirement and customer's acceptance, as applicable.
- 22.0** In case the bidder is an "Indian Agent of Foreign Principals", 'Agency agreement has to be submitted along with Bid, detailing the role of the agent along with the terms of payment for agency commission in INR, along with supporting documents.
- 23.0** The bidders shall not enter into any undisclosed M.O.U. or any understanding amongst themselves with respect to tender.
- 24.0** Void
- 25.0** The bidder shall submit documents in support of possession of 'Qualifying Requirements' duly self-certified and stamped by the authorized signatory,

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indexed and properly linked in the format for PQR. In case BHEL requires any other documents / proofs, these shall be submitted immediately.

- 26.0** The bidder may have to produce original document for verification if so decided by BHEL.
- 27.0** The offers of the bidders who are under suspension as also the offer of the bidders, who engage the services of the banned firms, shall be rejected. The list of banned firms is available on BHEL web site "www.bhel.com → tender notification".
- 28.0** It may be noted that guidelines / rules in respect of 'Suspension of Business dealings' available on BHEL web site "www.bhel.com → **Supplier Registration**", 'Vendor evaluation format', Quality, Safety & HSE guidelines', etc may undergo change from time to time and the latest one shall be followed.
- 29.0** The Bidder along with its associate/ collaborators/ sub-contractors/ sub-vendors/ consultants/ service providers shall strictly adhere to BHEL Fraud Prevention Policy displayed on BHEL website <http://www.bhel.com> and shall immediately bring to the notice of BHEL Management about any fraud or suspected fraud as soon as it comes to their notice.
- 30.0** Bid should be free from correction, overwriting, using corrective fluid, etc. Any interlineation, cutting, erasure or overwriting shall be valid only if they are attested under full signature(s) of person(s) signing the bid else bid shall be liable for rejection. All overwriting/cutting, etc., will be numbered by bid opening officials and announced during bid opening.
- 31.0** Integrity commitment, performance of the contract and punitive action thereof:
- 31.1 Commitment by BHEL:
BHEL commits to take all measures necessary to prevent corruption in connection with the tender process and execution of the contract. BHEL will during the tender process treat all Bidder(s) in a transparent and fair manner, and with equity.
- 31.2 Commitment by Bidder / Supplier / Contractor:
- 31.2.1 The bidder / supplier / contractor commit to take all measures to prevent corruption and will not directly or indirectly influence any decision or benefit which he is not legally entitled to nor will act or omit in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1891 or any other law in force in India.
- 31.2.2 The bidder / supplier / contractor will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to

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make to agents, brokers or any other intermediaries in connection with the award of the contract and shall adhere to relevant guidelines issued from time to time by Govt. of India/ BHEL.

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

If any bidder / supplier / contractor during pre-tendering / tendering / post tendering / award / execution / post-execution stage indulges in mal-practices, cheating, bribery, fraud or and other misconduct or formation of cartel so as to influence the bidding process or influence the price or acts or omits in any manner which tantamount to an offence punishable under any provision of the Indian Penal Code, 1891 or any other law in force in India, then, action may be taken against such bidder / supplier / contractor as per extant guidelines of the company available on www.bhel.com and / or under applicable legal provisions.

- 32.0** For this procurement, Public Procurement (Preference to Make in India), Order 2017 dated 15.06.2017 & 28.05.2018 and subsequent Orders issued by the respective Nodal Ministry shall be applicable even if issued after issue of this NIT but before finalization of contract/ PO/ WO against this NIT.

In the event of any Nodal Ministry prescribing higher or lower percentage of purchase preference and/ or local content in respect of this procurement, same shall be applicable.

- 33.0** In the course of evaluation, if more than one bidder happens to occupy L-1 status, effective L-1 will be decided by soliciting discounts from the respective L-1 bidders.

In case more than one bidder happens to occupy the L-1 status even after soliciting discounts, the L-1 bidder shall be decided by a toss/ draw of lots, in the presence of the respective L-1 bidder(s) or their representative(s).

Ranking will be done accordingly. BHEL's decision in such situations shall be final and binding.

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34.0 Order of Precedence:

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

- a. Amendments / Clarifications / Corrigenda / Errata etc. issued in respect of the tender documents by BHEL
- b. Notice Inviting Tender (NIT)
- c. Price Bid
- d. Technical Conditions of Contract (TCC)—Volume-1A
- e. Special Conditions of Contract (SCC) —Volume-1B
Rev. 01 Dt. 01 Jun 2012; Amendment: 01 Dt. 1st October 2015
- f. General Conditions of Contract (GCC) —Volume-1C
Rev. 01 Dt. 01 Jun 2012; Amendment: 03 Dt. 1st October 2015
- g. Forms and Procedures —Volume-1D
Rev. 01 Dt. 01 Jun 2012; Amendment: 01 Dt. 1st October 2015

For and on behalf of BHARAT HEAVY ELECTRICALS LTD

Additional General Manager / SCT & Purchase

Enclosure

1. Annexure-1: Pre Qualifying criteria.
2. Annexure-2: Check List.
3. Annexure-3 Technical Pre qualifying criteria.
4. Annexure-4 Annexure to Pre-Qualifying Criteria.
5. Annexure-5 Tender Schedule.
6. Other documents as per this NIT.

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ANNEXURE - 1 **PRE QUALIFYING CRITERIA**

JOB	Construction of Single Steel Flue RCC Chimney of 275M height including all civil (excluding foundation), electrical and elevator works for Unit 5 at 5x800MW Yadadri Power project, Veerlapalem village, Dameracherla Mandal, Nalgonda District, Telangana State		
Tender No.	BHEL: PSSR: SCT: 1891		
Sl. No.	PRE QUALIFICATION CRITERIA	Bidders claim in respect of fulfilling the PQR Criteria	
		Name and Description of qualifying criteria	Page no of supporting document. Bidder must fill up this column as per applicability
A	Submission of Integrity Pact duly signed (if applicable) (Note: To be submitted by Prime Bidder & Consortium / Technical Tie up partner jointly in case Consortium bidding is permitted, otherwise by the sole bidder)	Applicable	
B	<u>Technical</u>		
	Refer Annexure 3	Applicable	To be filled in Annexure-4
C C-1	<u>FINANCIAL Turnover</u> Bidders must have achieved an average annual financial turnover (Audited) of Rs.7,49,00,000/- (Rupees Seven Crores Forty-Nine Lakhs only) or more over last three Financial Years (FY) i.e., 2016-17, 2017-18 and 2018-19.	Applicable	To be filled in Annexure-4
C-2	Net worth (only in case of Companies) Net worth of the Bidder based on the latest Audited Accounts as furnished for 'C-1' above should be positive	Applicable	To be filled in Annexure-4

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C-3	Profit Bidder must have earned profit in any one of the three Financial Years as applicable in the last three Financial Years as furnished for 'C-1 above.	Applicable	To be filled in Annexure-4
C-4	Bidder must not be under Bankruptcy Code Proceedings (IBC) by NCLT or under Liquidation / BIFR, which will render him ineligible for participation in this tender, and shall submit undertaking to this effect.	Applicable	To be filled in Annexure-4
D	Assessment of Capacity of Bidder to execute the work as per Sl. No 9 of NIT (if applicable)	Applicable	By BHEL
E	Approval of Customer (if applicable) Note: Names of bidders who stand qualified after compliance of criteria A to D shall be forwarded to customer for their approval.	Applicable	
F	Price Bid Opening Note: Price Bids of only those bidders shall be opened who stand qualified after compliance of criteria A to E	Applicable	BY BHEL
G	Consortium criteria (if applicable)	Not Applicable	
<u>Explanatory Notes for the PQR (unless otherwise specified in the PQR):</u> 1. Bidder to submit Audited Balance Sheet and Profit and Loss Account for the respective years as indicated against C-1 above along with all annexures. 2. In case audited financial statements have not been submitted for all the three years as indicated against C-1 above, then the applicable audited statements submitted by the bidders against the requisite three years, will be averaged for three years. 3. If Financial Statements are not required to be audited statutorily, then instead of audited financial statements, financial statements are required to be certified by Chartered Accountant. 4. C-2:-NETWORTH: Shall be calculated based on the latest Audited Accounts as furnished for C-1 above. Net worth =Paid up share capital* + reserves (* Share capital OR Partnership Capital OR Proprietor Capital as the case may be) (Net worth is required to be evaluated in case of companies). 5. C-3:- PROFIT : shall be PBT earned during any one year of the three financial years as in C-1 above			

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	6. For Evaluation of PQR, the credential of the Bidder alone, and not that of the Group Company shall be considered. 7. Completion date for achievement of the technical criteria specified in the Common QR should be in the last 7 years ending on the 'latest date of Bid Submission' of Tender irrespective of date of the start of work. 8. Boiler means HRSG or WHRB or any other types of Steam Generator 9. Power Cycle piping means Main Steam, Hot Reheat, Cold Reheat, HP Bypass. 10. For the purpose of evaluation of the PQR, one MW shall be considered equivalent to 3.5TPH where ever rating of HRSG/BOILER is mentioned in MW. Similarly, where ever rating of Gas Turbine is mentioned in terms of Frame size, ISO rating in terms of MW shall be considered for evaluation. 11. In case the experience/PO/WO certificate enclosed by bidders do not have separate break up prices for the E&C portion of Electrical and CI Works, (i.e. the certificates enclosed are for composite order for supply and erection of Electrical & CI and other works if any), then value of Erection and Commissioning for the Electrical & CI portion shall be considered as 15% of the supply & erection of Electrical & CI. 12. Scope for capital overhaul of STG shall cover Bearing Inspection work and overhauling of all cylinders of the Turbine. 13. In case the tendered scope is not a Pulverized Fuel Bidder, experience of Oil/Gas Fired Boilers can be considered unless otherwise specifically indicated in the PQR. 14. No consortium bid is allowed for this Tender. However, for the purpose of qualification, after successful execution of one similar work with a consortium partner under direct orders from BHEL, the prime bidder shall be eligible for becoming a standalone bidder for works similar to that for which consortium partner was engaged, for subsequent tenders.

Note:

- (i) BIDDER SHALL SUBMIT PRE-QUALIFICATION CRITERIA FORMAT (Refer Annexure-4), DULY FILLED-IN, SPECIFYING RESPECTIVE ANNEXURE NUMBER AGAINST EACH CRITERIA AND FURNISH RELEVANT DOCUMENT INCLUSIVE OF WORK ORDER AND WORK COMPLETION CERTIFICATE ETC. IN THE RESPECTIVE ANNEXURES IN THEIR OFFER.
- (ii) **Authenticity of Credentials submitted by the Bidder against 'Pre-Qualifying Criteria' shall be verified from the Issuing Authority, by BHEL. In case, any credential(s) is/are found to be unauthentic, offer of the bidder is liable to be rejected. BHEL reserves the Right to Initiate any further action as per the "Guidelines for Suspension of Business Dealings with Suppliers/Contractors" (Published in http://www.bhel.com/vender_registration/vender.php) and "Fraud Prevention Policy" (Published in <http://www.bhel.com/home.php>) as applicable.**

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ANNEXURE - 2

CHECK LIST

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

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

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9	Whether all pages of the Offer Documents are signed by the person authorized to sign this offer	Applicable	Yes/ No
10	Whether all pages of the Tender documents including annexures, appendices etc are read understood and signed	Applicable	Yes/ No
11	Submission of Integrity Pact	Applicable	Yes/ No
12	Submission of Declaration by Authorized Signatory	Applicable	Yes/ No
13	Submission of No Deviation Certificate	Applicable	Yes/ No
14	Submission of Declaration confirming knowledge about Site Conditions	Applicable	Yes/ No
15	Submission of Declaration for relation in BHEL	Applicable	Yes/ No
16	Submission of Non-Disclosure Certificate	Applicable	Yes/ No
17	Submission of Copy Bank Account Details for E-Payment	Applicable	Yes/ No
18	Submission of Capacity Evaluation of Bidder for current Tender	Applicable	Yes/ No
19	Submission of Tie Ups / Consortium Agreement as per format	Not Applicable	
20	Submission of Power of Attorney for Submission of Tender / Signing Contract Agreement	Applicable	Yes/ No
21	Submission of Analysis of Unit rates	Applicable	Yes/ No
22	Submission of Unquoted Price Bid	Applicable	Yes/ No
23	Tabular column showing Category- wise, month wise, man power deployment sub package wise planned for the execution of the scope of works.	Applicable	Yes/ No
24	Declaration by bidder for price opening through Reverse Auction (Refer Annexure-6 of Notice Inviting Tender)	Not Applicable	
25	Copy of Organization Chart	Applicable	Yes/ No
26	Copy of Registration / Incorporation certificate, Partnership Deed (Certified by Notary Public) as applicable for firm.	Applicable	Yes/ No
27	Undertaking as per Financial C 4 Criteria of Annexure 1 of NIT regarding Bankruptcy Code Proceedings (IBC)	Applicable	Yes/ No

NOTE:

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

DATE:

AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

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Annexure-3

B Technical Pre-Qualification Criteria

B.1. Technical Qualification Criteria

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

B.1.1 One (1) work of value not less than **Rs. 19.96 Crores**

(OR)

B.1.2 Two (2) works each of value not less than **Rs.12.48 Crores**

(OR)

B.1.3 Three (3) works each of value not less than **Rs.9.98 Crores**

(AND)

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

Executed at least 165m height of shell of one RCC Chimney of any height of 165m or above in any one of running/completed contract.

(OR)

Executed at least 110m height of shell of one RCC NDCT (Natural draught cooling tower) of any height of 110m or above in any one of running/ completed contract.

Note: -

- I. 'Similar Works' in the QR B.1 means Piling or Civil or Structure or 'Civil and Structural works' or RCC Chimney or RCC Cooling Tower or RCC Silo or Mill Bunker or any combination of these.
- II. The term 'Executed' in the above QR (B.1 & B.2) means; the bidder should have achieved the criteria specified in QR even if the contract has not been completed or closed.
- III. Value of work in 'B.1' is to be updated with indices for "All India Avg. Consumer Price index for industrial workers" and "Monthly Whole Sale Price Index for All Commodities" with base month as per last month of work execution and indexed up to three (3) months prior to the month of latest due date of bid submission. as per following formula-

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

Where

P = Updated value of work

R = Value of executed work

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

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

Y_N = Monthly Whole Sale Price Index for All Commodities for the month, three months prior to the month of latest due date of bid submission (e.g. If latest bid submission date is 03-Apr-17, then bid submission month shall be reckoned as April'17 and index for Jan'17 shall be considered).

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

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

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ANNEXURE - 4

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

Name of the Bidder: M/s.....

Sl. No.	PQR Ref	PQR (Reproduced from Annexure – 1)	Qualifying Experience	Work order Ref with page no in Offer for supporting documents	Completion certificate ref for the referred Work with page no in Offer for supporting documents	Details of work with Project, Unit, Quantity / rating & Period	Remarks
1	<u>Technical B:</u>	<u>B.1. Technical Qualification Criteria</u> Bidder should have executed "Similar works" for any one of the following in the last seven years preceding the latest due date of bid submission B.1.1 One (1) work of value not less than <u>Rs. 19.96 Crores</u> (OR) B.1.2 Two (2) works each of value not less than <u>Rs.12.48 Crores</u> (OR)					

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		B.1.3 Three (3) works each of value not less than <u>Rs.9.98 Crores</u> (AND) <u>B.2.</u> Bidder should have executed the following in the last seven years preceding the latest due date of bid submission. Executed at least 165m height of shell of one RCC Chimney of any height of 165m or above in any one of running/completed contract. (OR) Executed at least 110m height of shell of one RCC NDCT (Natural draught cooling tower) of any height of 110m or above in any one of running/ completed contract.					

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2	Financial C1	TURNOVER Bidders must have achieved an average annual financial turnover (Audited) of Rs.7,49,00,000/- (Rupees Seven Crores Forty-Nine Lakhs only) or more over last three Financial Years (FY) i.e. 2016-17, 2017-18 and 2018-19.					
3	Financial C2	NETWORTH (only in case of Companies) Net worth of the Bidder based on the latest Audited Accounts as furnished for 'C-1' above should be positive					
4	Financial C3	PROFIT Bidder must have earned profit in any one of the three Financial Years as applicable in the last three Financial Years as furnished for 'C-1' above.					
5	Financial C 4	Bidder must not be under Bankruptcy Code Proceedings (IBC) by NCLT or under Liquidation / BIFR, which will render him ineligible for participation in this tender, and shall submit undertaking to this effect.					

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

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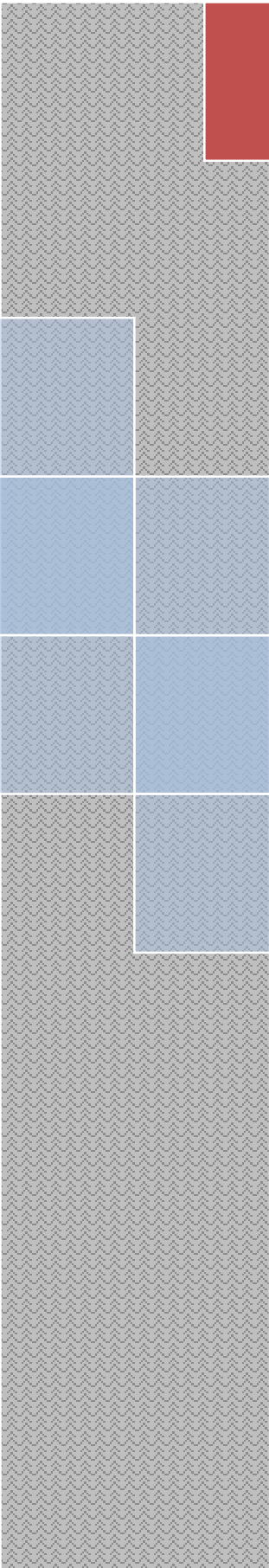
ANNEXURE-5

Tender Schedule

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

Note:

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



VOLUME – IA Part I & II

TECHNICAL CONDITIONS OF CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED



TECHNICAL CONDITIONS OF CONTRACT (TCC)

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VOLUME - IA PART – I CHAPTER – I

1.1 PROJECT INFORMATION INTRODUCTION

5 x 800 MW Yadadri Thermal power station is being set up by **TELANGANA STATE GENERATION CORPORATION** at a site in Veerlapalem village, Dameracherla Mandal, NALGONDA DISTRICT, TELANGANA STATE, India. The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on BHEL/Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

A. PROJECT INFORMATION

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

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

VOLUME-IA PART-I CHAPTER – II

1.2 SCOPE OF WORKS

- 1.2.1 The scope covers Construction of single steel flue Concrete Chimney of 275M height including all civil (excluding foundation work), structural, insulation, installation of borosilicate lining works, painting, electrical and elevator works of Unit-5 of 5X800 MW Yadadri Thermal Power Project site, including supply of all materials, labour, tools and plants. **(Cement & Reinforcement steel for civil works, Structural steel for structural works and borosilicate glass blocks for borosilicate lining system shall be provided by BHEL free of cost only for incorporation in the permanent work of the subject tender. Note: Structural steel required for embedments/ inserts will not be provided by BHEL)**. The scope of work is indicative but not limited to the given below.
- 1.2.2 Note: Any other building / structure / foundation not mentioned above, but **required for completion of the package in total, deemed to have been included in the bidder scope under this contract.** Such work will be executed under this contract by bidder as per the direction of Engineer in charge. If any item of work not available in the rate schedule of this contract, the rate will be fixed in line with clause 2.15.7 of GCC.
- 1.2.3 The works to be performed under this contract consist of providing all labour, supervision, material, scaffolding, construction equipment's, tools and plants, temporary works, supplies including POL (fuel, oil & lubricant), transportation and all incidental items not shown or specified but reasonably implied or necessary for the proper completion of work in all respects. Testing of all materials, concrete, earthwork other allied works, preparation of bar bending schedules on the basis of construction drawings, preparation of fabrication drawings etc. are included on the rates of items of work. Works shall only be carried out with approved structural fabrication drawings.
- 1.2.4 The area of work shall be cleared of all vegetation, rubbish and other objectionable Matter and materials removed shall be burnt or otherwise disposed of as directed by The Engineer-in-Charge. 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.

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- 1.2.5 All the works areas shall be adequately flood lighted to the satisfaction of the Engineer-in-Charge when the work is in progress during the night shifts.
- 1.2.6 The unit rates shall include all material equipment, fixtures, labour construction plant, temporary works and everything whether of permanent or temporary nature necessary for the completion of job in all respects.
- 1.2.7 The unit rates for various items shall include all the stipulations mentioned in technical specifications for the particular B.O.Q. item and nothing extra over B.O.Q rates shall be payable.
- 1.2.8 Drawings showing enough details for the construction as per the specification shall be furnished to the contractor in a phased manner.
- 1.2.9 The bidder should fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, local conditions, soil strata and site specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may have not been specifically brought out in the specifications.

FOR FURTHER DETAILED SCOPE OF WORKS REFER RELEVANT CHAPTERS IN THIS BOOK – TECHNICAL SPECIFICATION.

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VOLUME IA PART – I CHAPTER – III

1.3 FACILITIES & CONSUMABLES IN THE SCOPE OF CONTRACTOR / BHEL (SCOPE MATRIX)

Sl.No	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
1.3.1	ESTABLISHMENT			
1.3.1.1	FOR CONSTRUCTION PURPOSE:			
1.3.1.1.1	Open space for office	Yes		Free of charges as provided by TSGENCO
1.3.1.1.2	Open space for storage	Yes		
1.3.1.1.3	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	At bidder's own cost
1.3.1.1.4	Bidder's all office equipment's, office / store / canteen consumables		Yes	At bidder's own cost
1.3.1.1.5	Canteen facilities for the bidder's staff, supervisors and engineers etc.		Yes	At bidder's own cost
1.3.1.1.6	Firefighting equipment's like buckets, extinguishers etc.		Yes	At bidder's own cost
1.3.1.1.7	Fencing of storage area, office, canteen etc. of the bidder		Yes	At bidder's own cost
1.3.1.2	FOR LIVING PURPOSES OF THE BIDDER			
1.3.1.2.1	Open space	Yes		Free of charges as provided by TSGENCO
1.3.1.2.2	Living accommodation		Yes	At bidder's own cost
1.3.1.3	ELECTRICITY			
1.3.1.3.1	Electricity For construction purposes	Yes		Free of charges as provided by TSGENCO
1.3.1.3.1a	Single point source (In general). For detail, refer clause 1.3.3.1	Yes		

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Sl.No	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
1.3.1.3.1b	Further distribution for the work to be done which include supply of materials and execution		Yes	At bidder's own cost
1.3.1.3.2	Electricity for the office, stores, canteen etc of the bidder which include:		Yes	At bidder's own cost
1.3.1.3.2a	Distribution from single point including supply of materials and service		Yes	At bidder's own cost
1.3.1.3.2b	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	At bidder's own cost
1.3.1.3.2c	Duties and deposits including statutory clearances for the above		Yes	At bidder's own cost
1.3.1.3.3	Demobilization of the facilities after completion of works		Yes	At bidder's own cost
1.3.1.3.4	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc on the above lines. (in case BHEL provides this facility, the scope should be given without ambiguity)		Yes	At bidder's own cost
1.3.1.4	WATER SUPPLY			
1.3.1.4.1	For construction purposes:	Yes		Free of charges as provided by TSGENCO
1.3.1.4.2	Making the water available at single point	Yes		Free of
1.3.1.4.3	Further distribution as per the requirement of work including supply of materials and execution		Yes	charges as provided by TSGENCO At bidder's own cost
1.3.1.4.4	Water supply for bidder's office, stores, canteen etc.			
1.3.1.4.5	Making the water available at single point		Yes	At bidder's own cost

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Sl.No	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
1.3.1.4.6	Further distribution as per the requirement of work including supply of materials and execution		Yes	At bidder's own cost
1.3.1.5	LIGHTING			
1.3.1.5.1	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
1.3.1.5.2	For construction work (Execution of the lighting work / arrangements) At office storage area At the preassembly area At the construction site / area		Yes	At bidder's own cost
1.3.1.6	COMMUNICATION FACILITIES for site operations of the bidder	-		
	Telephone, Fax, internet, intranet, email etc		Yes	At bidder's own cost

Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
	PART II			
	CONSTRUCTION FACILITIES			
1.3.2.1.0	Engineering works for construction			
1.3.2.1.1	Providing the construction drawings for all the equipment covered under this scope	Yes		
1.3.2.1.2	Drawings for construction methods		Yes	In consultation with BHEL
1.3.2.1.3	As-built drawings – wherever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes	Yes	Yes	”

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Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
	PART II			
1.3.2.1.4	Shipping lists etc for reference and planning the activities	Yes	Yes	"
1.3.2.1.5	Preparation of site construction schedules and other input requirements		Yes	In consultation with BHEL, As per requirement of BHEL targets
1.3.2.1.6	Review of performance (Form-14) and revision of site construction schedules in order to achieve the end dates and other commitments		Yes	
1.3.2.1.7	Weekly construction schedules based on SI No 1.3.2.1.5		Yes	
1.3.2.1.8	Daily construction / work plan based on SI No 1.3. 2.1.7		Yes	For daily monitoring meeting at site
1.3.2.1.9	Periodic visit of the senior official of the bidder to site to review the progress so that works is completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two months.		Yes	At bidder's own cost
1.3.2.1.10	Preparation of preassembly bay		Yes	At bidder's own cost
1.3.2.1.11	Laying of racks for gantry crane if provided by BHEL or brought by the contractor / bidder himself			Not applicable

1.3.2 OPEN SPACE:

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

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fabrication, batching plant, 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 the lands (as received from BHEL during various stages of construction) after completion of tendered work.

- 1.3.2.2 Land for labour colony shall be provided by BHEL approximately nearer to site (outside plant premises) free of charges as provided by TSGENCO. The contractor to construct labour colony/ hutment as per the technical specification No.PSSR/PMX/CVL/Labour colony/01, Rev-00 enclosed along with this tender at his own cost. The contractor shall provide adequate water arrangement for drinking/washing/bathing with required toilets, drainage system, and electrification etc. in labour colony at his own cost. Suitable paved area to be provided in the labour colony at his own cost.

1.3.3 ELECTRICITY:

- 1.3.3.1 Construction power will be provided to the contractor free of cost at one single point within the plant area by BHEL as provided by TSGENCO. However, based on request of Contractor and requirement of project, BHEL Site in charge, at his discretion, may provide construction power at multiple point (as close to work area as possible), free of cost, for smooth execution of the work at site. If, BHEL provides electricity at more than one point (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. 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. The contractor to Provide necessary meter for measuring the power consumption. The contractor shall make his own arrangement for further distribution with necessary isolator/LCB etc at their own cost.
- 1.3.3.2 Necessary "Capacitor Banks" to improve the Power factor to a minimum of 0.9 shall be provided by the contractor at his cost. Penalty if any levied by customer on this account will be recovered from contractor's bills.
- 1.3.3.3 Any duty, deposit involved in getting the Electricity shall be borne by the bidder.
- 1.3.3.4 Contractor has to make their own arrangements for electricity requirement for office shed, canteen, storage sheds at their cost.
- 1.3.3.5 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

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electrical authority of the State / BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor.

- 1.3.3.6 BHEL is not responsible for any loss or damage to the contractor's equipment as a result of variations in voltage / frequency or interruptions in power supply.
- 1.3.3.7 Contractor has to make their own arrangements for electricity requirement for labour colony at their cost. Any duty, deposit involved in getting the Electricity for contractors use i.e. Office shed, labour colony etc., shall be borne by the bidder.
- 1.3.3.8 As there are bound to be interruptions in regular power supply, power cut/ load shedding in any construction sites, contractor should make his own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown / failure to get urgent and important work to go on without interruptions. No separate payment shall be made for this contingency.

1.3.4 WATER:

- 1.3.4.1 Water (Raw water) required for construction purposes will be provided at one single point within the plant area free of cost. The required pumps & accessories, pipes for drawing water from the given point and further distribution will be arranged by the contractor at their cost to go on without interruptions.
- 1.3.4.2 In case of non-availability of water, the contractor shall make his own arrangements of water suitable for construction purpose to have uninterrupted work. No separate payment shall be made for any contingency arrangement made by contractor, due to delay / failure for providing water supply.

1.3.5 MATERIAL SUPPLY:

- 1.3.5.1 Supply / providing aggregate, sand (river sand only) and all other materials required (except free supply materials i.e. cement, reinforcement steel, structural steel for structural works, structural steel for embedments/inserts from scraps (if available), borosilicate glass blocks for borosilicate lining works, foundation bolts & insert/ embedments supplied by manufacturing unit(s) of BHEL) for the work are in the scope of the contractor. BHEL shall provide Cement, reinforcement steel for civil works, structural steel for fabrication works, borosilicate glass blocks for borosilicate lining works only for incorporation in the permanent work AS FREE SUPPLY. (Note: Structural steel required for embedments/ inserts will not be provided by

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BHEL.) Supply of stainless steel, non-metallic expansion compensator, electrical items, etc are in the scope of bidder.

- Regarding supply of cement, the cement shall be provided normally in bulkers and shall be unloaded in the silos (Adequate number of silos for cumulative storing capacity minimum of 200MT per 30 Cum/hr batching plant) to be installed by the bidder nearer to their batching plants. Making arrangement for unloading of cement into the silo and provision of necessary manpower support is in the scope of successful bidder within the quoted price. On advance request of the bidder, the cement shall be supplied in Bags for other than RCC works like masonry, flooring works etc. Advance request for supply of cement in bags shall be minimum two months. Cement shall be supplied in bags for carrying out design mix for the package. Advance request for supply of cement in bags required for design mix shall be minimum one month.
- 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.

1.3.5.2 If any matching sections of steel are not available with BHEL, contractor may arrange these sections on certification of BHEL and the landing cost of sections to site will be reimbursed based on the prevailing rate at SAIL at the time of procurement at the nearest SAIL outlet with the freight charges against supporting document.

1.3.5.3 BOROSILICATE GLASS BLOCKS

- Borosilicate glass blocks will be supplied by BHEL free of cost. However, handling of Borosilicate Glass blocks procured by BHEL for this tender scope, at site, including transportation from BHEL Stores/ Contractor's Stores to work/ erection area will be in the scope of contractor. No Extra payment shall be made for this work.
- BHEL shall supply borosilicate glass block lining system, including closed cell borosilicate glass blocks, adhesive membrane and compatible primer. BHEL shall also arrange for onsite QA supervision/ expert supervision by borosilicate glass manufacturer

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during installation of borosilicate glass blocks by the Bidder in the steel flue can and the SS minishell.

- The borosilicate glass blocks shall be of thickness 51 mm. Nominal adhesive/ membrane thickness shall be minimum 3 mm behind & between each block. A 1.5 mm thick layer should be troweled onto the liner as well as to the sides and back of each block before installation. Double buttering technique shall be used to ensure full bond of each block to the liner and to each other. Installation of blocks shall be carried out as per specification, drawings, direction of engineer in charge, in expert supervision by borosilicate glass manufacturer and accepted by the customer. Contractor shall prepare the installation procedure taking into consideration the requirements of Borosilicate glass block manufacturer/ supplier and get the same approved by TSGENCO & BHEL before installation including verification of installation procedure & workmanship standards of the lining system.
- The surface preparation (before priming) by blast cleaning to Sa 2 1/2 of internal surface of flue can, application of suitable primer as per manufacturer specification, surface cleaning (after priming) using hot air, application of adhesive membrane and installation of borosilicate glass block at any height on ground or over erected position in flue can including cost of skilled labour, material, tools & tackles, equipment etc. all complete required to complete the job at any height in the scope of the bidder.
- Installation of borosilicate glass block lining shall be performed strictly under supervision of BOROSILICATE GLASS BLOCK supplier's representative. Supervisory person of borosilicate glass block supplier shall be arranged by BHEL. However, in addition to the above, continuous supervision by the bidder's engineer is very essential at all stages of installation of borosilicate glass blocks.
- The bidder shall follow the instruction & guidance of the Borosilicate Glass Block supplier from the time the material is issued to the Contractor, during handling, transportation till completion of installation of Borosilicate Glass Block & handing over of the flue can with borosilicate lining system.
- Allowed wastage in handling, transportation and application of borosilicate glass block liner shall be as per instruction of BOROSILICATE GLASS BLOCK SUPPLIER. Any wastage beyond the limit specified by supplier, shall be recovered from the contractor as per recommendation of supplier or shall be mutually settled between borosilicate glass block supplier and contractor

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1.3.6 CONSUMABLE

- 1.3.6.1 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.
- 1.3.6.2 In the event of failure of contractor to bring necessary and sufficient consumables, BHEL may arrange for the same at the risk and cost of the contractor. The entire cost towards this along-with overhead shall be paid by the contractor or deducted from the contractor's bills.

1.3.7 LIGHTING FACILITY:

- 1.3.7.1 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.

1.3.8 CONTRACTOR'S OBLIGATION ON COMPLETION:

- 1.3.8.1 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, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

1.3.9 Blasting

- 1.3.9.1 If required, at any stage of construction, blasting is to be carried out by the bidder, bidder should produce documentary evidence of valid blasting license for Telangana State (or) should produce documents for having tie-up with agency who is possessing valid blasting license for Telangana State.
- 1.3.9.2 For details on Blasting refer enclosed Bill of quantity (rate schedule) & Volume-IA Part-II Chapter 2 Technical Specification.

1.3.10 DEWATERING

- 1.3.10.1 Contractor shall ensure at all times that his work area & approach/ access roads are free from accumulation of water, so that the materials are safe and the erection/ progress schedule are not affected. No separate claim in this regard shall be admitted by BHEL. No separate payments for dewatering of subsoil, surface water or catchments water, if required, at any time during

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execution of the work including monsoon period shall be considered by BHEL.

1.3.11 BID DRAWINGS

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

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VOLUME-IA PART-I CHAPTER – IV

1.4 T&Ps TO BE DEPLOYED BY CONTRACTOR

- 1.4.1 All the tools and plants required for satisfactory completion of the work have to be arranged by the contractor.
- 1.4.2 The contractor is required to arrange the following tentative Major T&Ps and other T&Ps for the satisfactory completion of the work.

Sr No	T&P items	Mobilizing time from the date of start of work
A	Major T&P items	
1.	1 no. automatic concrete batching plant with printing facility (30 cum/hr (or adequate capacity) with adequate number of cement silo of cumulative storage capacity minimum 200MT cement) with DG back up	Within 30 days or as mutually agreed between bidder and BHEL Engineer In-Charge at site as per the requirement of work.
2.	1 nos concrete pump (60 cum/hr) capacity and lift up to 70 metres or 1 nos truck mounted concrete mixer cum pump along with placing boom minimum 36m high i.e. concrete boom placer	Within 30 days or as mutually agreed between bidder and BHEL Engineer In-Charge at site as per the requirement of work.
3.	Complete hydraulic slip form assembly with jacks and climbing rods of adequate nos including 2 nos of power pack with hanging platform inside and outside, safety ropes, MS shutters , required scaffolding materials, etc	Within 30 days or as mutually agreed between bidder and BHEL Engineer In-Charge at site as per the requirement of work.
4.	Passenger lift cabin along with power winch for carrying min 6 person with safety block (safety devices).	Within 45 days or as mutually agreed between bidder and BHEL Engineer In-Charge at site as per the requirement of work
5.	Minimum 3MT capacity power winch for lifting concrete – 3 nos including 1nos stand-by	Within 45 days
6.	Minimum 3MT capacity power winch for lifting reinforcement - 2nos	Within 45 days

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7.	20 MT capacity winch for girder beam lifting – 2nos	As per site requirement
8.	Transit mixers (5/6 cum) – 3 nos including 1 nos standby	2 nos within 30 days and balance as per work requirement at site
B	Other T&P items	
9.	2 nos. multistage high lift water pump (for curing, lifting height 300 metres). One shall be working type and other shall be stand by.	Before start of chimney shell
10.	Welding rectifier (400 Amps to 600 Amps) – 10 nos	As per site requirement.
11.	1nos- 40MT tyre/ crawler mounted crane and 2 nos pick & carry crane of minimum 9 tonne capacity	As per site requirement.
12.	2 sets of strand jacks of required capacity (includes 2 nos standby jacks) with 2 nos power pack including strand rope of adequate thickness & length	As per site requirement (to carry out both flue cans parallely)
13.	1 no. motorized MS plate bending machine (width capable of bending one standard width of the plate) along with angle bending device	As per site requirement
14.	Power winch – 2.5 T- 2 nos. for internal/ external finishing with adequate capacity of suspended platform	As per site requirement.
15.	Walky Talky – 6 nos	As per site requirement
16.	Plate compactor	As per requirement in site
17.	Civil laboratory equipment's as per list in SI 1.4.6 with temporary building one AC lab size 4.5mtrx6mtr and 1 non AC lab 4.5 mtrx4.5 mtr.	Within 55 days or as mutually agreed between bidder and BHEL Engineer In-Charge at site as per the requirement of work.
18.	60 nos. concrete cube moulds	Within 15 days.

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19.	Adequate no. of small trucks 2T/5T for shifting of reinforcement/cement/shuttering etc. within site	As per requirement.
20.	Construction power cable (1000 RM)	As per Requirement
21.	Construction water Pipeline 3000 RM(100/75/32/25 dia GI Pipe)	As per Requirement
22.	10 nos. Concrete vibrator with adequate needle (Minimum 10 nos. diesel driven)	4 Nos (at least 2 nos. diesel driven) within 45 Days. Balance as per site requirement.
23.	Portable fire extinguishers as below: Soda acid – 40 sets. Dry chemical powder – 40 sets CO2 – 25 sets. Water & sand bucket (4 buckets in one stand) – 20 sets. Fire hose with nozzle (50 M length) – 8 sets.	25% within 30 days and balance progressively within 90 days.
24.	1 Nos. Radial drill machine	as per site requirement.
25.	1 nos. magnetic base drill machine	as per site requirement.
26.	2 nos. submerged arch welding machine	as per site requirement per site requirement.
27.	2 nos. MIG machine	as per site requirement
28.	1 no. trailor – 15T	As per site requirement
29.	1 no. power driven HSFG bolt tightening m/c	As per site requirement
30.	1 no. torque tightening m/c. (Capacity up to 30 dia HSFG bolt tightening)	As per site requirement
31.	Sufficient quantity of steel ladders for approach up to the top of each erected column to be required during erection of columns.	As per site requirement.

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32.	1 no ultra-sonography testing machine with printing/ recording facility for structural work.	– As per site requirement.
33.	1 nos. Painting equipment sets complete with required compressor, hopper, screen, blasting hose pipe, nozzle airless/conventional spray (within CGI temporary cover shed)	– As per site requirement.
34.	Ropes/slides including D-shackles	As per site requirement
35.	Grinding & Buffing machines	As per site requirement
36.	Steel jolly for temporary working platforms	As per site requirement
37.	2 nos. drinking water tank – 5000 lit.	2 nos. Within 30 days or as mutually agreed between bidder and BHEL Engineer In-Charge at site as per the requirement of work.
38.	1 no. mobile toilet blocks for labour use.	1 no. within 30 days or as mutually agreed between bidder and BHEL Engineer In-Charge at site as per the requirement of work

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 & other 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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

3. In the event of contractor failing to arrange the required tools, plants, machinery, equipment, material or non-availability of the same owing to breakdown, BHEL will make alternative arrangement at the risk and cost of the contractor.

Case 1: BHEL provides its own Capital T&P

In case the BHEL provides any T&P which is owned by BHEL, hire charges (as per BHEL norms) will be recovered from the contractor as per the prevailing BHEL Corporate hire charges. In case, the T&P is specifically listed in "T&Ps to be deployed by Contractor", "hire charges applicable to outside agencies other than contractors working for BHEL" will apply. If not listed, "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.

Case 2: In all cases other than that specified in Case 1 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. 1.6.1. of this specification (i.e. TCC) shall be referred for date of start of work.

6. Mobilization of concrete boom placer in place of concrete pump will be allowed based on site requirement of BHEL.

7. Deployment of batching plant of lesser capacity than mentioned above may be allowed with conditions as stipulated hereunder:

- Batching plant shall be automatic and equipped with printing facility
- No. of such batching plant deployed shall not be less than 2 and cumulative production of all the batching plants shall be equal to or more than the production capacity of 30 cum/hr capacity batching plant.
- Cement will be provided by BHEL in bulker and hence adequate silo arrangement shall be provided for storage cement.

8. Crane of upto SWL 150MT is in the scope of bidder and shall be brought to site/ arranged in site as per requirement for erection of steel structures at site (As and when required).

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- 1.4.3 In addition to the above, any other tools and plants required for execution of the above work are in contractor's scope.
- 1.4.4 The Bidder shall establish and maintain a field laboratory on the site and this laboratory shall be available at all time for testing.
- 1.4.5 The laboratory must have qualified technicians to carry out all tests and must be adequately equipped to ensure that all necessary testing work can be carried out in compliance with the standards.
- 1.4.6 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 Angeles Abrasion testing machine	Standard	IS 2386
4	Aggregate Impact value test	Aggregate Impact value testing machine with blow counter	Standard	IS 9377
5	Aggregate crushing value test	Crushing value apparatus	Standard	IS 2386
6	Flakiness index	Thickness gauge for measuring flakiness index	Standard	IS 2386
7	Elongation Index	Elongation 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	Motorised vibration machine for cement testing	Standard	IS 4031

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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	

Soil Testing Equipment				
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

- 1.4.7 List of testing equipment mentioned in the table above is tentative and final requirement shall be as mutually agreed between successful bidder and BHEL Engineer In-Charge in compliance with requirement spelt in FQP (Field quality plan).
- 1.4.8 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.

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- 1.4.9 The area and infrastructure development of the work area are to be carried out by the customer. However, in construction projects of this magnitude it is possible that all the areas / approaches may not be ready. In such cases consolidation of ground and arrangement of sleepers / sand bag filling etc for safe operation / movement of equipment including cranes / trailers etc shall be the responsibility of the contractor at his cost. No compensation on this account shall be payable.
- 1.4.10 In general, any crane for the tendered will not be provided by BHEL. However, if requirement of crane of higher capacity arises for any unforeseen circumstance (i.e. more than 150MT), bidder may request BHEL to provide crane on chargeable basis but BHEL reserves right of provision of crane. If provided, in that case, Crane operators deployed by the contractor shall be tested by BHEL before they are allowed to operate the cranes.
- 1.4.11 Crane operators deployed by the contractor shall be tested by BHEL before they are allowed to operate the cranes. 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
- 1.4.12 In case, cement is issued through bulkers being supplied from manufacturer /stockiest, the same shall be emptied in cement silos of batching plant and necessary assistance shall be provided by contractor. Contractor to note that batching plant being established at site shall have adequate number of cement silos of cumulative capacity 200 MT as mentioned in clause 1.4.2.A-list of Tools & Plants to be deployed by the contractor.

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1.5 T&Ps to be PROVIDED BY BHEL

- 1.5.1 BHEL will not provide any T & Ps for the tendered work. 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.

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VOLUME-IA PART-I CHAPTER - VI

1.6 TIME SCHEDULE

- 1.6.1 The commencement of work at site shall be mutually agreed date between bidder and BHEL to start the work. Foundation of RCC chimney shall be handed over to contractor by BHEL.
- 1.6.2 The entire work of construction of single flue RCC chimney (excluding foundation work) as detailed in the Tender Specification shall be completed within 18 (Eighteen) months from the date of commencement of work at site.
- 1.6.3 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.
- 1.6.4 The contractor is required to refer Form 15 in Vol-1A Part-II Chapter 6 for all the instructions to be taken immediately after receipt of LOI.
- 1.6.5 MOBILISATION**
- 1.6.5.1 The Contractor has to subsequently augment his resources in such a manner to achieve the COMPLETION SCHEDULES:
- 1.6.5.2 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 tenderer taking in to consideration of the COMPLETION SCHEDULES /site decision on drawings flow (latest) and submitted for BHEL's approval.
- 1.6.6 In order to meet above schedule in general, and any other intermediate targets set, to meet customer / project schedule requirements, contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL.
- 1.6.7 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.
- 1.6.8 SUBMISSION OF L3 SCHEDULE**
- 1.6.8.1 The contractor shall submit a detailed area/structure wise L3 schedule within 15 days from date of issue of LOI, in consultation with BHEL based on the tentative schedule provided as per the clause 1.6.11. 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

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& 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.

1.6.9 **MAJOR INTERMEDIATE MILESTONES**

The following Intermediate Milestones shall be applicable for this work.

<u>S. N</u>	<u>Description</u>	<u>Completion month from the date of start of the work at site</u>	<u>Intermediat e Milestone</u>
1	Completion of RCC works of chimney shell	8th Month	M1
2	Erection of flue can with borosilicate lining	14th month	M2

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

1.6.10 **GUARANTEE PERIOD (UNIT)**

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

1.6.11 **CIVIL WORKS SCHEDULE FOR 5X800MW YADADRI POWER PROJECT**

The schedule for civil works is as given below.

SI N.	SYSTEM DESCRIPTION	Completion from the date of commencement of civil work
1.	Completion of RCC works of chimney shell	Progressively upto 8th month
2.	Erection of floor beams & staircase	Progressively upto 9 th month
3.	Fabrication of flue cans	Progressively by 8th month
4.	Roof slab completion	Progressively by 10th month
5.	Erection of roof beams, dismantling of slip form, erection of other floor staircase & casting of roof slab	Progressively by 10 th month

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6.	External platforms	Progressively by 12th month
7.	Erection of flue can with borosilicate lining	Progressively by 14 th month
8.	Electrical works	Progressively by 16th month
9.	Painting & finishing works and all balance miscellaneous work & handing over	Progressively by 17th month
10	Elevator erection & commissioning	Progressively by 18 th month
11	Submission of final bill & reconciliation of steel & cement	Progressively by 18th month

- 1.6.12 The above schedule is tentative.
- 1.6.13 The above completion schedule is for entire completion and handing over the chimney to BHEL. The foundations, pedestals, floors, and any structure, required for the start of mechanical equipment erection/ commissioning work, shall be handed over to BHEL progressively within the scheduled period given in the above table, as per the BHEL site requirement.
- 1.6.14 In case the activities in the schedule are to be advanced, the related civil/ structural activities in the scope of the contractor are to be advanced to meet the project requirement. No extra payment whatsoever shall be paid on this account.
- 1.6.15 The bidder must submit a detail schedule (area wise) for completion of work to meet work schedule given in CLAUSE 1.6.11 within 15 days from the date of issue of LOI.
- 1.6.16 The major activities as mentioned against the work schedule given in clause No.1.6.11 are to be indicated in detailed schedule which will be prepared by the bidder.
- 1.6.17 RECORDS TO BE MAINTAINED AT SITE:
- 1.6.17.1 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.
- 1.6.17.2 The under mentioned Records/ Log-books/ Registers applicable to be maintained.
- 1.6.17.3 Hindrance Register.
- 1.6.17.4 Site Order Book.
- 1.6.17.5 Test Check of measurements.
- 1.6.17.6 Cement Supply and Consumption Daily Register

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- 1.6.17.7 Records of Test reports of Field tests.
- 1.6.17.8 Records of manufacture's test certificates.
- 1.6.17.9 Records of disposal of scraps generated during and after the work completion.

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VOLUME-IA PART-I CHAPTER – VII

1.7 TERMS OF PAYMENT

1.7.1 Secured Advance

Not applicable

1.7.2 Advance for Mobilization

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

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

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

1. Automatic concrete Batching plant of specified capacity & number as per clause 1.4.2
2. Transit mixer of 5/6 cum capacity – 2 nos
3. Concrete pump (60 cum/ hr) – 1 no

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

1. Motorized Plate bending machine for MS plates– 1 no
2. Transit mixer of 5/6 cum capacity – 1 No
3. Power winch of capacity minimum 3MT - 2 nos.
4. Strand jack system for flue can erection with all required assembly – 2 nos
5. Civil Laboratory – 1 No.

Note:

1. Mobilization of concrete boom placer (of adequate capacity as required in site and approved by Engineer In-Charge) in place of concrete pump will be allowed based on site requirement of BHEL.
2. Deployment of batching plant of lesser capacity than mentioned above may be allowed with conditions as stipulated hereunder:
 - Batching plant shall be automatic and equipped with printing facility

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- No. of such batching plant deployed shall not be less than 2 and cumulative production of all the batching plants shall be equal to or more than the production capacity of 30 cum/hr capacity batching plant.
- Cement will be provided by BHEL in bulker and hence adequate silo arrangement shall be provided for storage cement.

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

1.7.3 Interim Payment

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

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

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

1.7.4 For Performance Security Deposit–
Please refer SI No.16 of Vol-1A Part II Chapter-1.

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

1.7.6 Royalty/seigniorage charges

1.7.6.1 Royalty/ seigniorage charges (if any) for excavation inside plant premises as applicable as per Govt of Telangana shall be reimbursable to the bidder by BHEL for the quantum of earth work done on submission of necessary proof of payments as required by M/s TSGENCO for reimbursement and realization of reimbursement from TSGENCO to BHEL.

1.7.7 METHOD OF MEASUREMENT

1.7.7.1 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

TECHNICAL CONDITIONS OF CONTRACT (TCC)

interpretation of BHEL will be final and binding to the contractor. Measurement guidelines as a ready reference is also available in the technical specification.

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.

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VOLUME-IA PART-I CHAPTER - VIII

TAXES AND OTHER DUTIES

- 1.8.1 Goods and service Tax (GST) & Cess
- 1.8.1.1 The successful bidder shall furnish proof of GST registration with GSTN Portal in the State in which the Project is being executed, covering the services under this contract. Registration should also bear endorsement for the premises from where the billing shall be done by the successful bidder on BHEL for this project/ work.
- 1.8.1.2 Contractor's price/rates shall be exclusive of GST & Cess (if applicable) (herein after termed as GST). Contractor shall submit to BHEL the GST compliant tax invoice/debit note/revised tax invoice on the basis of which BHEL will claim the input tax credit in its return. Since this is a works contract, the applicable rate shall be @ 18% GST, as applicable presently
- 1.8.1.3 Bidder shall note that the GST Tax Invoice complying with GST Invoice Rules wherein the 'Bill To' details will as below:
- BHEL GSTN - 36AAACB4146P1ZG
NAME - BHARAT HEAVY ELECTRICALS LIMITED
ADDRESS - Yadadri Thermal Power Station, 5X800 MW (Coal based), Veerlapalem village, Dameracherla Mandal, Nalgonda District, Telangana State.
- 1.8.1.4 GST charged in the tax invoice/debit note/revised tax invoice by the contractor shall be released separately to the contractor only after contractor files the outward supply details in GSTR-1 on GSTN portal and input tax credit of such invoice is matched with corresponding details of outward supply of the contractor and has paid the GST at the time of filing the monthly return.
- 1.8.1.5 In case BHEL has to incur any liability (like interest / penalty etc.) due to denial/reversal / delay of input tax credit in respect of the invoice submitted by the contractor, for the reasons attributable to the contractor, the same shall be recovered from the contractor.
- 1.8.1.6 Further, in case BHEL is deprived of the Input tax credit due to any reason attributable to contractor, the same shall not be paid or Recovered if already paid to the contractor.
- 1.8.1.7 Tax invoice/debit Note/revised tax invoice shall contain all such particulars as prescribed in GST law and comply to the timelines for issue of the same. Invoices shall be submitted on time to the concerned BHEL Engineer In Charge.

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- 1.8.1.8 TDS under GST (if/ as & when applicable) shall be deducted at prevailing rates on gross invoice value from the running bills.
- 1.8.1.9 E-way bills / Transit passes / Road Permits, if required for materials / T&P etc., bought into the project site is to be arranged by the Contractor only.
- 1.8.1.10 BHEL shall not reimburse any amounts towards any interest / penalty etc., incurred by contractor. Any additional claim at a later date due to issues such as wrong rates / wrong classification by contractor shall not be paid by BHEL.

1.8.2 All taxes and duty other than GST & Cess

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

1.8.3 Statutory Variations

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

1.8.4 New Taxes/Levies

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

1.8.5 Direct Tax

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

VOLUME-IA PART-I CHAPTER -IX

1.9.0 BILL OF QUANTITY

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

NOTE TO BOQ:

- A) The Price bid contains the consolidated list of BOQ with brief description of items. The quantity indicated in the BOQ / Price bid is approximate only and is liable for variation. Payment will be as per actual quantity executed as certified by BHEL Engineer.
- B) Before filling the Rates in the Price bid, the bidder shall go through the detailed specification of all items of BOQ as well as Scope of Work as specified in relevant Clause of this document
- C) Tenderers are requested to affix their company seal and authorized signature in all pages.
- D) Bidders shall refer Volume II, Price Bid, Part –A for Instructions.

**VOLUME-IA PART-I CHAPTER -X
GENERAL**

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

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

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

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

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

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

1.10.4 BOCW Act & BOCW Welfare Cess Act

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

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

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

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

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

- 1.10.4.4 The contractor irrespective of their nature of work and manpower (Civil, Mechanical, Electrical works etc) should register their establishment under BOCW Act 1996 and comply with BOCW Welfare Cess Act 1996.
- 1.10.4.5 Contractor shall make remittance of the BOCW cess as per Act in consultation with BHEL as per the rates in force (presently 1%). BHEL shall reimburse the same upon production of documentary evidence. However, BHEL shall not reimburse the Fee paid towards the registration of establishment, fess paid towards registration of beneficiaries and contribution of beneficiaries remitted.
- 1.10.4.6 Non-compliance to provisions of the BOCW act and BOCW welfare Cess act is not acceptable. In case of any non-compliance, BHEL reserves the right to withhold any sum it deems fit. Only upon total compliance to the BOCW act and also discharge of total payment of Cess under the BOCW Cess act by the contractor, BHEL shall consider refund of the amounts.

1.10.5 PROVIDENT FUND

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

1.10.6 OTHER STATUTORY REQUIREMENTS

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

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

- 1.10.6.3 The Contractor should ensure compliance of Sec 21 of Contract Labour (R&A) Act 1970 regarding responsibility for payment of Wages. In case of “Non-compliance of Sec 21 or non-payment of wages” to the workmen before the expiry of wage period by the contractor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.
- 1.10.6.4 The Contractor shall submit copies of Final Settlement statement of disbursement of retrenchment benefits on retrenchment of each workman under I D Act 1948, copies of Form 6-A (Annual Return of PF Contribution) along with Copies of PF Contribution Card of each member under PF Act and copies of monthly return on ESI Contribution – Form 6 under ESI Act 1948 (If applicable) to BHEL along with the Final Bill.
- 1.10.6.5 In case of any dispute pending before the appropriate authority under I D act 1948, WC Act 1923 or ESI Act 1948 and PF Act 1952, BHEL reserve the right to hold such amounts from the final bills of the Contractor which will be released on submission of proof of settlement of issues from the appropriate authority under the act.
- 1.10.6.6 In case of any dispute prolonged/pending before the authority for the reasons not attributable to the contractor, BHEL reserves the right to release the final bill of the contractor on submission of Indemnity bond by the contractor indemnifying BHEL against any claims that may arise at a later date without prejudice to the rights of BHEL.

1.10.7 DEPLOYMENT OF SKILLED / SEMI-SKILLED TRADESMEN

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

The contractor shall, at all stages of work deploy skilled / semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute / Industrial Training Institute / National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed / certified by State / Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled / semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and

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the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in-Charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 100 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

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

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

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

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

1.10.8.3 Compensation in respect of each of the victims:

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

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

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

1.10.9 GENERAL

1.10.9.1 Site Visit by the Bidder

Prior to submitting his tender for the work, the bidder shall visit, examine and acquire full knowledge & information of necessary conditions prevailing at

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

1.10.9.2 The bidder shall satisfy themselves about the following factors:

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

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

1.10.9.4 A bidder shall be deemed to have full knowledge of the site, whether he inspects it or not, and no extra charges consequent on any

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misunderstanding or otherwise shall be allowed.

- 1.10.9.5 The bidder and any of his personnel or agents will be granted permission by the Site-In-Charge or his authorized nominee, on receipt of formal application in respect thereof a week in advance of the proposed date of inspection of site, to enter upon his premises and lands for purpose of such inspection, but only on the express condition that the tenderer (and his personnel and agents) will relieve and indemnify the Employer (and his personnel and agents) from and against all liability in respect thereof and will be responsible for personal injury (whether fatal or otherwise), loss of or damage to property and any other loss, damage, costs and expenses however caused which, but for the exercise of such permission, would not have arisen.
- 1.10.9.6 Scope of work covered under this specification requires quality workmanship, engineering and green belt management along with the supply of all consumables, tools and tackles and testing instruments. The contractor shall ensure timely completion of work. The contractor shall have adequate tools, measuring instruments etc. in his possession. He shall also have adequate trained, qualified and experienced engineers, supervisory staff and skilled personnel. The manpower deployment identified by contractor shall match with above scope of works.
- 1.10.9.7 It is not the intent to specify herein all details of all material. Any item related this work not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.
- 1.10.9.8 All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there at no extra cost.
- 1.10.9.9 Site testing wherever required shall be carried out for all items / materials installed by the contractor to ensure proper installation and functioning in accordance with drawings, specifications and manufacturer's recommendations.
- 1.10.9.10 The contractor shall carryout additional tests, if any, which the Engineer feels necessary because of site conditions and also to meet system specification.
- 1.10.9.11 The work shall be executed under the usual conditions without affecting power plant construction / operation and in conjunction with other operations and contracting agencies at site. The contractor and his personnel shall co-operate with the personnel of other agencies, co-ordinate his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.
- 1.10.9.12 All the work shall be carried out as per instructions of BHEL engineer. BHEL engineer's decision regarding the correctness of the work and method of working shall be final and binding on the contractor.

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- 1.10.9.13 Wherever Construction sequences are furnished by BHEL, the contractor shall follow the same sequence.
- 1.10.9.14 Contractor shall execute the supply and works as per sequence prescribed by BHEL at site engineer. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of execution of similar job in any other site or for any reasons whatsoever.
- 1.10.9.15 If required by BHEL, the contractor shall change the sequence of his operation so that work on priority sectors can be completed within the projects schedule. The contractor shall afford maximum assistance to BHEL in this connection without causing delay to agreed completion date.
- 1.10.9.16 Contractor shall, transport all materials to site and unload at site / working area for inspection and checking. All material handling equipment required shall be arranged by the contractor.
- 1.10.9.17 Contractor shall retain all T&P / Testing instrument / Material handling equipment's etc. at site as per advice of BHEL engineer and same shall be taken out from site only after getting the clearances from engineer in charge.
- 1.10.9.18 The contractor at his cost shall arrange necessary security measures for adequate protection of his machinery, equipment, tools, materials etc. BHEL shall not be responsible for any loss or damage to the contractor's construction equipment and materials. The contractor may consult the Engineer-in-Charge on the arrangements made for general site security for protection of his machinery equipment tools etc.
- 1.10.9.19 The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. However, completion time for construction, agreed will be subject to the condition that contractor's work is not hampered by the agencies.
- 1.10.9.20 Contractor has to work in close co-ordination with other agency at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less / more at a particular given time. Activities and Construction program have to be planned in such a way that the milestones are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.
- 1.10.9.21 The contractor must obtain the signature and permission of the security personnel of the customer / BHEL for bringing any of their materials inside the site premises. Without the Entry Gate Pass these materials will not be allowed to be taken outside.
- 1.10.9.22 Contractor shall remove all scrap materials periodically generated from his working area and collect the same at one place earmarked for the same. Load of scraps is to be shifted to a place earmarked by BHEL. Failure to

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collect the scrap is likely to lead to accidents and as such BHEL reserves the right to collect and remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect.

- 1.10.9.23 The contractor shall ensure that his premises are always kept clean and tidy to the extent possible. Any untidiness noted on the part of the contractor shall be brought to the attention of the contractor's site representative who shall take immediate action to clean the surroundings to the satisfaction of the Engineer-in-Charge.
- 1.10.9.24 The contractor is strictly prohibited from using BHEL's regular components like angles, channels, beams, plates, pipe / tubes, and handrails etc. for any temporary supporting or scaffolding works. Contractor shall arrange himself all such materials. In case of such misuse of BHEL materials, a sum as determined by BHEL engineer will be recovered from the contractor's bill. The decision of BHEL engineer is final and binding on the contractor.
- 1.10.9.25 No member of the already erected structure / buildings, other component and auxiliaries should be removed / modified without specific approval of BHEL engineer.
- 1.10.9.26 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on latest ISO 9001 Standards.
- 1.10.9.27 Some time it may be required to re-schedule the activities to enable other agencies to commence / continue the work so as to keep the overall project schedule.
- 1.10.9.28 The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.
- 1.10.9.29 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.
- 1.10.9.30 On Completion of work, all the temporary buildings, structures, pipe lines, cable etc. shall be dismantled and leveled and debris shall be removed as per instruction of BHEL by the contractor at his cost. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.
- 1.10.9.31 It is the responsibility of the contractor to do the checking, testing etc. if necessary, repeatedly to satisfy BHEL Engineer with all the necessary tools and tackles, manpower etc. without any extra cost. The testing will be completed only when jointly certified so, by the BHEL Engineer.
- 1.10.9.32 If any item not covered but requires being executed, same shall be carried out by the contractor. Equivalent or proportional unit rate shall be considered

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wherever possible from the BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.

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

1.10.9.34 SITE INSPECTION

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

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

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

1.10.9.35 DOCUMENTATION

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

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

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

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VOLUME-IA PART – I CHAPTER - XI

PROGRESS OF WORK

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

1.11.0 PROGRESS AND MONITORING OF WORK

- 1.11.1 Refer forms F -14, F-15 as per relevant chapters of Vol-1A Part-II of TCC. Also refer Form F-16 to F-18 in Volume I D of Volume -I Book-II. Plan and review will be done as per the above formats.
- 1.11.2 Contractor is required to draw mutually agreed monthly construction programs in consultation with BHEL well in advance monthly as per the Form-14. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL. Progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled program shall be discussed for actions to be taken for achieving targets. Contractor shall also present the program for subsequent week. The contractor shall constantly update / revise his work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of nonconformities.
- 1.11.3 The contractor shall submit daily, weekly and monthly progress reports, manpower reports, materials report, consumables (gases / electrodes / ferules / lugs) report, T&Ps availability report and other reports as per Performa considered necessary by the Site Engineer as per the BHEL formats.
- 1.11.4 The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.
- 1.11.5 The monthly report ending on 24th of every month shall be submitted as a booklet and shall contain the following details: -
 - a) Colour Progress photographs to accompany the report should be submitted.
 - b) Construction progress in terms of quantity, CUM,etc., completed as relevant to the respective work areas against planned.
 - c) Site Organization chart of engineers & supervisors as on 24th of the month with further mobilization plan

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- 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.
 - f) Availability report of cranes/T&Ps
 - g) Safety implementation report in the format
 - h) Pending material and any other inputs required from BHEL for activities planned during the subsequent month.
- 1.11.6 The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.
- 1.11.7 During the course of construction, if the progress is found unsatisfactory, or if the target dates fixed from time to time for every milestone are to be advanced, or in the opinion of BHEL, if it is found that the skilled workmen like fitters, operators, technicians etc employed are not sufficient BHEL will induct required additional workmen to improve the progress and recover all charges incurred on this account including all expenses together with BHEL overheads from contractor's bills.
- 1.11.8 It is the responsibility of the contractor to provide all relevant information on a regular basis regarding construction progress, labour availability, equipment deployment, testing, etc.
- 1.11.9 The progress reports shall indicate the progress achieved against plan, indicating reasons for delays, if any. The report shall also give remedial actions which the contractor intends to make good the slippage or lost time so that further works can proceed as per the original plan the slippages do not accumulate and affect the overall programme.
- 1.11.10 The contractor to reflect actual progress achieved during the month and will be submitted to BHEL, so that slippages can be observed and necessary action taken in order to ensure that the situation does not get out of control will update the construction schedule forming part of this contract each month.

1.12.0 MATERIAL HANDLING

- 1.12.1 Open land as available & as provided by TSGENCO shall be provided by BHEL on free of cost basis. 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.
- 1.12.2 The system for receipt, storage & issue of materials shall be available with vendors for easy traceability.
- 1.12.3 Periodic audit of system of purchasing, storing and issue, etc. will have to be carried out by the vendors. BHEL will also audit the same.
- 1.12.4 As applicable, the contractor shall construct waterproof cement store (capacity 400MT) at his own cost for initial period for storing and stacking of cement, 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.
- 1.12.5 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.
- 1.12.6 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.
- 1.12.7 The contractor shall maintain proper store account for all the BHEL issued materials and shall give three copies of once in every month (along with running bill) computerised reconciliation statement of such account to the BHEL.
- 1.12.8 All TMT shall be stacked over sleeper's diameter wise.

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- 1.12.9 All structural steel shall be stacked plate size wise and thickness wise beams, channels and angles shall be stacked separately on sleepers.
- 1.12.10 Materials shall not under any circumstances taken out of the project site unless otherwise permitted by BHEL.

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VOLUME-IA PART –I CHAPTER -XIII

1.13 ACCOUNTING OF MATERIAL ISSUE

1.13.1 ACCOUNTING OF MATERIALS ISSUE

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

1.13.2 ISSUE OF CEMENT

1.13.2.1 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 (Adequate numbers of cement silo of cumulative capacity of 200MT per 30CUM batching plant or as required for batching plant mobilized other than the capacity mentioned) 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.

1.13.2.2 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.

1.13.2.3 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.

1.13.2.4 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

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- 1.13.2.5 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.
- 1.13.2.6 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/TSGENCO. 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 required workability and durability, shall be the responsibility of the bidder without any extra cost to BHEL.
- 1.13.2.7 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).

SLNO	ISSUE OF MATERIALS	MAX. QTY IN CONTRACTOR'S STORE
1.	Cement	Requirement of one month

1.13.2.8 **RETURN OF CEMENT**

Sealed cement bags remaining unused and in perfectly good condition at the time of completion or termination of the contract shall be returned promptly, (within 15 days from assessment) if BHEL/ Engineer is satisfied of the physical condition of the cement. Return of such cement to the project stores/ place as identified within the project area by Engineer/ BHEL will not be entitled to handling and incidental charges. Surplus sealed and good conditioned cement bags will be taken back on weighment basis.

1.13.2.9 **CEMENT CONSUMPTION AND WASTAGE**

The theoretical consumption of cement shall be based on the following.

- For design mix concrete as per approved design mix.
- For nominal mix concrete work, as per minimum cement as specified or as approved by Engineer-in-charge.

For item of works, where volume mix is permitted in writing by the BHEL, for masonry works, plaster other miscellaneous items, the cement consumption shall be governed by the "Statement of Cement Consumption" attached to the Delhi schedule of Rates of CPWD-DSR- LATEST REVISION unless otherwise specified in the specifications or the drawing of contract or mutually agreed by Engineer-in-charge and contractor.

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Actual consumption = Issue – Surplus/ unused quantity of cement returned in good condition by contractor to store. (No sweep cement will be taken back by BHEL).

1.13.2.10 CEMENT WASTAGE

Allowable wastage: One and half percent (+1.5%) of theoretical consumption of cement unless specified otherwise in the technical specification.

For any material issued by BHEL to the contractor free of cost, and which is not accounted by the contractor to BHEL, then recovery for such material shall be effected at penal rates.

SI No	Cement consumption	Basis of issue & penal recovery
C-1	Theoretical consumption (without considering any wastage or loss).	Free
C-2	Actual consumption being Limited to one and half percent (+1.5%) of aforesaid theoretical consumption towards allowable wastage.	Free
C-3	Actual consumption beyond one and half percent (+1.5%) of above (C-1).	Penal rate

1.13.3 ISSUE OF STEEL

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

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

(b) Reinforcement Steel and

Earthing rod (MS round) : Weighment basis (Unit – MT)

1.13.3.2 All the steel (structural, reinforcement, earthing MS rod) issued by the BHEL shall be properly accounted for. The total quantity of steel required for the work will be calculated from the approved Bar Bending schedule, fabrication drawings, approved laps, chairs and lugs. The measurement for payment as well as for accounting shall be based on the sectional weights as indicated in the following IS standards. No rolling tolerances shall be

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accepted in any case for issue, return of materials, reconciliation and payment purposes.

IS: 808- latest revision Beams, Channels and Angles

IS: 1730- latest revision Plates, Sheets and Strips/Flats

IS: 1732- latest revision Rounds including deformed high yield strength bars. In case any such sectional weights are not available in the above documents, the manufacturer recommendation shall be binding.

- 1.13.3.3 The steel issued to the contractor shall be mainly in standard length and sections as received from the supplier. However, the contractor shall be bound to accept the steel in length as available in the project stores no claims for extra payment because of issue of non-standard length will be entertained.
- 1.13.3.4 The contractor shall satisfy himself of the quality and quantity of the materials at the time of taking delivery from BHEL stores. No claims whatsoever will be entertained by BHEL because of quality or quantity after the materials are taken by the contractor from BHEL stores.
- 1.13.3.5 The contractor shall submit to the engineer, a statement indicating estimated quantity of steel required during a quarter, at least two months in advance of the quarter. In addition, the contractor shall also furnish the estimated requirement of steel during a month by the third week of the previous month indicating his requirement.
- 1.13.3.6 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).

S.No	Issue of Materials	Max Qty in Contractor's scope
1	Reinforcement Steel and Earthing rod MS round	Requirement of one month
2	Structural Steel	Requirement of one month

- 1.13.3.7 Bidders to ensure that no lamination materials are taken over by them from BHEL.
- 1.13.3.8 Fabrication wastage, if any due to above, shall not be compensated by BHEL.
- 1.13.3.9 Bidder to note that steel materials required for MS Grating, Galvanised Grating, GI Handrail, Stainless Steel Handrail, Stainless steel for SS Flue can, fasteners like MS/HT/HSFG bolts/nuts, lock nuts, washers and foundation bolts, embedded items other than those supplied by BHEL, etc shall be supplied by the bidder. However, Bidder shall use the scrap materials for their use in the permanent works as embedment/inserts etc.

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after necessary store issue formalities and shall be accounted for monthly reconciliation.

1.13.4 **RETURN OF MATERIALS**

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

1.13.4.2 Surplus, unused and untampered steel shall be sorted section-wise and returned separately for a place directed by BHEL/Engineer within the project area. Return of such materials will not be entitled to any handling and incidental charges.

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

1.13.5 **SCRAP & SERVICEABLE MATERAILS:**

- i. All Structural steel of length above 2 M except M.S. Plate shall be considered as serviceable materials provided the materials is in good and acceptable condition. Structural steel in length less than 2 M shall be treated as scrap.
- ii. Plates having both sides greater than 1 Metre OR if any side is less than 1 M but greater than 0.5 M and the total area is equal or greater than 2 Sq. Metre shall be considered as serviceable.
- iii. All pipes measuring 2 M and above in length shall be treated as serviceable materials provided they are in good and acceptable condition. Pipe in less than 2 M length shall be treated as scrap.
- iv. All TMT measuring 3 M and above in length shall be treated as serviceable materials provided they are in good and acceptable condition. TMT in less than 3 M length shall be treated as scrap.

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1.13.6 **STEEL CONSUMPTION AND WASTAGE**

1.13.6.1 **REINFORCEMENT AND EARTHING ROD MS ROUND STEEL CONSUMPTION AND WASTAGE.**

1.13.6.1.1 **a) CONSUMPTION.**

The theoretical consumption of various sections and/or diameter of reinforcement and earthing rod steel shall be based on approved construction drawing and bar bending schedule. Weight shall be calculated considering the sectional weights as per Indian standards. No extra cost shall be payable to the contractor for any deviation in weights for the different procedures adopted for issue and calculation of the theoretical consumption including rolling tolerances.

- Actual consumption = Issue – Surplus.
- Surplus = Un-tampered, unused, uncut QTY of steel and serviceable materials as stipulated under clause “Scrap and Serviceable Materials” (Refer clause 1.13.5 above) returned by the contractor to BHEL store along-with relevant documents.
- Wastage = Actual consumption – Theoretical consumption.

1.13.6.1.2 **b) WASTAGE**

ALLOWABLE WASTAGE: - (+3%) of the theoretical consumption shall be considered as allowable wastage. Invisible wastage (max limit to 0.5%), if any, shall be considered to be included in the specified 3 % allowable wastage.

S.No	CONSUMPTION OF REINFORCEMENT STEEL & EARTHING ROD, MS ROUND	BASIS OF ISSUE
R-1	Theoretical consumption (without Considering wastage and scrap or loss) as per spec. & drg.	Free
R-2	Wastage limited to plus THREE percent (+3%) of aforesaid theoretical consumption (R-1) towards allowable wastage including invisible wastages (invisible wastages limited to 0.5% of theoretical consumptions)	Free
R-3	Wastage beyond THREE percent (+3%) of the aforesaid theoretical consumption (R-1)	Penal Rate

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

1.13.6.2.1 **a) CONSUMPTION: -**

The theoretical consumption of various sections shall be based on approved drawings. Weights shall be calculated considering the sectional weights as per Indian standard. No extra shall payable to the contractor for any deviation in weights for the two different procedures adopted for issue and calculation of the theoretical consumption including rolling tolerances.

- Actual consumption = Issue – Surplus.
- Surplus = UN tampered, unused, uncut quantity of steel and Serviceable materials as stipulated under clause “Scrap and Serviceable Materials (Refer Clause 1.13.5 above)” returned by the contractor to BHEL store along with relevant documents.
- Wastage = Actual consumption – Theoretical consumption.

1.13.6.2.2 **b) WASTAGE**

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

S.No	CONSUMPTION OF STRUCTURAL STEEL (ROLLED SECTION, PLATES & SS liner)	Basis of issue and Recovery rate
S-1	Theoretical consumption (without Considering any wastage, scrap or loss) as per spec. & drg.	Free
S-2	Wastage limited to plus Four percent (+4%) of the aforesaid theoretical consumption (S-1) towards allowable wastage. including invisible wastages (invisible wastages limited to 0.5% of theoretical consumptions)	Free
S-3	Wastage beyond Four percent (4%) of the aforesaid theoretical consumption (S-1).	Penal Rate

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1.13.7 RECONCILIATION OF MATERIALS

- 1.13.7.1 The contractor shall submit a reconciliation statement of steel issued to him with each RA Bill.
- 1.13.7.2 At the time of submission of bills, the contractor shall properly account for the material issued to him as specified herein to the satisfaction of BHEL certifying that the balance material is available with contractor's custody at site.
- 1.13.7.3 At the time of submission of bills by the contractor, if it is noticed by BHEL that the wastage is high and calls recovery at the penal rate, then, BHEL will proceed for recovery for the excess wastage as per penal recovery rates as specified.
- 1.13.7.4 The reference drawings for actual material consumption to be used for the purpose of reconciliation shall be drawings prepared by the BHEL and drawings approved by BHEL for fabrication works and such other drawings approved by BHEL. This shall also include the bar bending schedule prepared by the contractor and approve by BHEL.

1.13.8 RECOVERY OF MATERIAL

- 1.13.8.1 If wastage exceeds the specified limit, the recovery of excess wastage shall be made from monthly R/A Bill at the Penal Rate. For the not returning the surplus serviceable materials

A	REINFORCEMENT STEEL Cold rolled steel, high strength, deformed bar or mild steel round bars including earthing rod MS round	Rs. 44,100/- per MT + GST and/or other taxes & duties
B	STRUCTURAL STEEL MS plates, MS flats, rolled steel joists, channels, and angles, MS pipes, Chequered Plates, etc in sizes and lengths as available	Rs. 48,615/- per MT + GST and/or other taxes & duties
C	CEMENT (OPC/ PPC/PSC)	Rs. 4,266/- per MT + GST and/or other taxes & duties

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VOLUME-IA PART – II CHAPTER 1

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

SI No: 1

Clause 4.1.11 of SCC is deleted.

SI No: 2:

OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT MANAGEMENT/ QUALITY ASSURANCE PROGRAMME

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

Chapter IX Clause 9.1 is modified as below:

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

Chapter IX Clause 9.1.1 to 9.1.25 stands deleted.

Chapter IX Clause 9.2 to 9.62 stands deleted.

SI No: 3:

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

The payment for running bills will normally be released within 30 days of submission of running bill complete in all respects with all documents. It is the responsibility of the contractor to make his own arrangements for making timely payments towards labour wages, statutory payments, outstanding dues etc., and other dues in the meanwhile.

SI No: 4

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

1.9 EARNEST MONEY DEPOSIT

- 1.9.1 Every tenderer must furnish the prescribed amount of Earnest Money Deposit (EMD) to BHEL PSSR, only in the following forms: -
- i. Electronic Fund Transfer credited in BHEL account (before tender opening).
 - ii. Through Online EMD payment portal, before tender opening, by following these steps.

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1. Visit www.onlinesbi.com -> Go to State Bank Collect (In the tab section)
 2. Click Check box to proceed for payment -> Click on Proceed
 3. Under State of Corporate/Institution -> Select Tamilnadu
 4. Under Type of Corporate/Institution -> Select PSU – Public Sector Undertaking -> Go
 5. Under PSU – Public Sector Undertaking Name -> Select BHEL PSSR CHENNAI and Submit
 6. Under Select Payment Category -> SCT Tender EMD & Tender Fees
- iii. Banker's cheque or Pay order or Demand Draft in favour of 'Bharat Heavy Electricals Limited' (along with offer) and payable at Chennai.
- iv. Fixed Deposit Receipt (FDR) issued by Scheduled Banks/ Public Financial Institutions as defined in the Companies Act (FDR should be in the name of the Contractor, a/c BHEL) along with the offer.
- v. In case EMD amount is more than Rs. Two Lakhs, Tenderer has the option to submit Rs. Two lakhs in the forms described above in clause no. 1.9.1. (i) to (iv) and the remaining amount over and above Rs. Two Lakhs in the form of Bank Guarantee from Scheduled Bank (along with the Offer).

Note:

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

Bank Details for the purpose of Taking EMD BG

Name and Address of Beneficiary:	Bharat Heavy Electricals Ltd. #690, EVR Periyar Building, Nandanam, Anna Salai, Chennai - 35
Name of Bank of Client :	State Bank Of India
Bank Branch Address:	SBI Saidapet Branch, EVR Periyar Building, Nandanam, Anna Salai, Chennai - 600035
IFSC Code :	SBIN0000912
Account No. :	10610819499

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

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

- 1.9.2 EMD shall not carry any interest.
- 1.9.3 EMD by the Tenderer will be forfeited as per NIT Conditions, if:
- After opening the tender and within the offer validity period, the Tenderer revokes his tender or makes any modification in his tender which is not acceptable to BHEL.
 - The Contractor fails to deposit the required Security deposit or commence the work within the period as per LOI/Contract
- 1.9.4 EMD given by all unsuccessful tenderers will be refunded normally within 15 days of award of work.
- 1.9.5 EMD of successful tenderer will be retained as part of Security Deposit.
- 1.9.6 EMD by the tenderer shall be withheld in case any action on the tenderer is envisaged under the provisions of extant" Guidelines on Suspension of Business dealings with suppliers/contractors" and forfeited / released based on the action determined under these guidelines.

SI No: 5

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

1.10 Security Deposit:

- 1.10.1 Upon acceptance of Tender, the successful Tenderer should deposit the required amount of Security Deposit for satisfactory completion of work, as given below:
- 1.10.2 The total amount of Security Deposit will be 5% of the contract value. EMD of the successful tenderer shall be converted and adjusted towards the required amount of Security Deposit.
- 1.10.3 The security Deposit should be furnished before start of the work by the contractor.
- 1.10.4 Modes of deposit:
- 1.10.4.1 The balance amount to make up the required Security Deposit of 5% of the contract value may be furnished in any one of the following forms
- Cash (as permissible under the extant Income Tax Act)

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- ii. Local cheques of Scheduled Banks (subject to realization)/ Pay Order/ Demand Draft/ Electronic Fund Transfer in favour of BHEL
- iii. Bank Guarantee from Scheduled Banks / Public Financial Institutions as defined in the Companies Act. The Bank Guarantee format for Security Deposit shall be in the prescribed formats.
- iv. Fixed Deposit Receipt issued by Scheduled Banks/ Public Financial Institutions as defined in the Companies Act. The FDR should be in the name of the contractor, A/C BHEL, duly discharged on the back.
- v. Securities available from Indian Post offices such as National Savings Certificates, Kisan Vikas Patras etc. (Certificates should be held in the name of Contractor furnishing the security and duly endorsed/ hypothecated/ pledged, as applicable, in favour of BHEL and discharged on the back)

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

- 1.10.5 At least 50% of the Security Deposit including the EMD should be deposited in any form as prescribed before start of the work and the balance 50% of the Security Deposit will be recovered by deducting 10% of the gross amount progressively from each running bills of the contractor till the total amount of the required Security Deposit is collected.
- 1.10.6 The recoveries made from running bills (cash deduction towards balance SD amount) will be released against submission of equivalent Bank Guarantee in the prescribed formats, but only once, before completion of work.
- 1.10.7 The Security Deposit shall not carry any interest.
- 1.10.8 If the value of work done at any time exceeds the contract value, the amount of Security Deposit shall be correspondingly enhanced and the excess Security Deposit due the enhancement shall be immediately deposited by the Contractor or recovered from payment/s due to the Contractor.
- 1.10.9 The validity of Bank Guarantees towards Security Deposit shall be initially upto the completion period as stipulated in the Letter of Intent/Award + 3 months, and the same shall be kept valid by proper renewal till the acceptance of Final Bills of the Contractor, by BHEL Date

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

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

1.10.11 Penalty for Delayed Remittance of Security Deposit

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

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

Sl No: 6

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

2.7.2.

- 2.7.2.1 To terminate the contract or withdraw portion of work and get it done through other agency, at the risk and cost of the contractor after due notice of a period of 14 days' by BHEL in any of the following cases:
- i. Contractor's poor progress of the work vis-à-vis execution timeline as stipulated in the Contract, backlog attributable to contractor including unexecuted portion of work does not appear to be executable within balance available period considering its performance of execution.
 - ii. Withdrawal from or abandonment of the work by contractor before completion of the work as per contract.

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- iii. Non-completion of work by the Contractor within scheduled completion period as per Contract or as extended from time to time, for the reasons attributable to the contractor.
- iv. Termination of Contract on account of any other reason (s) attributable to Contractor.
- v. Assignment, transfer, subletting of Contract without BHEL's written permission.
- vi. Non-compliance to any contractual condition or any other default attributable to Contractor.

Risk & Cost Amount against Balance

Work:

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

Where,

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

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

H = Overhead Factor to be taken as 5

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

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

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

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

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

Substitute/ extra items whose rates have already been approved would form part of contract quantities for this purpose. Substitute/ extra items which have been executed but rates have not been

TECHNICAL CONDITIONS OF CONTRACT (TCC)

approved, would also form part of contract quantities for this purpose and rates of such items shall be determined in line with contractual provisions.

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

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

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

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

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

- i). Let the time period from scheduled date of start of work till termination of contract excluding the period of Hold (if any) not attributable to contractor = T_1
- ii). Let the value of executed work till the time of termination of contract = X
- iii). Let the Total Executable Value of work for which inputs/fronts were made available to contractor and were planned for execution till termination of contract = Y
- iv). Delay in executed work attributable to contractor i.e. $T_2 = [1 - (X/Y)] \times T_1$
- v). LD shall be calculated in line with LD clause (clause 2.7.9) of the Contract for the delay attributable to contractor taking " X " as Contract Value and " T_2 " as period of delay attributable to contractor.

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

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

Following sequence shall be applicable for recoveries from contractor:

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

SL No: 7

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

2.7.9.1 Penalty for Intermediate Milestones

- 2.7.9.1.1 M1 and M2 shall be intermediate Milestones for this work.
- 2.7.9.1.2 In case of slippage of these identified Intermediate Milestones, Delay Analysis shall be carried out on achievement of each of these two Intermediate Milestones in reference to Form 14.
- 2.7.9.1.3 In case delay in achieving M1 milestone is solely attributable to the contractor, 0.5% per week of executable contract value* limited to Maximum 2% of executable contract value will be withheld.
- 2.7.9.1.4 In case 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.

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- 2.7.9.1.5 Amount already withheld, if any, against slippage of M1 milestone, shall be released only if there is no delay attributable to contractor in achievement of M2 milestone.
- 2.7.9.1.6 Amount required to be withheld on account of slippage of identified intermediate milestone(s) shall be withheld out of respective milestone payment and balance amount (if any) shall be withheld @10% of RA Bill amount from subsequent RA bills.
- 2.7.9.1.7 Final deduction towards LD (if applicable), on account of delay attributable to contractor shall be based on final delay analysis on completion / closure of contract. Withheld amount, if any due to slippage of intermediate milestones shall be adjusted against LD or released as the case may be.
- 2.7.9.1.8 In case of termination of contract due to any reason attributable to contractor before completion of work, the amount already withheld against slippage of intermediate milestones shall not be released and be converted in to recovery.

Note: *Executable contract value-value of work for which inputs/fronTS were made available to contractor and were scheduled for execution till the date of achievement of that milestone.

SL No: 8

OVERRUN COMPENSATION (ORC)

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

2.12 OVERRUN COMPENSATION (ORC)

- 2.12.1 **ORC during original contract period:** No ORC shall be applicable during the original contract period.
- 2.12.2 **ORC during extended period for the reasons solely attributable to contractor:** No ORC shall be applicable during the extended period granted for the reasons solely attributable to contractor and work executed during this period shall be paid as per original contract rates.
- 2.12.3 **ORC during extended period for the reasons not attributable to contractor:** ORC shall be payable as per following procedure:
 - 2.12.3.1 For initial period of twelve months of extended period, ORC rate applicable over executed value shall be 5%. For every subsequent period of twelve

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

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

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

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

2.12.3.3 For the purpose of calculation of ORC, executed value of work in the month shall be divided in Part-1 and Part-2 in proportion of percentage shortfall attributable to BHEL and contractor respectively, based on the last delay analysis as worked out in 2.12.3.2.

ORC shall be payable only on Part-1 and no ORC shall be payable on Part-2. Value of Part-1 shall be further limited to the value of actual inputs provided by BHEL i.e. "Plan - Shortfall attributable to BHEL" for the month, as per Form-14 for calculation of ORC.

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

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

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

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- 2.12.3.6 In case, there is no shortfall attributable to contractor for the month and also contractor has deployed the resources as agreed in Form-14 but ORC amount payable for the month worked out as per procedure mentioned in clause 2.12.3.3, 2.12.3.4 and 2.12.3.5, is less than Rs.1,00,000/-, then ORC amount payable for the month shall be Rs.1,00,000/- otherwise ORC amount payable for the month shall remain same.
- 2.12.3.7 In case execution is on **HOLD** (Other than Force Majeure), ORC shall be payable as per following:
- i). Contractor has not been permitted by BHEL to de-mobilize
 - a) ORC amount of Rs. 1,00,000/- per month shall be applicable during the period of HOLD provided resources as planned are deployed (not demobilized) during the period of hold.
 - b) Subsequent to lifting of HOLD, Period of HOLD shall not be excluded in calculation of period for deciding applicable ORC rate as per clause 2.12.3.1.
 - ii). Contractor has been permitted to demobilize and to remobilize after lifting of HOLD
 - a) No ORC shall be payable to contractor for the period of HOLD.
 - b) Subsequent to lifting of HOLD, Period of HOLD shall not be excluded in calculation of period for deciding applicable ORC rate as per clause 2.12.3.1.
- 2.12.3.8 In case **Force Majeure** is invoked:
- i). No ORC shall be applicable during the period of Force Majeure.
 - ii). Subsequent to revocation of Force Majeure, period of Force Majeure shall be excluded in calculation of period for deciding applicable ORC rate as per clause 2.12.3.1.
- 2.12.4 Applicability of ORC: ORC shall not be applicable for following activities.
- (i) Area cleaning, removal of temporary structures and return of scrap.
 - (ii) Punch list points / pending points liquidation pending due to reasons attributable to contractor
 - (iii) Submission of "As built Drawing"
 - (iv) Material Reconciliation
 - (v) Completion of Contract Closure formalities like HR Clearance/ No dues from various dept./ Statutory Authorities etc.

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

SI No: 9

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

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

9.1.1 Clause 2.13.1 in GCC is revised as "Normally no advance payment shall be payable to the contractor. Mobilization advance payment in exceptional circumstances shall be interest bearing and secured through a Bank Guarantee and shall be limited to a maximum of 5% of contract value. This 'Interest Bearing Recoverable Advance' shall be payable in not less than two installments with any of the installment not exceeding 60% of the total eligible advance".

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

9.1.3 Clause 2.13.7 in GCC is revised as "Unadjusted amount of advances paid shall not exceed 5% of the total contract value at any point of time. Recovery of advances shall be made progressively from each Running Bill such that the advance amounts paid along with the interest is fully recovered by the time the contractor's billing reaches 90% of contract value."

SI. No: 10

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

2.14.1 The quantities given in the contract are tentative and may change to any extent (both in plus side and minus side). The quoted rates for individual items shall remain firm irrespective of any variations in the individual quantities. No compensation becomes payable in case the variation of the final executed contract value is within the limit of Minus (-) 30% of awarded contract value."

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SI No: 11

PRICE VARIATION COMPENSATION (PVC)

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

2.17 PRICE VARIATION COMPENSATION

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

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

Sl. No	CATEGORY	BASE INDEX	PERCENTAGE COMPONENT ('K')				
			CIVIL PACKAGES (See Note A/B/C)			MECHANICAL PACKAGES	Electrical, C&I, Material Management / Handling and other labour oriented packages
			A	B**	C		
i)	LABOUR (ALL CATEGORIES)	'MONTHLY ALL-INDIA AVERAGE CONSUMER PRICE INDEX NUMBERS FOR INDUSTRIAL WORKERS' published by Labour Bureau, Ministry of Labour and Employment, Government of India. (Website: labourbureau.nic.in)	40	25	30	65	80
ii)	HIGH SPEED DIESEL OIL	Name of Commodity: HSD Commodity code: 1202000005 (See Note E)	5	3	5	5	5
iii)	WELDING ROD	Name of Commodity: MANUFACTURE OF BASIC METALS Commodity code: 1314000000 (See Note E)				15	

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iv)	CEMENT	Name of Commodity: ORDINARY PORTLAND CEMENT Commodity code: 1313050003 (See Note E)		20	30		
v)	STEEL (Structural and Reinforcement Steel)	Name of Commodity: MILD STEEL: LONG PRODUCTS Commodity code: 1314040000 (See Note E)		25			
vi)	ALL OTHER MATERIALS (Other than Cement & Steel)	Name of Commodity: ALL COMMODITIES Commodity code: 1000000000 (See Note E)	40	12	20		

Note: A) Cement & Steel: Free Issue (BHEL Scope)

B) Cement & Steel: In Contractor Scope

C) Cement in Contractor Scope, and Steel is Free Issue (BHEL Scope)

D) For Composite packages (i.e. Civil + Mechanical + Electrical and / or CI or Civil + Mechanical or Mechanical + Electrical and / or CI), the Component ('K') for various categories shall be as per respective packages as above

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

2.17.3 **Void**

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

$$P = K \times R \times \frac{(X_N - X_0)}{X_0}$$

Where

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

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

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

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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

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

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

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

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

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

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

However, the total Quantum of Price Variation Amount payable/recoverable shall be regulated as follows:

- i) For the portion of shortfall/backlog not attributable to contractor, PVC shall be worked out on the basis of indices applicable for the respective month in which work is done. Base index shall be applicable as defined in clause 2.17.5
- ii) In case of Force Majeure, the PVC shall be regulated as per (a) or (b) below.
 - a) Force Majeure is invoked before “Base Date” / “revised base date” (as explained below) OR immediately after “base date” / “revised base date” in continuation (i.e. during the period when PVC is not applicable):
 - vii. Base date shall be revised: Revised Base date = Previous base date + duration of Force Majeure.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

No PVC will be applicable for the work done till revised base date.

- viii. PVC will be applicable for the work done after “base date”/ “revised date” as the case may be (during extended period when delay is not attributable to contractor). PVC shall be worked out on the basis of indices applicable for the respective month in which work is done with base index as on “base date”/ “revised base date” as the case may be.
- b) Force Majeure is invoked after “base date”/ “revised base date” as the case may be (during extended period when delay is not attributable to contractor).
 - 2. PVC shall be applicable for the work done after revocation of Force Majeure.
 - 3. PVC for the work done after revocation of Force Majeure shall be worked out on the basis of indices applicable for the respective month on which work is done excluding the effect of change in indices during total period of Force Majeure(s) invoked after “base date” / “revised base date” as the case may be. Base index shall be taken as on “base date” / “revised base date” as the case may be.

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

SI No: 12

Clauses 2.21 in GCC regarding Arbitration is amended as below

2.21 ARBITRATION & CONCILIATION

2.21.1 ARBITRATION:

2.21.1.1 Except as provided elsewhere in this Contract, in case Parties are unable to reach amicable settlement (whether by Conciliation to be conducted as provided in Clause 2.21.2 herein below or otherwise) in respect of any dispute or difference; arising out of the formation, breach, termination, validity or execution of the Contract; or, the respective rights and liabilities of the Parties; or, in relation to interpretation of any provision of the Contract; or, in any manner touching upon the Contract (hereinafter referred to as the ‘Dispute’), then, either Party may, commence arbitration in respect of such Dispute by issuance of a notice in terms of section 21

TECHNICAL CONDITIONS OF CONTRACT (TCC)

of the Arbitration & Conciliation Act, 1996 (hereinafter referred to as the 'Notice'). The Notice shall contain the particulars of all claims to be referred to arbitration in sufficient detail and shall also indicate the monetary amount of such claim. The arbitration shall be conducted by a sole arbitrator to be appointed by the Head of the BHEL Power Sector Region issuing the Contract within 60 days of receipt of the complete Notice. The language of arbitration shall be English.

The Arbitrator shall pass a reasoned award.

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

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

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

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

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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

2.21.2 CONCILIATION:

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

Notes:

1. No serving or a retired employee of BHEL/Administrative Ministry of BHEL shall be included in the BHEL Panel of Conciliators.
2. Any other person(s) can be appointed as Conciliator(s) who is/are mutually agreeable to both the parties from outside the BHEL Panel of Conciliators.

The proceedings of Conciliation shall broadly be governed by Part-III of the Arbitration and Conciliation Act 1996 or any statutory modification thereof and as provided in Procedure 2.3 enclosed in Vol 1A Part II Chapter 12. The Procedure 2.3 together with its Formats will be treated as if the same is part and parcel hereof and shall be as effectual as if set out herein in this GCC.

The Contractor hereby agrees that BHEL may make any amendments or modifications to the provisions stipulated in the Procedure 2.3 enclosed in Vol 1A Part II Chapter 12 from time to time and confirms that it shall be bound by such amended or modified provisions of the Procedure 2.3 with effect from the date as intimated by BHEL to it.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

2.21.3 No Interest payable to Contractor

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

SI No: 13: Reverse Auction

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

SI No: 14

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

SI No: 15

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

SI No:16

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

2.22 Performance Security Deposit

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

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

(or)

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

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

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

TECHNICAL CONDITIONS OF CONTRACT (TCC)

2.22.2 Refund of Performance Security Deposit:

- a) 50% of Performance Security Deposit shall be released along with the final bill.
- b) Balance 50% will be released after completion of Performance Guarantee Period (i.e., after expiry of Guarantee period), provided all the defects noticed during the guarantee period have been rectified to the satisfaction of BHEL Site Engineer/ BHEL Construction Manager, and after deducting all expenses/ other amounts due to BHEL under the contract/ other contracts entered into by BHEL with them. This portion of Performance Security Deposit, amount can be released on commencement of the Guarantee Period, on submission of equivalent Bank Guarantee.

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

SI No: 17

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

SI No: 18

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

SI. No.: 19

PRICE BID OPENING

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

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

SI No: 20

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

TECHNICAL CONDITIONS OF CONTRACT (TCC)

SI No: 21

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

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

MAN-HOUR RATE FOR ELIGIBLE EXTRA WORKS:

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

VOLUME-IA PART – II

CHAPTER 2-14

In the next 606 pages as below:

CHAPTER	Details	No. of sheets
CHAPTER 2	Technical Specification	458
CHAPTER 3	Bore Log details	09
CHAPTER 4	Technical Specification for Labour Colony	10
CHAPTER 5	HSE Plan For Site Operations By Subcontractor	82
CHAPTER 6	Form 15 Rev 02	06
CHAPTER 7	Form 14 Rev 01	06
CHAPTER 8	T&P Hire Charges	10
CHAPTER 9	Proforma Of Bank Guarantee (In Lieu Of Earnest Money)- Form WAM 23	03
CHAPTER 10	Proforma Of Bank Guarantee (In Lieu Of Security Deposit)-Form WAM 22	03
CHAPTER 11	Integrity Pact Format	05
CHAPTER 12	Procedure For Conduct Of Conciliation Proceedings	11
CHAPTER 13	No Deviation certificate (Form F-03, Rev 01)	01
CHAPTER 14	Drawings	02

TELANGANA STATE POWER GENERATION
CORPORATION LIMITED
[TSGENCO]



5X800 MW YADADRI TPS

TECHNICAL SPECIFICATIONS
FOR
RCC CHIMNEY

SPECIFICATION NO. PE-TS-417-620-C001



BHARAT HEAVY ELECTRICALS LIMITED
PPEI BUILDING, HRD & ESI COMPLEX
PLOT NO.- 25, SETOR 16 A
NOIDA (U.P.)



PROJECT: 5x 800 MW YADADRI TPS

SPECIFICATION NO. PE-TS-417-620-C001

SECTION A

**TECHNICAL SPECIFICATIONS FOR RCC
CHIMNEY**

REV.NO. 0 DATE 16/11/2017

Page 1 of 8

PROJECT TITLE : 5x 800 MW YADADRI TPS

**2 Nos. twin flue steel RCC chimney + 1 no. single flue steel
RCC chimney.**

RATING : 5x 800 MW

LOCATION : TELANGANA



PROJECT: 5x 800 MW YADADRI TPS

SPECIFICATION NO. PE-TS-417-620-C001

**TECHNICAL SPECIFICATIONS FOR RCC
CHIMNEY**

SECTION A

REV.NO. 0 DATE 16/11/2017

Page 2 of 8

PREAMBLE

This Tender document contains three (3) volumes. The bidder shall meet the requirement of all three volumes.

VOLUME – 7-D

This volume is subdivided into following sections:

Section-A: This section outlines the scope of enquiry.

Section-B: This section provides “Project Information”.

Section-C1 & C2: This section indicates the technical requirements specific to the contract not covered in the section-D.

Section-D: This section comprises of technical specification.

NOTE: In case of any conflict between section –C and section-D, Section C of specification prevails.



PROJECT: 5x 800 MW YADADRI TPS

SPECIFICATION NO. PE-TS-417-620-C001

**TECHNICAL SPECIFICATIONS FOR RCC
CHIMNEY**

SECTION A

REV.NO. 0 DATE 16/11/2017

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VOLUME -7-D

SECTION	DESCRIPTION
Section-A	SCOPE OF ENQUIRY
Section-B	PROJECT INFORMATION
Section-C	SPECIFIC TECHNICAL REQUIREMENTS i) CIVIL ii) ELECTRICAL iii) Chimney Elevator
Section-D	1) SPECIFICATION FOR CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS 2) SPECIFICATION FOR ELECTRICAL WORKS 3) ELEVATOR



PROJECT: 5x 800 MW YADADRI TPS

SPECIFICATION NO. PE-TS-417-620-C001

**TECHNICAL SPECIFICATIONS FOR RCC
CHIMNEY**

SECTION A

REV.NO. 0 DATE 16/11/2017

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VOLUME – 7-D

SECTION-A

SCOPE OF WORK

SPECIFICATION NO. PE-TS-417-620-C001



PROJECT: 5x 800 MW YADADRI TPS

SPECIFICATION NO. PE-TS-417-620-C001

SECTION A

TECHNICAL SPECIFICATIONS FOR RCC CHIMNEY

REV.NO. 0 DATE 16/11/2017

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Scope of Work

1.0.0 SCOPE

1.1.1

The work to be done under this specification comprises of construction of two unit of 275 M high Reinforced Concrete Twin steel flue with borosilicate liner Chimney and one unit of 275 M high Reinforced Concrete single steel flue with borosilicate liner Chimney complete with reinforced concrete raft foundation, RCC, steel, internal steel platforms, staircase, appurtenances, fixtures, fittings, conduit and other embedment, lift (inside windshield), ventilation etc. complete. R.C.C. shell, insulation and provision of other accessories including external platforms, fabrication and fixing of flue duct inside the chimney, complete interior and Air Aviation Obstruction lighting system, gas sampling ports, opacity measurement ports, lightning protection and grounding system, doors for access to the shell, external platforms and inspection of the liners, ladders, communication system components, embedments for installation of equipments and fixtures and painting both internal and external of the chimney shell as well as of all doors, stairs, ladders and other structural steel items in accordance with this specification and approved drawings.

1.1.2

The supply, erection, testing and commissioning of chimney Elevator are in the scope of this work. The tenderer shall make provision to accommodate chimney elevator within the annular space of R.C.C. Shell and all Civil and structural steel works required for erection, testing and commissioning of the elevator shall be in the scope of this work.

1.1.3

The scope under this specification covers the construction of single/twin flue Reinforced Concrete Chimney including providing all labour, supervision, materials, scaffolding, power, fuel, construction equipments, tools and plants, supplies, transportation, storage, insurance and all incidental items not herein specifically mentioned but reasonably implied or which may be found necessary for successful completion of the work including contractor's, and where necessary manufacturer's expert supervision in strict compliance with the requirements of this specification and approved construction drawings. The tendered amount shall be for the chimney to be completed in all respect as per this specification for the purpose required.



PROJECT: 5x 800 MW YADADRI TPS

SPECIFICATION NO. PE-TS-417-620-C001

SECTION A

**TECHNICAL SPECIFICATIONS FOR RCC
CHIMNEY**

REV.NO. 0 DATE 16/11/2017

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1.1.4

It should be noted that during the course of construction or thereafter, before the project handover, if certain tests, as specified by the owner, are required to establish the quality of construction, then cost of such test should be borne by tenderer without any extra implication. Further, the decision of the owner regarding the quality of construction shall be final and binding on the tenderer. Also, no test (quality or otherwise) shall be done on the subject chimney, without the permission of owner, and reports/ tests results shall treated confidential, are not to be shared with any party without the permission of the owner.

1.1.5

The successful tenderer shall have to prepare bar bending schedule & schedule of embedments & schedule of opening in RCC shell and get the same approved by the Engineer. The detailed fabrication drawings for doors, flue ducts, liners, platforms, ladders, staircases, hand rails and other fixtures shall also be prepared by the successful tenderer and got approved from the Engineer before undertaking the actual fabrication or erection of construction.

1.1.6

The contractor shall prepare, at his own cost, the detailed working drawings showing all details of the formwork staging (adequacy to be supported by design calculations) and other arrangements for the concreting work and submit six copies of the same for the approval of the Engineer-in-Charge /consultants and only on the receipt of the approval of the consultants the work shall be taken up.

1.1.7

The contractor shall prepare, at his own cost, the detailed working drawings showing all Electrical details and Elevator details.



PROJECT: 5x 800 MW YADADRI TPS

SPECIFICATION NO. PE-TS-417-620-C001

**TECHNICAL SPECIFICATIONS FOR RCC
CHIMNEY**

SECTION A

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2.0.0 TENDER DRAWINGS

2.1.1

The following drawing which forms part of Tender Documents are indicative and give overall dimensions, and some other typical details of the work required to be done under this contract. The accessories shown in the drawings are also indicative:

S. NO.	DRG. NO.	TITLE
1.	PE-DG-417-620-C101	GENERAL ARRANGEMENT OF CHIMNEY (FOR SINGLE STEEL FLUE).
2.	PE-DG-417-620-C201	GENERAL ARRANGEMENT OF CHIMNEY. (FOR TWIN STEEL FLUE).

2.1.2

The drawings and specifications furnished are to be considered as explanatory of each other. Should anything appear in one drawing that is not described in the other, no advantage shall be taken of such omission. Should any discrepancies, however, appear, or should any misunderstanding of drawings or as to the dimensions or quality of the materials or the due and improper execution of the works or as to the measurements or quality or valuation of the works executed under this contract or as extra thereupon, the same shall be clarified by the Engineer-in-charge or his authorised representative and his explanation shall be binding upon the contractor. Directions as given by the Engineer-in-charge or his authorised representatives being considered necessary for the proper completion of the work as implied by the specifications and drawings, even though such works and things are not specially shown and described in the said drawings and specifications shall be binding on the contractor. Supplementary dimensions or drawings may be given by the Engineer/Engineer-in-charge in addition to those already given and changes may also be effected in them and the contractor shall have to execute the works on the basis of the supplementary drawings or changed drawings and specifications without any additional claim whatsoever.



PROJECT: 5x 800 MW YADADRI TPS

SPECIFICATION NO. PE-TS-417-620-C001

SECTION A

**TECHNICAL SPECIFICATIONS FOR RCC
CHIMNEY**

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3.0.0 DOCUMENTS MUTUALLY EXPLANATORY AND SECTION C.

3.1.0

Contractor shall read the parts of the specification relevant to the contract and shall ignore the other parts of the 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) Part C c) Part D

3.2.0 GENERAL

3.2.1

The overall coordination for all works specified in the scope of work will be the responsibility of the contractor. The contractor shall also provide adequate supervisory personnel for works executed under his Scope of Work.

3.2.2

Any clarification from customer/customer's representative shall have to be furnished by the contractor.



**PROJECT: 5x 800 MW YADADRI
TPS**

**TECHNICAL SPECIFICATIONS FOR
RCC CHIMNEY**

PROJECT INFORMATION

SPECIFICATION NO. PE-TS-417-620-C001

VOLUME - II B

SECTION - B

REV.NO. 0 DATE- 10/11/2017

SHEET 1 OF 2

VOLUME – 7-D

SECTION-B

PROJECT INFORMATION

SPECIFICATION NO. PE-TS-417-620-C001



**PROJECT: 5x 800 MW YADADRI
TPS**

**TECHNICAL SPECIFICATIONS FOR
RCC CHIMNEY**

PROJECT INFORMATION

SPECIFICATION NO. PE-TS-417-620-C001

VOLUME - II B

SECTION - B

REV.NO. 0 DATE- 10/11/2017

SHEET 2 OF 2

OWNER	TELANGANA STATE POWER GENERATION CORPORATION LIMITED
NAME OF PROJECT	5X800 MW YADADRI TPS
SITE LOCATION	➤ 30 KM FROM MIRYALAGUDA TOWN., and ➤ 3 KM FROM VISHNUPURAM RAILWAY STATION ➤ NEAREST AIRPORT is HYDERABAD WHICH is ABOUT 200 KM FROM SITE
TYPE OF CHIMNEY	1. 2 NOS. RCC SHELL TWIN STEEL FLUE 2. 1 NO. RCC SHELL SINGLE STEEL FLUE
HEIGHT OF CHIMNEY	275 m
FOUNDATION	RAFT FOUNDATION



**TITLE: TSGENCO
5 X 800 MW YADADRI TPS**

SPECIFICATION NO.: PE-TS-417-620-C001

VOLUME - 7-D

SECTION - C1

REV.NO. 0

DATE – 16/11/2018

SHEET 3

5X800 MW YADADRI TPS

TSGENCO

VOLUME – 7-D

CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-417-620-C001

SECTION – C1

SPECIFIC TECHNICAL REQUIREMENTS



**BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
NOIDA 201301**



**TITLE: TSGENCO
5 X 800 MW YADADRI TPS**

SPECIFICATION NO.: PE-TS-417-620-C001

VOLUME - 7-D

SECTION - C1

REV.NO. 0

DATE – 16/11/2018

SHEET 4

SECTION – C1

NOTE: In case of any conflict between section –C1 and section-C2,
Section C1 of specification prevails.



PROJECT :
5X800 MW YADADRI TPS

SPECIFICATION NO. PE-DC-417-620-C008

VOLUME- C

TITLE:
DESIGN MEMORANDUM FOR CHIMNEY

REV-2

DATE -24/12/2018

SHEET 1 OF 19

1.1 GENERAL PARAMETERS OF THE CHIMNEY

1	No. of Chimneys	:	3 (2 Nos. twin steel flue & 1 No. single steel flue)
2	Total height of the chimney above finished grade level	:	275 M
3	No of boilers	:	5
4	No of flues in each chimney	:	2 Nos. in twin steel flue & 1 No. in single steel flue)
5	Flue gas pressure at chimney entry level	:	10 mmWC
6	Exit gas velocity at top of chimney	:	24-28 m/s (with FGD) 28-32m/s (without FGD)
7	Design ambient temperature	:	27 degree centigrade.
8	Inlet-duct centre line elevation	:	17.80M.
9	Duct dimensions	:	7.0M(wide)X13.0M(height)- (Twin flue chimney) 5.0M(wide)X9.0M(height)- (Single flue chimney)
10	Minimum internal diameter of flue	:	7.1 M (approx.).
11	Mass of flue gas flow per boiler (t/h)	:	3790(t/h).
12	Temperature of gas (deg.C)	:	85-90°C(with FGD) 128-150°C(without FGD)
13	Density of gas (kg/m ³)	:	0.840(kg/m ³)
14	Flue gas volume flow (m ³ /sec.)	:	1253.3(m ³ /sec.)



PROJECT :
5X800 MW YADADRI TPS

SPECIFICATION NO. PE-DC-417-620-C008

VOLUME- C

TITLE:
DESIGN MEMORANDUM FOR CHIMNEY

REV-2

DATE -24/12/2018

SHEET 2 OF 19

GENERAL DESCRIPTION:

- 1.2 Chimney shall be 275m high for either twin steel flue or single steel flue. The lower concrete shell windshield up to +268 level encloses flue made up of mild steel. The upper flue from 268 level to 275m level shall be made up of 316L SS liner. Flue shall be supported on steel platforms at an interval of 45 m approx. Mild steel shall be used for the flue throughout the chimney height.
- 1.3 External platforms with minimum clear platform width of 1.0m, shall be provided at an interval of approximately 45 m. These external platforms shall be spaced approximately equally between the hood platform and ground level and shall also be located at levels of internal platforms for easy access.
- 1.4 All internal platforms, supporting flue, shall be supported on steel beams. The steel beams shall be supported on the concrete shell windshield. Internal structural steel staircase (with 6mm thick chequered plate over treads & landings), connecting all platforms, shall be provided. This staircase shall be supported on structural steel brackets taken out from shell. Access doors shall be provided at grade level and external platform levels for entry into the shell at finished grade level and for entry to external platforms. Inspection / maintenance doors shall also be provided in the flue at appropriate level near internal platform level.

Lateral stability of staircase shall be provided.

2.0 BASIS FOR DESIGN

- 2.1 The concrete shell windshields shall be designed in accordance with IS : 4998 2015 latest code, "Criteria for Design of Reinforced Concrete Chimneys". Reference may also be made to ACI : 307-1979, "Specification for Design and Construction of Reinforced Concrete Chimneys", if some aspect is not covered in the Indian Code.
- 2.2 In addition to the codes specified in clause 2.1 above, the latest editions of the following codes, standards and documents shall also be followed in the design and construction of the RC chimney system.
- | | |
|--------------------------|--|
| a) IS:456-2000 | - Code of Practice for Plain & Reinforced Concrete |
| b) IS:875 (Part 3 -1987) | - Code of Practice for Wind Load |
| c) IS: 1893 (Part I) | - Criteria for Earthquake Resistant Design of Structures |
| d) IS: 1893-2015(Part 4) | - Criteria for Earthquake Resistant Design of Structures |
| e) IS: 432 (Part-I) | - Mild Steel and Medium Steel Bars. |
| f) IS: 1786 | - Cold Twisted Steel Bars for Concrete Reinforcement |
| g) IS: 800 | - Use of Structural Steel in General Building Construction |
| h) CICIND | - International Committee on Industrial Chimneys |



PROJECT :
5X800 MW YADADRI TPS

SPECIFICATION NO. PE-DC-417-620-C008

VOLUME- C

TITLE:
DESIGN MEMORANDUM FOR CHIMNEY

REV-2

DATE -24/12/2018

SHEET 3 OF 19

i) Manohar S.N., " Tall Chimneys – Design and Construction ", Tata McGraw Hill
Publication.

j) Pinfold M.G., " Reinforced Concrete Chimneys and Towers ", View Point Publication

2.3 Concrete shell windshields shall be of concrete grade min. M-30. Foundation shall be of M-25 grade concrete . Reinforcement shall be TMT steel of grade Fe-500 confirming to IS:1786 as per latest codes.

3.0 LOADS AND THEIR COMBINATIONS

3.1 Dead Loads

All permanent loads due to the weight of concrete shell windshields, hood platform, external platforms, internal platforms and linings supported on them, ladders, flue ducts, staircases, elevators and other accessories shall be considered.

3.2 Imposed Loads

Imposed load on external platforms shall be taken as 500 kg/m²

3.3 Wind Load

3.3.1 The wind loading shall conform to IS:875 (Part -3) for a basic wind speed of 44 m/sec..

The final design will be checked and verified by wind tunnel tests at any reputed institute. Dynamic interference effects due to additional chimney(s) and other structures located in area of future expansion shall be determined with wind tunnel tests of chimney model. If needed, modifications shall be made in the design of concrete shell windshields and foundation.

Design of discrete galvanised steel strakes shall be as per IS 4998 (Part-1). However, strakes shall be provided if found necessary by wind tunnel studies.

3.4 Seismic Load

The seismic Zone-III is considered as directed by customer. Analysis and design of structures to resist the seismic forces will be established in accordance with the recommendations of IS: 1893.

3.5 Thermal Effect

Due to the effect of temperature gradient, vertical and circumferential stresses are developed. Thermal stresses induced in the concrete shell shall not exceed values given in IS:4998 2015.

The temperature gradient ΔT across the shell thickness shall be calculated as per IS:4998 2015. Temperature stresses will be calculated according to the procedures given in ACI -307 and IS:4998 2015.

Vertical and circumferential reinforcement shall be provided for temperature stresses.



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3.6 Load Combinations

Various load combinations for design of chimney shell shall be as under :

- a) dead loads
- b) dead loads + wind loads + loads due to temperature effects;
- c) dead loads + earthquake loads + loads due to temperature effects; and
- d) circumferential ring moments due to wind + due to temperature effects.

In load combinations (a) to (d) above, dead load considered shall be with & without the weight of flues. Whichever condition is more critical, shall be adopted for design. Across wind loads shall be combined with coexisting wind loads. The combined design moment at any section shall be taken as the SRSS of the moments due to across wind loads and co-existing along wind loads.

4.0 DESIGN OF CHIMNEY SHELL

The design of chimney shell shall be as per IS: 4998 2015 for various combinations of loads by limit state method.

5.0 ANALYSIS

5.1 Free Vibration Characteristics of Concrete Shell Windshield

Natural frequencies and mode shapes shall be calculated. For this purpose the chimney shaft shall be idealized as a vertical cantilever with lumped masses at different nodes. Nodes shall be provided at each platform level. Natural frequencies and mode shapes shall be computed for two cases of dead loads (with & without flues + platforms).

Lower values of dynamic modulus of elasticity of concrete, as recommended in IS:4998 2015 shall be used for calculating the natural frequencies of the chimney.

5.2 Wind Analysis

5.2.1 Along Wind Analysis

The basic wind speed is 44 m/sec.



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The gust factor shall be calculated using the method given in IS:4998 2015. Drag co-efficient C_d shall be taken as 0.8 for the concrete shell windshield with no provision of strakes. However drag co-efficient C_d shall be modified as per IS:4998 2015 if strakes to be provided on windshield.

Along wind response of chimney shall be calculated both by the gust factor method of IS: 4998 2015.

5.2.2 Across Wind Analysis

Across wind response of the chimney will be evaluated as per the method given in IS:4998 2015. Lift co-efficient $C_L = 0.16$ and $S = 0.2$ shall be considered with no provision of strakes on windshield. However Lift co-efficient C_L and S shall be modified as per IS:4998 2015 if strakes to be provided on windshield.

5.2.3 Ring Moments Due to Wind

The circumferential ring moment due to wind shall be calculated in accordance with IS:4998 2015.

5.3 Seismic Analysis

Seismic Zone-III is considered.

5.4 Stability Check

For a lined chimney, factor of safety against overturning is not less than 1.5, when the weights of lining, insulation and accessories are not considered and shall not be less than 2, when weights of lining, insulation and accessories are considered.

6.0 COMPONENT DESIGN CRITERIA

6.1 CONCRETE SHELL WINDSHIELD

Design conditions for the concrete shell windshield shall be as follows :

- (1) The concrete shell shall be designed for natural phenomena, loads and load combinations. Limit state method shall be used for design. Modular ratio shall be calculated as per Annexure-B of IS 456 – 2000. Only one grade of concrete shall be used throughout the height of the concrete shell.
- (2) Maximum deflection at the top of the chimney for both static and dynamic cases shall not be more than $H/500$ where H is the total height of the concrete shell windshield above top of the raft.
- (3) The static modulus of elasticity of concrete shall be taken as $5000\sqrt{f_{ck}}$ for instantaneous loadings, where f_{ck} is the characteristic compressive strength of concrete as per clause 6.2.3 of IS : 456 – 2000. The dynamic modulus of elasticity of concrete for various concrete grades will be taken as lower values in the range of values specified in IS:4998 2015.
- (4) Minimum thickness of concrete shell shall not be less than **400 mm**. Minimum clear cover to reinforcement shall be 50 mm.



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- (5) Reinforcement in the concrete shell shall be provided as per IS : 4998 2015. However, the maximum spacing of reinforcement shall not be more than 250 mm both ways in the shell and 300mm for the foundation raft.

Minimum Reinforcement for shell shall be as per the provisions of relevant IS code.

The total number of vertical bars in the concrete shell shall be continued till such height where alternate bars can be discontinued. However, reduction of bar diameter along the height is permissible. Vertical bars shall be uniformly spaced at any section of the shell. One third of the vertical bars can only be lapped at one section.

- (6) Extra reinforcement around the opening shall satisfy the requirements given in the following documents and the highest shall be provided :
- IS 4998 2015
 - ACI 307
 - "Reinforced Concrete Chimney and Tower" by M.G. Pinfold : Value of K₁, given in page no. 186 shall be taken as 0.11.
- (7) Embedment shall be provided in the concrete shell to support the stair case.
- (8) Expansion anchors shall be used to attach conduits, earthing lightning protection conductor, lighting fixtures and other lightweight appurtenances.
- (9) Suitable cutouts (openings) shall be provided in the concrete shell for intake of air for ventilation. Similar cutouts (openings) shall be provided near the hood platform.
- (10) Concrete shell surface shall have smooth surface.

6.2 FLUE

The function of chimney flue is to exhaust the combustion gases from the chimney. The flue are designed to protect the concrete shell from high temperature, pressure, corrosion and abrasion properties of the flue gases.

The flue shall be made up of mild steel throughout the height of chimney. Only at top portion of chimney (approx. 6m) the flue shall be made up SS liner.

The design conditions for the steel flue shall be as follows:

- The steel flue shall be designed as per specifications of Design & Construction of steel Chimney liner, Task Committee on Steel chimney liner, Fossil Power Committee, Power Division published by ACE 1975.
- The Structural steel liners and the inlet transition ducts including stiffeners and liner bearing shall be fabricated using materials conforming to the requirements of IS:800 and IS:2062 (grade A for plates and sections upto 20mm thick and grade-B killed & normalized for plates and sections thicker than 20 mm) and shall be from steel having an ultimate tensile strength of not less than 410 N/sq.mm. Minimum thickness of 10 mm (inclusive of corrosion allowance) shall be provided for liner plates.



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3. Minimum clearance between the flue and concrete shell shall not be less than 0.9 m.
4. Provisions shall be made for flue to expand both circumferentially and vertically without producing stress in the concrete shell.
5. Mild steel flue liner with minimum 38 mm thick borosilicate lining system shall be provided.

6.3 INTERNAL PLATFORMS

- 6.3.1 Steel flue shall be supported by structural steel internal platforms. Internal platforms shall be located at approximately 45.0 m intervals along the height of the chimney. The platforms are made up of structural steel girders. The girders are supported on mild steel bearing assembly in pockets within the shell and corbels.

- 6.3.2 Internal platforms shall be designed for the following loads :

- 1) Dead loads of the component.
- 2) Dead loads of the flues
- 3) Live loads on the platforms during operation and maintenance (500 Kg/m² min.)
- 4) Construction loads and live load during construction.

- 6.3.3 Chequered plate shall be provided for internal platforms .

6.4 STEEL GIRDERS

- 6.4.1 Deflection of girders shall not exceed span / 325.

- 6.4.2 The minimum thickness of web for girders carrying the flue load shall be kept as 12mm. The two girders carrying the load of steel flues shall rest on mild steel bearing assembly supported on the concrete shell in pockets or through and through openings in the concrete shell. Through and through openings beyond the mild steel bearing assembly shall be closed later on by bending back reinforcement bars at the external face of the concrete shell and concreting with same grade of concrete as that of the concrete shell. Working stress method shall be adopted for the design as per IS 800:2007.

- 6.4.3 The steel framing system for platforms shall be painted with epoxy paint over epoxy resin based zinc rich primer.

6.5 HOOD & PLATFORMS

RCC hood platform at 269m level are to be built with the concrete shell. 75 mm thick acid resistant A/R bricks shall be provided at roof platform. Proper drainage arrangement shall be provided for hood & platform.



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6.6.0 EXTERNAL PLATFORMS

6.6.1 External platforms are to be provided for aviation obstruction lights to meet the requirements of IS : 4998 (latest edition), ICAO regulations & instructions issued by Director General of Civil Aviation.

6.6.2 Minimum clear width of platforms shall be 1000 mm. A live load of 500 kg/m² shall be considered for their design.

6.6.3 20mm thick acid resistant tiles conforming to IS : 4457 (latest edition) in acid resisting mortar shall be laid over waterproofing for hood platform and all external platforms. Average thickness of mortar bed shall be 10 mm and it shall slope outwards.

6.6.4 Hand railing shall be provided all around the external platforms and hood platform using 32 NB galvanised steel pipes medium grade of IS 1239 / IS 1161. Spacing of railing posts shall not be more than 1500 mm centre to centre with a minimum height of 1000 mm.

150 mm dia galvanised steel RWD pipe shall be provided to carry rain water from hood platform to discharge point at ground level. The number of down take pipes shall be decided as per design .

6.6.5 External Platforms: Suitable provision (openings/pipe sleeves) shall be made at all the external platforms to facilitate routing the lightning protection down comers in a straight manner avoiding bends.

6.7.0 FOUNDATION

A circular foundation, preferably annular, shall be provided. The foundation shall have uniform thickness. Minimum thickness of raft shall neither be less than 0.09 times the diameter of raft nor 0.4 times the overhang of the raft from the face of the concrete shell. Minimum reinforcement shall not be less than 0.12% in each direction and each face of foundation. Wind and earthquake loads shall be treated as normal load without increase in allowable stress in soil, concrete and steel. No tension will be allowed under the raft during earthquake and wind loads. Working stress method shall be adopted for design of foundation. The top of foundation shall be kept at minimum 1.0m below the surrounding grade level of chimney area.

All recommendations for foundation design given in soil report are to be considered.

6.8.0 ROLLING SHUTTER DOOR

6.8.1 A rolling shutter, electrically and manually operated, of size approx. 8 m X 7 m shall be installed at the base of the chimney shell so that a truck could go inside the chimney if required. The door shall be installed complete with guides, hood, hardware, weather baffles, combination end locks and wind locks, mechanisms and accessories as required for proper operation and weather protection. Details of rolling shutter shall conform to IS : 6248 (latest edition) " Metal Rolling Shutters & Rolling Girds " and to the technical specifications. The door shall be painted with synthetic enamel paint with appropriate primer.



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6.9 PERSONNEL ACCESS DOORS

- 6.9.1 Steel personnel access doors shall be hollow metal doors of size 1200 mm x 2100 mm. One personnel access door shall be provided at grade level for access inside area of the chimney. Personnel access doors shall also be provided in chimney shell at external platform levels so that civil aviation lights mounted on these platforms could be approached for maintenance and replacement purposes. All these doors shall swing to bear against the seals. Door surfaces, frames and other hardware facing the interior of the chimney shall be painted with primer and finished painted with two coats of acid and heat resistant paint. Other surfaces shall be painted with primer and finish painted with two coats of aluminium paint to give an even shade.

6.10 INSPECTION & MAINTENANCE HATCH

- 6.10.1 Steel leak proof hollow M.S. doors of size 800 mm ϕ shall be provided diametrically opposite in each steel flue at all those levels where external platforms are provided. The hollow space in the door shall be filled with insulating material so that the temperature of outside surface of door is not more than 50 °C. Additional insulation on exterior face of the doors shall be provided.
- 6.10.2 Proper sealing arrangement using woven asbestos gaskets shall be provided in the doors, so that there is no leakage of the flue gas from mild steel flues into the annular space between liner and shell through these doors.

6.11 ACCESS HATCHES

- 6.11.1 A mild steel hatch frame with door shall be provided for access to the hood platform of the chimney.
- 6.11.2 Hatch frames & doors shall be painted with two coat of primer and finish painted with two coats of acid and heat resistant paint on both sides.
- 6.11.3 The hatch doors shall be flat and shall be operated upwards. They shall be provided with locking arrangements from under side for the hatch door at hood platform.

6.12 MILD STEEL BEARING ASSEMBLY

Mild steel bearing assembly conforming to relevant codes shall be provided below steel girders at support points in concrete shell pockets to accommodate thermal movements and to provide a suitable distribution of load.

6.13 FLUE OPENINGS AND DUCT WORK

The concrete shell at flue duct entry shall be adequately protected against high temperature by castable refractory lining. The gap between the shell and duct shall be properly sealed off by asbestos or any other suitable seal.

Openings in the concrete shell for flue duct entry shall be adequately reinforced to withstand design loads.



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6.14 CHIMNEY PAINTING

- 6.14.1 The inside surface of the chimney shell **including** above roof, horizontal surface of the shell at top, underside of roof slab, inside and outside surfaces of mini-shell, top exposed surface of external platforms etc shall be painted with acid & heat resistant black bituminous paint conforming to IS:158. Total dry film shall not be less than 150 micron.
- 6.14.2 The entire outside surface of concrete shell shall be painted with alternate bands of signal red and white colour, out of which top 50 m (approx.) shall be painted with acid and heat resistant polyurethane paint and rest of the outside surface shall be painted with synthetic enamel paint (Total DFT of 150 micron in minimum 2 coats of synthetic enamel paint including 2 coats of primer confirming to IS 2932 and IS 2933) in alternate bands of red and white colour.
- 6.14.3 Inner and outer surface of mild steel flue shall be blast cleaned to near white cleaning surface (Sa 2½ finish) and applied 2 coats of suitable epoxy primer.
- 6.14.4 **51mm thick** borosilicate glass block lining system on entire inner surface of mild steel flue shall be applied.
- 6.14.5 Outer surface of mild steel flue shall be applied with epoxy paint.
- 6.14.6 **All concrete surface in contact with soil shall be provided with minimum two coats of bituminous painting of grade 85/25 conforming to IS:702 @ 1.7kg/sqm.**

6.14 EXPANSION COMPENSATOR

A flexible textured cloth type including glass felt bolster shall be provided at every location, wherever provision of vertical expansion is kept for liner.

7.0.0 CHIMNEY ELECTRICALS

7.1.0 POWER

Power Supply

The following power supply arrangement is envisaged for the Chimney electricals –

- a) One (1) 415 V $\pm$ 10%, 3 phase, 4 wire, 50 Hz +3% to -5% (fault level 50 KA) supply to AC Distribution Board for Normal AC Lighting and elevator for Chimney.
- b) One (1) 415 V $\pm$ 10%, 3 phase, 4 wire, 50 Hz +3% to -5% (fault level 50 KA) supply from emergency source to Lighting board for Emergency lights and Aviation Warning Lights and elevator for Chimney.



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(Any other, supply voltage, if required for the electrical system, the same shall be arranged by the Contractor through suitable means as necessary without any price implication.)

ACDB & Emergency distribution boards shall be the terminal point for the contactor & further all equipment will be contractor scope

7.2.0 DISTRIBUTION BOARDS

The following distribution boards have been envisaged:

7.2.1 AC Distribution Board

AC distribution board (ACDB) shall be provided for feeding lighting distribution boards, elevator and power receptacles. This AC distribution board shall be inside the concrete shell of the chimney. The incoming to the ACDB shall be suitable for 415V, 3phase, 4 wire, 50 Hz supply. 10% spare feeders with minimum one (1) of each type and rating shall be provided. AC distribution board shall also feed the normal lighting of the internal platforms.

7.2.2 Lighting Board

One (1) lighting board shall be provided for Normal A.C. Lighting and one (1) Lighting board shall be provided for Emergency A.C light and Aviation Warning lighting system for chimney. These lighting boards shall also be located at El.0.0m. Each lighting distribution board shall be provided with an adequately rated dry type, delta/star, lighting transformer with Z not more than 5% and off circuit taps for variation from (-5%) to (+)5% in steps of 2.5% on the primary side. The star point of the secondary side shall be solidly grounded to get the 3 phase, 4 wire supply required for the lighting distribution board. The lighting distribution boards shall have 10% with minimum two (2) spare feeders of each type and rating.

The dry type transformer shall have the following properties:

- i) Insulation class of lighting transformer shall be "F"
- ii) Temperature rise shall be limited class "B".
- iii) The transformer shall be cast resin type.

7.2.3 AC Distribution Board / Lighting Board Constructional Details

- 7.2.3.1 AC Distribution Board (ACDB) and Lighting Boards shall be metal enclosed, fabricated from CRCA sheet steel minimum 2 mm thick. AC Distribution Board shall be modular construction, fixed type module, floor-mounted and free-standing type. Each module of ACDB shall be provided with hinged door. Lighting Boards shall be suitable for either wall/column mounting on brackets or floor mounting on channel sills with hinged door on the front.



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- 7.2.3.2 AC Distribution Board and Lighting Boards shall be dust and vermin-proof, IP-54 or better.
- 7.2.3.3 AC Distribution Board and Lighting Boards shall be so constructed as to permit free access to the terminal connections and easy replacement of parts. Front access doors shall have padlocking arrangements.
- 7.2.3.4 AC Distribution Board and Lighting Boards shall have provision of cable entry from bottom as required, with removable gland plates. Necessary double compression type brass cable glands, heavy duty tinned copper cable lugs (for aluminium and copper conductor) shall be furnished .
- 7.2.3.5 Two ground pads with M10 G.I. bolts and nuts shall be provided on AC Distribution Board and Lighting Boards for connection to 75mmx10mm G.I.flat.
- 7.2.3.6 AC Distribution Board shall be complete with designation and caution notice plates fixed at front and back side and feeder name plate fixed on the front cover. Each Lighting Board shall be complete with designation and caution notice plates fixed on front cover and a circuit directory plate fixed on inside of the front cover. Circuit directory plate shall contain details of the points to be controlled by each circuit including the location of the point controlled, rating of the protective units and loading of the circuit.
The plates shall be of anodized aluminium with inscriptions indelibly etched on it.
- 7.2.3.7 Bus bar shall be electrolytic grade hard drawn aluminium, colour coded for easy identification and designed for a maximum temperature of 85 Deg.C.
- 7.2.3.8 Incoming and outgoing circuits shall be terminated in suitable terminal blocks.
- 7.2.3.9 AC Distribution Board shall consist suitable rated MCCB for over load and short circuit protection for incomer, voltmeter with selector switch and suitable PT, C.T. operated ammeter. Outgoing feeder from the AC Distribution Board shall also have MCCB with a over load and short circuit release. Proper discrimination between outgoing MCCB of AC Distribution Board and downstream MCCB of Lighting Boards will be ensured.
- 7.2.3.10 Each Lighting Board shall have an incoming triple pole MCCB with neutral link with over load and short circuit release., Lighting transformer and a number of outgoing miniature circuit breakers (MCB), 9 KA rating. The lighting transformer shall be dry type housed in the cubicle.
- 7.2.3.11 Access door of AC Distribution Board and Lighting Board shall be interlocked with incoming MCCB such that the door can be opened only when the MCCB is in OFF position. Means shall be provided to defeat this interlock.
- 7.2.3.12 MCBs (9 KA rating) in Lighting boards shall be suitable for manual closing and opening and also automatic trip on overload and short circuit.



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7.2.3.13 AC distribution board and lighting boards, after application of primer, shall be finished with electrostatic or powder painting process (thickness not less than 50 microns). For exterior shade refer to clause no.1.16.00 of section E0, Volume V-A.

7.3.0 AVIATION OBSTRUCTION LIGHTING FOR CHIMNEY

7.3.1 Illumination System for Chimney

7.3.1.1 Aviation Obstruction Lighting System

Aviation obstruction lighting system will conform to requirements of the latest Indian Standard, the International Civil Aviation Organization (ICAO), the instruction issued by the Director General of Civil Aviation – India and the Directorate of Air Routes & Aerodromes' (DARA) Circular.

In confirmation to tender specifications and clause no. 6.3.8 of Annex-14 of ICAO, high intensity Type 'A' white flashing XENON lights will be provided.

Top most AWL shall be mounted along parapet wall.

AWLs will be provided at 2 levels at E.L.271.0m (considering the Chimney height to be 275m and 185.0m & Medium intensity type 'B' Red Flashing LED at 105.0m in conformation to the clause no. 6.3.19 of Annex-14 of ICAO, which says vertical intervals shall not exceed 105.0m. Three (3) nos. of lights will be provided at each level spaced 120o apart, confirming cl.no.6.3.11 & 6.3.22 of Annex-14 of ICAO. AWLs will be installed with the setting angles as specified in 6.3.21 of Annex-14 of ICAO i.e.2o at EL105.0m & 0o at other levels. A common flasher with flash frequency of 40 flashes per minute will be provided in aviation control panel, such that all AWLs flashes simultaneously as per cl. 6.3.35 of Annex-14 of ICAO. AWLs at EL 271.0 are provided with 1.0m vertical projections and hence the light beam level is below the steel flue top by 3.0m in confirmation with cl.6.3.12 of Annex-14 of ICAO. As per ICAO obstacles in areas beyond the limits of obstacles limitation surfaces which extend to a height of 150m or more above ground elevation will be marked & lighted except that the marking may be omitted when obstacle is lighted by high intensity obstacles lights by day. All AWLs are distributed over 3 phases such that failure of any one phase would not blank any face of chimney i.e R-Y-B, Y-B-R & B-R-Y arrangement. Aviation control panel is provided with photoelectric switch that operates intensity step changer as under.

Ambient	North sky illuminance (Lux) Step changer operating range	AWL intensity Cd
Night to Twilight	21.5 < >53.6	From 2000 to 20000
Twilight to Day	377< >646	From 20000 to 200,000
Day to Twilight	377< >646	From 200,000 to 20000
Twilight to Night	21.5 < >53.6	From 20000 to 2000



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Temporary obstruction lighting will be provided during construction. Obstruction lights will be provided at the uppermost part of the stack or the surrounding scaffolding as construction proceeds upwards. As such level specified to have permanent obstruction lights is passed, that level will be provided with temporary lighting.

7.3.1.2 Temporary Obstruction Lights

At two (2) lights located at diametrically opposite points at the top of the chimney during the period of construction till the permanent obstruction lights are installed and energized, to serve as temporary obstruction lighting shall be provided.

- 7.3.2 The illumination system of chimney is governed by DCGA guidelines. In case of any changes in The guidelines in future, the same shall be adhered to.

7.3.3 Aviation Obstruction Light Fixtures (AOL Fixtures)

- 7.3.3.1 Each AOL fixture shall have 100% standby light i.e. twin type. In case of failure of one light, the standby should be activated automatically with auto changeover facility giving hooter feed back. AOL shall be L.E.D type for low and medium intensity and Xenon type for high intensity lights. The degree of protection shall conform to minimum IP 55 grade protection class. High intensity lights shall have intensity step changers.

The control panel for the AOLs shall be mounted near the main distribution board at ground level.

7.4.0 INTERIOR AND EXTERIOR LIGHTS

- 7.4.1 Interior platforms and staircase shall be illuminated by PHILIPS type NDC 21 or equivalent industrial well glass luminaries with 150 W HPSV lamp and separate control gear box. The number of fixtures shall be selected based on an illumination level of 70 lux for the staircase and platform. Fixture and control gear shall conform to degree of protection IP55 (min.). At least two (2) fixtures on each platform level shall be fed from aviation warning lighting board (emergency source). All staircase lights shall also be fed from emergency system.
- 7.4.2 Necessary junction boxes with MCBs shall be provided on each platform to control the platform and staircase lights.
- 7.4.3 One (1) 15A, 240V, single phase industrial, weatherproof type, suitable for wall/ column mounting, 3-pin receptacle with suitable interlock shall be provided on each internal and external platforms. At least two 63A, 415V, three phase industrial, weatherproof type, 5-pin receptacles shall be provided at the internal platforms.
- 7.4.4 Chimney Elevator Machine Room



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Industrial fluorescent luminaries with 2X28W fluorescent lamps with reflector shall be provided for Elevator machine room. The lux level shall be 100 lux. Four (4) numbers of bulk head luminaries with 100 W GLS lamp and wire guard shall be provided in the elevator pit.

7.4.5 Other Areas

Distribution & Lighting Boards area Industrial well glass luminaries with 150 W HPSV lamp and integral control gear shall be provided in the Distribution & Lighting boards area. The lux level shall be 150 lux.

7.5.0 CABLES AND CONDUITS

- 7.5.1 Power cables shall have stranded aluminium conductor, 1100 V grade XLPE insulated, extruded PVC inner sheath galvanized steel wire armoured, overall extruded PVC sheath.

Control cables shall have stranded annealed tinned copper conductor, 1100V grade PVC insulation, extruded PVC inner sheath, galvanized steel wire armoured, overall extruded PVC sheath. Minimum size of control cable shall be 2.5 sq. mm copper. The minimum sizes of LT cable to be chosen are as below:

AL - 16 sq.mm

CU - 2.5 sq.mm

Flexible trailing cable shall have annealed tinned copper conductor, EPR insulated, reinforced with nylon cord, cores laid up, HDCSP inner sheathed, cotton taped and HDCSP overall sheathed conforming to IS:9968.

Power, control and trailing cables shall be FRLS type.

Lighting wires shall have stranded copper conductor PVC insulated, 1100 V grade, laid in galvanized GI conduits and shall be of following minimum sizes:

- _ From Lighting panels to junction boxes : IC, 6 SQ.mm
- _ From junction boxes to lighting fixtures : IC, 2.5 SQ.mm
(Number of wires per lead as required)
- _ From Lighting panels to receptacles (15A) : IC, 6 SQ.mm
(A1)

- 7.5.2 Required number of GI pipe conduit of size not less than 32 mm dia shall be provided. Each conduit riser shall run from the lowest embedded pull box to the highest junction box. The lowest pull box shall be located 450mm above grade in the chimney / Cooling Tower. Pull boxes shall be installed at every 10m intervals vertically. The conduit risers shall run adjacent to the stairs such that the pull boxes become easily accessible from the stairs.



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- 7.5.3 Each conduit riser shall have one circumferential conduit at each platform level. The circumferential conduit at each level shall be provided with three (3) more junction boxes equally spaced at the locations of the aviation warning lights. Suitable conduits shall also be provided from the junction box to the respective light point. The GI pull boxes and junction boxes shall be of size at least 150mm x 150mm x 100mm, 3mm thk, preferably embedded in the concrete shell.
- 7.5.4 The conduits shall be electrically connected to all circumferential reinforcing rods which are in turn connected to the down conductors.
- 7.5.5 Conduit joints and connections shall be made thoroughly watertight and rust proof by application of white lead for embedded portion or red lead for exposed portion.
- 7.5.6 Conduits shall be hot dip galvanised conforming to relevant IS.
- 7.5.7 Conduit system shall be electrically bonded to the grounding system.
- 7.5.8 The conduits of lighting & I&C equipment are laid in the inner surface of the shell & cleated at regular intervals. Conduits shall be separate for AWLs/normal fixtures/ I & c equipment.

7.6.0 GROUNDING

- 7.6.1 A complete grounding system including underground mats needed for the RCC chimney shall be provided.
- 7.6.2 The grounding installation work shall conform to the requirements of the Indian Electricity Rules and Code of Practice for Earthing (IS: 3043) as amended up-to-date and grounding notes & details. DWG No. 13A06- DWGE-0600 attached with the specification. Each piece of electrical equipment/ structure shall be bonded to the grounding system at two (2) points min.
- 7.6.3 The main ground mat shall be of bare MS round bar of diameter identical to power house ground mat conductor, buried in earth at a min. depth of 1000 mm below finished grade level. Earth electrode of size 40 MM dia x 3 M length driven into the ground and connected to the ground grid conductor shall be provided, as required, to bring down the ground resistance.
- 7.6.4 Riser from the ground grid shall project 300 mm above grade / concrete floor level. All ground connections below grade shall be made by electric arc welding with low hydrogen content electrode. Above grade 75mmx10 mm galvanised mild steel (450 g/m2 zinc coating min) flats shall be run as main ground conductors securely fixed at intervals not exceeding 1500 mm. One end of the galvanized mild steel flat shall be connected to the MS round bar riser by electric arc welding and the other end to the equipment by welding / bolting, as necessary. All welded portion shall be painted with bituminous paints against possible corrosion.
- 7.6.5 The chimney ground mat shall be connected to the nearest main plant ground mat by MS round bar



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at least at two distinct locations.

7.6.6 Ground grid resistance of the grounding system shall not be more than 0.5 ohm.

7.6.7 The ground conductor sizes for grounding of electrical equipment, lighting fixtures, junction boxes etc. shall be as follows :-

- i) Distribution Boards, Lighting : 50 mm x 6 mm GI Flat
Panels and motors above 90 KW
- ii) Motors above 30 KW upto 90 KW : 35 mm x 6 mm GI Flat
- iii) Motors above 5 KW upto 30 KW : 25 mm x 3 mm GI Flat
- iv) Motors upto 5 KW : 8 SWG GI wire
- v) Lighting Fixtures, junction boxes, : 16 SWG G.I. wire ,conduits, etc.

7.7.0 CHIMNEY LIGHTNING PROTECTION

Lightning protection system shall confirm to the requirements of IS: 2309 amended up-to-date And Lightning protection notes and details. DWG. No.13Axx-DWG-E-1000 attached with the specification.

The number of termination rods will depend on the diameter of flue & quantity shall be as per codes

7.7.1 Air Termination Rod

The vertical air terminal rods shall be installed at the top of chimney to protect from lightning strokes.

For air terminals of chimney, lead coated copper tube suitably brazed with G.S band ring shall be provided as per specification.

Installation of air terminal at top the chimney for lightning protection shall be 20mm dia lead coated solid copper tube. The projected length of the tube shall be as required to protect the object from lightning stroke.

All the vertical air terminal rods shall be electrically connected together by means of horizontal conductors of size 75 x 10 mm galvanised steel flats. The air terminal rod shall be properly fixed on the top of the chimney to withstand very high wind pressure.

7.7.2 Circumferential Band

The circumferential band shall be 75 x 10 mm galvanised steel flat fixed to the circumference of top of chimney at interval not more than 1.0 m. This shall be mounted with suitable anchors at such a height as to be accessible from the top of platform for maintenance. The anchors shall be embedded in concrete wall of the stack.



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7.7.3 Down Conductors

Minimum four number of 75mm x 10mm GS flat down conductors shall be provided. These shall be not more than 15m apart on the periphery of the stack at the ground level. The down conductor shall be connected to circumferential band at the top portion of the stack and other end connected to the nearest mild steel rod riser from ground electrode. These conductors shall be continuous as far as practicable. Intermediate breaks shall be electrically bonded to form continuous circuit from top to bottom. Lapping of down conductor by bolting is not acceptable.

The down conductor shall be clamped along the surface at intervals of 1500mm by GS clamps. The connection between GS flat & GS clamps shall be done by arc welding.

At each chimney platform level, a circular band shall be provided which will be made of 75 x 10 mm GS flat and electrically connected to each down conductor.

7.7.4 Testing Points:-

Test joint shall be provided for each down conductor before termination on earth electrode at a height 1.5m from graded level. Test point shall be covered in 150 x 150 x 150 mm GS box. No sharp bends shall be formed in the down conductors and shall be kept as straight as possible.

7.7.5 Clamps, Anchors Etc.

All connections, clamps, anchors etc. of the lightning protection system shall be made of GS fittings. All joints or any other form of electrical connections, unless otherwise specified, shall be clamped or bolted by high pressure contact to form a connection of adequate current carrying capacity and mechanical strength. No solder connections will not be provided.

7.7.6 Vertical and Horizontal Reinforcing Bars:-

All reinforcing bars shall be properly bonded and connected to earthing system which shall be separate than lightning protection.

The testing point of the down conductors shall be convenient for testing. Testing point shall be phosphor-bronze gunmetal or copper or other suitable.

7.7.6 Temporary Lightning Protection:-

During construction of chimney, temporary lightning protection shall be maintained by connecting the reinforcement bars to two earth electrodes by means of two 75x10mm GS conductors. These temporary protections shall be provided even after the completion of the chimney till such time the



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permanent protections are installed.

To avoid mal effect of highly corrosive atmosphere around the chimney due to flue gas and weather, the exposed conductors, connections, clamps, base plate etc. shall be protected by hot dip galvanizing. All site-welded joints conductors shall be coated with anti corrosive paints over a coat of primer.

7.8.0 TESTS

Type Tests

The type tests for fire proof / penetration seal for floor and wall opening/ fire stop system for bottom of electrical switchgear/ panel base are as under:

- i) Fire rating test.
- ii) Hose Stream test
- iii) Accelerated aging test.
- iv) Fire rating test on the penetration seal system built out of accelerated aged components followed by hose stream test.
- v) Temp. rise test for cable in the fire stop.
- vi) Water absorption test followed by fire rating test.
- vii) Flame Resistance test for fire retardant coating material.
- viii) Anti-rodent test.

Illumination in different areas are as per designed lux level will be established.



**TITLE: TSGENCO
5 X 800 MW YADADRI TPS**

SPECIFICATION NO. : PE-TS-417-620-C001

VOLUME - II B

SECTION - C1

REV.NO. 0

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**5X800 MW YADADRI TPS
TSGENCO**

VOLUME – 7-D

CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-417-620-C001

SECTION – C2

SPECIFIC TECHNICAL REQUIREMENTS



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
NOIDA 201301

VOLUME : VII-A

GENERAL SPECIFICATION AND DESIGN CRITERIA
FOR
CIVIL AND STRUCTURAL WORKS

**NOTE: In case of any conflict between section ĩ C1 and
section-C2, Section C1 of specification prevails.**

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**VOLUME : VII-A GENERAL SPECIFICATION AND DESIGN CRITERIA FOR CIVIL
AND STRUCTURAL WORKS**

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10.00.00	DESIGN OF REINFORCED CONCRETE STRUCTURES
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22.00.00	SEQUENCE OF WORK AND PROGRESS REPORT

3.00.00

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/revisions of following codes and standards along with addendums/amendments, if any, shall be followed :

3.01.00

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 Work.
- e) IS-1256 : Code of Practice for Building Byelaws.
- f) APDSS where ever a) to e) does not speak off.

3.01.01

Earthwork

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

3.01.02

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.
 - 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-12269 : 53 grade ordinary Portland Cement

3.01.03

Foundations

- a) IS-1904 : Code of practice for structural safety of buildings : 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).
- d) IS 2911 : Code of practice for Design and Construction of Pile Foundation.

3.01.04

Loading

- a) IS-875 : Code of practice for Structural safety of buildings - loading standards.
- b) : Bridge Rules of Government of India, Ministry of Railways (Railway Board).
- C) IS 4995 : Criteria for design of RC bins for storage of granular and powdery materials.

3.01.05

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.
 - 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.
-

Doors, Windows and Ventilators

- a) IS-399 : Classification of commercial timbers and their zonal distribution.
- b) IS-883 : Code of practice for design of structural timber in building.
- 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.

3.01.07**Roof and 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 R.C. 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.

3.01.08**Waterproofing**

- a) IS-1322 : Bitumen felts for waterproofing and damp proofing.
- b) IS-1346 : Code of practice for waterproofing of roofs with bitumen felts.
- 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 waterproofed 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 waterproofing and damp proofing.
- h) IS-4365 : Code of practice for application of bitumen mastic for waterproofing of roofs.

3.01.09 **Soil Engineering**

- a) IS-1498 : Classification and identification of soils for general engineering purposes.
- b) IS-1892 : Code of practice for sub-surface investigation for foundations.
- c) IS-2131 : Method for standard penetration test for soils.
- d) IS-2720 : Methods of test for soils (all parts).

3.01.10 **Water Supply, Drainage and 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).

- 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 water, gas and sewage.
- 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 : Prestressed 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 enamelled cast iron sanitary 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 downpipes for roof drainage.

3.01.11 **Paving and Road work**

- a) IS-73 : Paving bitumen
- b) IS-702 : Industrial Bitumen
- c) IS-1201 : Method of testing tar and bituminous materials. thru' 1220
- d) Practice followed by Indian Road Congress (all parts).

3.01.12 **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.

3.01.13 **Chimney**

- a) IS-4998 : Criteria for Design of R.C. Chimneys (all parts).

3.01.14 **Structural Steelwork**

- 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.
 - Part-II : Fabrication, Galvanizing, Inspection & 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 of symbols for welding.
- f) IS-814 : Covered electrodes for manual metal arc welding of 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 : Method of measurement of steelwork and ironwork.
[Part-VIII]
- 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 fasteners.

u)	IS-1443	:	Code of practice for laying and finishing of cement concrete flooring tiles.
v)	IS-1608	:	Method for 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 tests for wire-flux combinations for submerged-arc welding of structural steels.
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 steels.
mm)	IS-7318 [Part-I]	:	Approval test for welders when welding procedure approval is not required.

- 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 steels.
- pp) AWS D.1.1 Structural Welding Code.

3.01.15 **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 : Code of practice for painting of ferrous metal
[I & II] in buildings.
- e) IS-2338 : Code of practice for finishing of wood and wood based
[I & II] 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) undercoating, b) finishing.
- j) IS-5410 : Specification for cement paint.

- #### 3.01.16
- a) Indian Road Congress (IRC) Bridge Codes
 - b) Indian Railway Standard Bridge Rules

3.01.17 **Environmental Protection**

Chapter on Corporate Responsibility for Environmental Protection (CREP) published in Gazette of India dated 27.08.2003.

4.00.00 UNITS AND LANGUAGE

4.01.00 Drawings

- All dimensions will be in SI Units - Metric (English)
- Scales
 - Planning Drawings: Site Layout & Elevations will be at 1:500, Section & Elevation of each building will be at 1:200.
 - Structural and architectural Plans, sections, and elevations will generally be at 1:100 and/or 1:50; for architectural and civil details; 1:1, 1:5, 1:10, 1:20 as required will be used.
 - Site work and yard piping plans will generally be at 1:200, 1:500
- Text will be in English language

4.02.00 Units for Calculations

All calculations will be in SI (English) units.

Length	mm, M
Area	mm ² , M ²
Volume (solids)	mm ³ , M ³
Volume (liquids)	mm ³ , M ³ , liter
Density	kN/M ³
Force	N, kN
Pressure (piping)	Bar
Moment	kNM
Stress	Mpa, N/mm ²
Distributed loads, ground pressures, etc.	kN/M ²

English language will be used in calculations

9.00.00 **BUILDING DESIGN CONCEPT**

9.01.00 **Framing System and Method of Analysis**

Analytical model of the building structure will be either two dimensional or a three dimensional space frame. Analysis of models shall be done using STAAD Pro Software.

For Steel frame structure, it will be either (1) Simple frames with vertical diagonal bracings at column lines in both directions and horizontal bracing at the roof and major floor levels or (2) Moment resisting frame in transverse direction with braced frames in longitudinal direction. For Concrete frame structure, it will be Moment resisting frame in both directions.

For composite framed building moment resisting frame will be provided in transverse and longitudinal direction with reinforced concrete columns and steel roof truss/girder framing members in transverse direction and reinforced concrete framing members in longitudinal direction.

9.02.00 **Method of Design**

The Strength design of Steel members will be done by working / allowable stress method using IS:800 (Latest Edition) whereas the Strength design of Concrete members will be done by limit state method using IS:456 (Latest Edition).

Un-braced lengths for steel beams will be as per code or as determined from following criteria

- Beams supporting concrete slab with shear connectors / compression flange embedded in RCC slab will be considered continuously supported.
- Beams supporting metal roof deck attached with welding washers plug welded will be considered continuously supported.
- Beams supporting metal deck or concrete slabs formed with metal decking will have an un-braced length based on framing member locations.
- Beams supporting grating floor will not be considered continuously supported.
- Beams which are part of a truss will use the distance between panel points as their un-braced length or, if the panel has connecting major members, the un-braced length will be based on the distance between panel points or connecting members, whichever is the shorter distance.

- In grating floor, for two parallel, interconnected beams, the beam with greater load will be considered as un-braced and the other beam as braced at the points of interconnection
- In grating floor, for three or more parallel, interconnected beams with loads of same order or magnitude, all beams will be considered as braced at points of intersection. When the beams are loaded disproportionately, the un-braced lengths will be determined as stated above.
- **Acceptance Criteria for required depth**
 - For steel members, minimum depth equals to $1/24$ of span unless clearance requirements will dictate lower depth in certain areas.
 - For Concrete members, minimum depth equals to $1/16$ of span unless clearance requirements will dictate lower depth in certain areas.
 - Members will be framed into members of equal or greater depth

10.00.00

DESIGN OF REINFORCED CONCRETE STRUCTURES

- a) The design of R.C. Structures shall be carried out by limit state or working stress method as per the provisions of IS-456.

Concrete tanks/water retaining structures shall be designed in accordance with the recommendation of IS-3370.
- b) For reinforcement detailing IS:5525 and SP:34 shall be followed. Ductile detailing of RCC structures will be as per IS: 13920.
- c) The walls shall be provided with reinforcement on both faces for sections 150 mm or more, even if not required from design consideration.
- d) **Liquid Retaining Structures**

RCC water retaining structure like storage tanks, reservoirs, etc. shall be leak proof and designed as un-cracked section in accordance with IS:3370 (part I to IV) by working stress method.

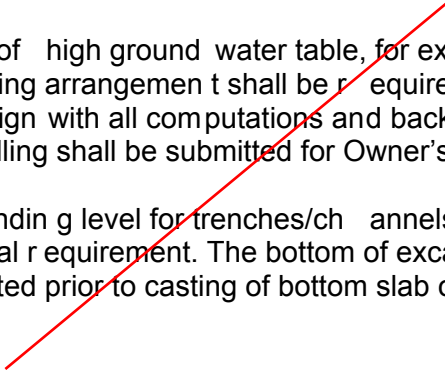
Substructure of pump houses shall be designed as cracked section with limiting crack width of 0.1 mm and limiting steel stresses as per IS:3370 (Part I to IV) by working stress method for concrete face away from water/liquid. For faces in contact with water/liquid the structure shall be designed as uncracked section in accordance with IS: 3370 (part I to IV) by working stress method.

All water retaining / storage structures shall be designed assuming liquid up to the height of wall irrespective of provision of any overflow arrangement. No pressure relieving devices shall be permitted in underground structures.

In all liquid retaining structures leak-tightness shall be ensured and guaranteed. To achieve the same, methodology in design and construction in the way of providing PVC water bars at construction/expansion joints and/or injection grouting, usage of admixture in concrete or any such method should be adopted. The sequence of construction shall also be specified on drawings showing construction joints.

FOUNDATION DESIGN

10.01.04 **Other Requirements**

- i) In case of high ground water table, for excavations comprehensive dewatering arrangement shall be required. Scheme for dewatering and design with all computations and back-up data of dewatering and sheet piling shall be submitted for Owner's information.
 - ii) The founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches/channels.
- 

- iii) Excavation for open foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil at founding level during excavation, the same shall be removed and compensated by PCC. The foundation pits shall be maintained dry during the complete construction period by means of suitable dewatering systems.
- iv) Backfilling, around foundations and bottom of pipes, thrust blocks, etc. shall be carried out with approved material in layers not exceeding 30 cm thickness and each layer shall be compacted to 90% standard proctor density for cohesive soil and to 75% of relative density for non-cohesive soils.
- v) Excess/surplus excavated material shall be disposed off by the EPC Contractor as per the instructions of the Owner up to a lead of about 5 km crow fly distance from the plant site.
- vi) CBR tests for flexible pavement design shall be carried out by the EPC Contractor after earth filling has been completed, if applicable.
- vii) The storage tanks shall rest on flexible tank pad resting on an open/shallow foundation or pile foundation. The tank pad shall be made of two layers. The first layer shall be thoroughly compacted fill of gravel, coarse sand or other suitable material topped with minimum 75mm thick compacted crushed stone, screenings, fine gravel, clean sand or similar material mixed in hot asphalt (80 / 100 bitumen or equivalent 8 to 10% by volume), rolled and compacted. The second layer shall be with minimum 25 thick premix carpet with 12 mm and down broken stone chips and 80/100 grade hot bitumen. The tank pad shall be laid by an expert agency having wide experience in execution of similar work. The tank pad shall be made up from founding level to the required level by controlled compaction in layers of 200 mm to achieve a relative density of 85% using suitable compaction equipment approved by the Owner. In addition to the above, in case of an open/shallow foundation, a ring wall shall be provided adjacent to the tank wall for retaining the fill below tank. The foundation system shall be designed as per the provisions of IS: 803. The tank shall have a flexible bottom plate, which shall establish complete bearing with the foundation fill.

After the tanks have been erected, hydro testing shall be done. Subsequent upon hydro testing of tank, the differential settlement.

10.02.00 **General Requirements**

• **Minimum Thickness of Structural Elements**

The following minimum thickness shall be followed :

Pile caps	900 mm
Suspended floor / slab / walkways / canopy slabs, etc	150 mm
Ground floor slab (non-suspended)	150 mm
Water Retaining slabs / walls	200 mm
Cable / pipe trenches / underground pits / Lauder walls and base slab	125 mm
All footings (including raft foundations)	300 mm
Width of beam	150mm
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	150 mm
Basement walls and base slab	200 mm
Silo / bin walls	150 mm
Underground reservoir	
Below ground water table	200 mm
Above ground water table	150 mm

From fire re sistance point of view minimum fire rating o f 2 hours shall be considered where fire hazard is expected and minimum thickness of reinforced concrete members shall be as per fig 1 and table 16a of IS 456 or specified above, whichever is higher.

- **Concrete Cover**

Following minimum clear concrete cover to steel reinforcement will be provided.

A.	Substructure Work	Bottom	Sides	Top	Ends
i)	Foundation	75	50	50	50
ii)	Columns, Pedestals, Grade Beams/Tie Beam	50	50	50	50
iii)	Trenches, Pits, Walls, Duct Bank etc. in contact with				
	Earth	50	50	50	50
	Water	50	50	50	50
	Others	25	25	25	40
iv)	Equipment Foundations	50	50	50	50
v)	Slab on Grade	25	50	25	50
B.	Super structure Work				
i)	Columns	-	40	-	-
ii)	Beams	35	35	35	50
iii)	Slabs/Walls	20	20	20	40
iv)	Lintel, Chajja, Bands etc.	20	20	20	25
v)	Pre-cast Concrete	20	20	20	20
vi)	Silo shell side cover		30		

- **Minimum Heights For Pedestals/Encasements of Steel Columns**

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 : 300 mm above paved level
- b) Covered area : 300 mm above FFL

Stair and ladder pedestal shall be kept 200 mm above the finished floor level.

Pedestals to Steel Columns for Equipment structure :

- a) Equipment in open area : as required (300mm min)
- b) Equipment in covered area : as required (150 mm min)

- c) Structures and equipment : as per vendor's data
supplied by vendor subject to minimum as
specified above

Foundation levels for some columns may be changed suitable to accommodate underground services, pits, trenches etc.

- **Ground floor slab-on-grade**

Ground floor slab-on-grade shall be RCC with Vacuum Dewatered Flooring (VDF) concrete construction laid over minimum 100mm thick lean concrete. Minimum 250mm thick graded stone (63 mm down size) soling with interstices filled with sand/gravel and compacted mechanically, shall be provided as sub-base below lean concrete. The sub-base shall be laid over rammed and well-compacted earth fill or hydraulically compacted sand fill as specified elsewhere in this specification.

- **Stairs, Platforms, Ladders and Handrails**

All internal stairs, platforms and walkways shall either be of RCC or GI gratings construction. All outdoor stairs, platforms and walkways shall either be of RCC or minimum 40mm thick grating. Stairway in a single run shall have the same slope. The vertical rise of the stairways shall not exceed 3.0 m for a single flight. All stairs shall have a maximum riser height of 125 mm and a minimum tread width of 250mm. Minimum width of stairs in all buildings shall be 1200 mm.

Hand railing comprising of posts 1000 mm (min.) high not exceeding 1.5m (max) c/c, shall be provided around all floors/ roof openings, projections, balconies, walkways, platforms, steel stairs etc. All hand rails and posts shall be 32NB heavy duty GI pipes as per relevant IS Codes and shall be galvanized with class-1 galvanization (as per IS-277) shall be provided for all structural steel stair cases and external RCC stairs. Hand rail will be provided with one horizontal pipe at mid-height and continuous flat iron toe guard at bottom. For all internal RCC stair cases in buildings, stainless steel hand railing shall be provided. For stainless steel handrail refer relevant architectural specification.

Steel cage ladder shall be hot dip galvanised. Stringers shall be of angles 90x90x10 with a minimum clear distance of 400 mm in-between. Rungs shall be of 20 mm diameter mild steel rods spaced at 300 mm centres. Ladder stringers shall be provided with suitable lateral stays. The ladder and its connection shall be designed for a minimum load of 200 kg at any location. Cage shall start from a height of 2.5 m above the base of ladder.

- a) Structural steel design shall be carried out as per the National Building Code with specific consultation to IS-800 working stress method unless noted otherwise. Design of structures in electrical substation shall be as per IS-802.
- b) Lateral forces along the length of the building shall be resisted by bracings in horizontal and vertical frames. The transverse lateral load shall be resisted by stiff jointed frame action. Additional bracing or moment connection shall be used to assure stability of the structures.
- c) Vertical bracing members which are connected to the beam shall be analyzed for all the vertical loads which the beam is subjected to along with lateral loads.
- d) Shear force in steel columns shall be transferred to the pedestals/foundations exclusively either through foundations bolts or through shear key arrangement.

Design of base plate shall be based on the design pressure on foundation which shall not exceed the following:

- i) Pedestal in concrete grade M20 5.0 N/mm²
- ii) Pedestal in concrete grade M25 6.25 N/mm²
- iii) Pedestal in concrete grade M30 7.5 N/mm²
- e) Shop connections shall be all welded and field connections shall generally be bolted unless specified otherwise. Field bolts, wherever provided shall be high tensile of 20 mm dia. or of higher diameter and of property class 8.8 as per IS-1367 for all major connections. The bolted joints shall be designed for friction type connection and the H.T. bolts shall be tightened to develop the required pretension during their installation. However, the nominal connections in the field like purlins, stairs, wall beams etc. shall be done by 16 mm dia. M.S. black bolts (minimum 4.6 grade) conforming to IS-1363 unless specified otherwise.
- f) Welding shall be in accordance with the recommendations of IS-816 - Code of Practice for use of metal arc welding for general construction in mild steel and IS-9595 - Recommendation for Metal Arc Welding of Carbon and Carbon Manganese Steels. Built-up members shall be fabricated using submerged arc welding procedure unless manual arc welding is specifically required. All butt welds in plate girders and columns shall be full penetration. All butt welds shall be radiographically or ultrasonically tested as per relevant IS codes and standard practice. The bare wire electrodes for submerged arc welding shall be as follows

AWS-A-5.17	Filler wire: AWS-A-5.17-EH14 Flux shall be agglomerated type of classification -F7A2EH14 g) All structural steel members for substation shall be hot dip galvanized in accordance with IS-4759. The fasteners shall also be galvanized in terms of IS-5358. Galvanizing of steel structure shall be done after all fabrication work is completed. Zinc coating of galvanized surface of structural members and threaded fasteners shall as recommended in IS:4759. However, fasteners may be tapped or re-run after galvanizing. Threads of bolts and nuts shall be capable of developing the full strength of the bolt. The spring washers shall be electro-galvanized as per IS-1573. All galvanizing shall be uniform and of standard quality and shall withstand tests in accordance with IS-2633. h) Shop primer paint shall be single coat of epoxy resin based zinc rich primer of grade 2 as per IS:14589. The surface preparation shall be done after sand blasting in accordance with IS: 1477 (Part I & II) – Code of Practice for Finishing of Ferrous Metals in Buildings. Second coat of primer shall be applied after erection and final alignment of the erected structures. Two or more coats of epoxy paint of approved shade and quality shall also be applied after erection. Total Dry film thickness of the finished paint shall not be less than 110 microns. i) All welding electrodes shall be of Low Hydrogen type conforming to IS:814 and shall be EB5426H3JX type. All electrodes, flux, wire etc. shall be of ADOR Welding Ltd., or ESAB India Ltd., or D & H Secheron Electrodes Pvt. Ltd or Modi electrodes or equivalent as approved by Owner. If submerged arc welding is used, the bare wire electrodes shall be as follows : Filler wire : AWS-A-5.17-EH14 Flux : agglomerated type of classification AWS-A-5.17-F7A2EH14 j) Minimum preheat & inter pass temperatures for welding over 40mm to 63mm (thickness of the thicker part at the point of welding) shall be 66°C and for over 63mm, it shall be 110°C. However, higher preheat & inter pass temperatures may be required due to joint restraint etc. and shall be followed as per approved welding procedure.

- k) Minimum tests to be carried out during fabrication and erection of structural steel shall be as follows:

Steel

Ultrasonic Test: Plates above 25mm thick shall be subjected to ultrasonic test as per ASTM-A435 or equivalent to check the presence of lamination.

Fillet weld

Dye Penetration Test: 25% of the total length, Dye penetration shall be carried out to the root run.

Butt weld

Dye Penetration Test : 100% of the total length, Dye penetration shall be carried out to the root run after back gouging

Radiographic Test: Splicing should not be provided in tension flange of Bunker Girders and crane girders. Spot radiography shall be carried out on 100% joints in tension zone. Minimum 300mm length shall be spot radiographed. When radiograph is not possible ultrasonic test shall be carried out after grinding the surface.

100% radiography test shall be carried out for the plates of 32mm thick and above.

25% radiography test shall be carried out for the plates below 32mm thick.

100% radiography test shall be carried out for the crane girders and bunker girders irrespective of thickness of the plate.

Ultrasonic Test : 10% of all other Butt welds except crane girder and bunker girder shall be subject to spot radiographic test and the entire balance butt weld for ultrasonic test.

l)

Connections

Connection of vertical bracings with connecting members and diagonal truss members shall be designed for full tensile capacity of the bracings.

Size of fillet weld for flange to web connection for built up column section shall be as follows:

Full shear capacity for box section.

80% of full shear capacity or actual shear (if indicated in drawings) or 0.5 times of the web thickness whichever ever is more for I section. Weld shall be double fillet.

All welds shall be continuous. The minimum size of fillet weld shall be as per relevant IS code. Shear connections shall be designed for 75% of section strength for rolled sections and 80% of section strength for built up section or rolled section with cover plates. Design shear force should be more than actual shear.

Moment connections between beam and column shall be designed for 100% of moment capacity of the beam section.

All butt welds shall be full penetration butt welds.

Connection of base plate & gusset members with the columns shall be done considering that total load gets transferred through weld.

Erection joints shall be provided with suitable splice plates as per design after conducting the relevant weld tests for the welded joints. All splicing work shall be of full strength. Shop splicing for all sections other than rolled sections shall be carried out by full penetration butt welds. Shop splicing of all rolled sections shall be carried out using web and flange cover plate.

Following connections shall be provided during erection :

Welded Connection

Connection of secondary beam to main beam

Connection of bracing to column

Connection of bracing to longitudinal tie beam

Connection of longitudinal tie beam to column

Connection of spandrel beam to column

Connection of other secondary structures

HSFG Connection (Grade 8.8 bolts)

Splicing of column/transverse frame beam/ longitudinal tie beam

Connection of frame beam to column

Connection of Crane Girder to column

Connection between crane girders

Other major connections

Bearing Type Connection (HT bolts Grade 8.8)

All removable type connections

M.S. bolts (Grade 4.6)

Purlins, stairs, wall beams etc.

11.01.00 Other Specific Requirements

All steel framed structures shall be either “rigid frame “or “simple space frames “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.

Simple space frame design utilises single-span beam systems, vertical diagonal bracing at main column lines and horizontal bracing at the roof and major floor levels.

Concrete floors shall be considered to provide continuous lateral support to the top (compression) flange of the support beams. However, wherever large cut outs (area more than 1.0 m^2) are provided in the floor slabs horizontal floor bracing shall be provided. Grating/ chequered plate floor shall neither be considered to provide lateral support to the top flange of supporting beams nor to provide a shear diaphragm. Adequate lateral support in the form of shear connector and horizontal bracing shall be provided as required.

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.

All indoor gratings shall be electro forged type and outdoor gratings shall be welded type. Minimum thickness of grating shall be 40mm for indoor installation and 32mm for outdoor installation. The opening size shall not be more than 30mm x 100mm. The minimum thickness of the main bearing bar shall be 4mm. All gratings shall be hot dip galvanized.

Where a steel beam or member is to be connected on RCC structure, it shall be connected using an insert plate and through shear connection.

For crane girders, welding between web and flange plates shall be carried out by submerged arc welding process. Full penetration of weld between web plate and top flange shall be ensured. Intermediate stiffeners shall be connected with top flange plate by full penetration butt weld. Welding a cross tension flange shall not be permitted. Bearing edges of crane girders shall be machined.

The pipe and cable rack structures shall accommodate the pipes/cables with proper access and adequate working space for erection and maintenance. These shall be designed to carry safely all the loads acting on them (DL, LL, WL, EQL, forces from pipelines etc.). The structures shall be adequately rigid to carry the forces from the pipelines at anchor points without undue deflection so that the pipe lines are really anchored at the anchor points.

The working point of the bracing connection shall be the center of column and girder to which it connects, where practical. The connections of gusset plates to column and girders shall be made to include provisions for eccentricity in connection. The double angle back-to-back with gusset plate in between shall not be used in dust-laden areas. Where double angles are not adequate, beam sections with web in the plane of bracing are used.

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

11.02.00 Permissible Deflections

The permissible deflections of various steel members under normal load 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.

Vertical Deflection

a)	For beams supporting dynamic equipment	:	Span / 500
b)	For beams supporting floors/masonry	:	Span / 325
c)	For beams supporting pipes (pipe racks)	:	Span / 400

d)	For roofing and cladding components :	Span / 250
e)	For gratings and chequered plates :	Span / 250 subject to a maximum of 6 mm
f)	Coal conveyor gallery bridges:	Span/450

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

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
c)	Pipe rack columns :	Height / 200
d)	Open Structures :	Height / 200
e)	Crane gantry girder due to surge :	Span / 2000 limited to maximum of 15 mm
f)	Building main columns at crane rail level due to action of crane surge load only :	Height / 2500 limited to maximum of 10 mm

g)	Open gantry columns at crane rail level due to action of crane surge load only	:	Height/4000 limited to maximum of 10 mm
h)	Coal Handling Trestles	:	Height/1000

Provisions of IS: 800 and relevant IS Code shall be followed for limiting deflections of structural elements not listed above.

11.03.00 **Minimum Thickness of 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 (Exposed to open air i.e., to Rain; Contact with Soil, Coal, ash, Contact with drained liquid or contaminated water, acid/alkali etc.) shall be increased suitably in thickness or suitably protected otherwise as per good practice and sound engineering judgment in each instance.

a)	Trusses, purlins, girts and bracing	:	6 mm
b)	Columns and beams	:	8 mm
c)	Gussets	:	8 mm
d)	Stiffeners	:	8 mm
e)	Base plates	:	10 mm & above
f)	Chequered plates	:	6 mm o/p & above
g)	Grating flats	:	5 mm

Minimum thickness of structural members other than gratings and chequered plate directly exposed to weather and inaccessible for painting and maintenance shall be 8 mm.

11.04.00 **Minimum Sizes of steel elements**

For Joists	:	I - 150
For Channels	:	MC - 100
For Angles	:	L 50 x 50 x 6
Gusset plates	:	8mm thick

The flange width of purlins supporting light weight concrete slab	:	65 mm
The flange width of purlins supporting roof sheeting and wall cladding	:	50 mm.
Width of steel rolled section connected to other member	:	50 mm.
The depth of beams for platform	:	125 mm.

11.05.00 **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 column	:	1 / 30

12.00.00 **STRUCTURAL MATERIALS**

Following materials shall be used in design and construction of the structure and foundation:

12.01.00 **Structural Steel**

12.01.01 Structural steel shall conform to Grade A of IS: 2062 for rolled steel members or plates up to 20 mm thickness. For plates above 20 mm thickness and welded construction, steel conforming to Grade B (Killed and normalized) of IS: 2062 shall be used except for crane girders where Grade C (Killed and normalized) (IS: 2062) steel shall be used. All structural steel plates and sections shall be of Main producer such as "SAIL" or "TATA STEEL" or "RINL" or "JINDAL" make or vendor approved by owner.

12.01.02 Structural pipes conforming to IS 806 (YST 25)

12.01.03	Structural hollow sections (square & rectangular) conforming to IS:4923
12.01.04	Pipes of hand rail conforming to IS:1161 (Medium class Grade YST=240)
12.01.05	Plates, Flats, Ordinary steel washers conforming to IS:2062 (Grade A, B & C).
12.01.06	Steel Gratings – Carbon steel conforming to IS:2062.
12.01.07	Chequered plates (6 mm thick) – Carbon steel conforming to IS:3502.
12.01.08	Anchor Bolts, Studs or Threaded Bars – Mild Steel of grade 4.6 conforming to IS:5624.
12.01.09	Connection Bolts – All High strength connection Bolts shall be of grade 8.8 conforming to IS:1367 and shall be supplied conforming to IS:3757. All mild steel connection bolts shall be of grade 4.6 conforming to IS:1367.
12.01.10	All nuts shall be of heavy duty hexagonal type and shall be compatible with the bolts.
12.01.11	All nuts & washers for high strength bolts shall conform to IS:6623 & IS:6649 respectively.
12.01.12	Washers for mild steel bolts shall be of mild steel conforming to IS:5369/IS:5372 or IS:5374 as the case may be.
12.01.13	Welding Electrodes – Low Hydrogen electrodes conforming to IS:814.
12.02.00	Concrete
12.02.01	Cement
	All cement shall be Fly ash based Portland pozzolana cement conforming to IS:1489 (Part-1).
	Ordinary portland cement conforming to IS:8112 (43 grade) / IS 12269 (53 grade) shall necessarily be used for the following structures :
	i) TG foundation top deck and sub-structure
	ii) Major machine foundations such as PA/FD/ID Fans, Pulverizers, TDBFP AND MDBFP
	iii) Chimney shell
	iv) Shell and racker columns of NDCT
	v) Structures requiring grade of concrete of M25 and above excluding water-retaining structures.

As an alternative to Fly ash based Portland pozzolana cement, Fly ash can be added to ordinary Portland cement (Grade 43/53). Batching plant shall have facility for mixing fly ash. Fly ash shall conform to IS: 3812 (Part I & Part II). Percentage of fly ash to be mixed in concrete shall be based on trial mix and subject to maximum of 25% replacement of cement. Detailed design mix shall be carried out by the bidder and approved by the consultant / owner.

PP Cement shall be used only for miscellaneous buildings like storage sheds, concrete pavements. For all other works OP Cement (grade 43/53) shall be used.

The cement procured from mini plants will not be acceptable.

12.02.02 **Grade of Concrete**

The following minimum grades of concrete as per IS-456 shall generally be used :

Sl. No.	Class	Grade of conc.
1.	i) Plain cement concrete used for screeds and mud-mat	M15
	ii) Subgrade filling	M7.5
2.	Paving in main plant area, Slab on grade, Duct bank	M20
3.	i) Reinforced concrete for super structure and foundation & Chimney raft	M25
	ii) Reinforced concrete for water retaining structure	M25
4.	Pre-cast concrete	M30
5.	Reinforced concrete for foundation of TG, Mill, BFP & Fan foundations	M30
6.	TG top deck, chimney foundation	M30
7.	chimney shell	~~M40~~ M30
8.	Piles	M30

Detailed design mix shall be carried out by the contractor and approved by the Engineer.

All underground trenches, basement and water retaining/conveying system structures shall have plasticiser cum waterproofing cement additives such as 'SIKA', 'FOSROC' make or equivalent conforming to IS:9103. In addition, limits on permeability as given in IS:2645 shall also be met with. Addition of admixtures should not reduce the strength of the concrete below the specified strength in any case. In case of water leakage during hydro-test or otherwise, additional chemical injection grouting treatment shall be applied for repairing the leakage with no cost implication to the owner.

All concrete surface in contact with soil shall be provided with minimum two coats of bituminous painting of grade 85/25 conforming to IS:702 @ 1.7 kg/sqm (minimum) for water / damp proofing up to 400 mm above finished grade level. Storm water drains shall not be provided with bituminous paint.

12.02.03 **Concrete Reinforcing Steel**

Reinforcing bars shall be TMT bars of grade Fe415 or Fe500 conforming to IS-1786 and Mild Steel bars conforming to IS : 432 (Grade I) of either of "SAIL", "TATA STEEL" and "RINL". However, for TMT re-bars above 25mm diameter shall be of 'SAIL', 'TATA' or 'RINL' only.

Further, vendor approval is required for additional vendors other than approved vendors of APGENCO.

14.04.00 **RCC Stack**

14.04.01 **General Arrangement**

~~The reinforced concrete single brick flue stack of 275 M height shall be comprising of a wind shield of reinforced concrete shell with insulated twin steel lining inside the wind shield from hopper level to top. The flue shall be vertically supported on pockets provided in wind shield at certain vertical spacing as described elsewhere in this specification.~~
~~The external RCC platforms shall be supported on RCC wind shield. Access to the platforms shall be through staircase inside of chimney.~~

i) **General Parameters**

1)	Total height of stack above ground level.	275 M
2)	Number of Stack (wind shield)	TWO
3)	Number of flue per Stack	2
4)	Number of Boilers	4 (ONE FOR EACH UNIT)

5) Particulate emission	50 mg/Nm ³ (approx)
6) Foundation level	To be decided by BHEL as per recommendation based on geotechnical investigation carried out by bidder and approved by Owner
7) Allowable Soil Bearing Capacity	To be decided by BHEL as per recommendation based on geotechnical investigation carried out by bidder and approved by Owner
8) Exit velocity of flue gas	15 m/s with partial load 29.2 m/sec. with full load
9) Type of stack (wind shield)	RCC wind shield with twin steel flue

- ii) The wind shield shall be of RCC construction. External RCC platforms shall be provided at regular intervals satisfying all functional as well as statutory requirements. The flue ducts shall be entering the wind shield at a particular level.

All external RCC platforms shall be supported on R.C. shell of the wind shield. Access door at grade level shall be provided for access into the windshield and to the hopper. All doors like inspection/maintenance doors shall be as per IS code / environment regulation.

Natural Ventilation within the windshield shall be provided as required.

iii) **Elevator and Caged Ladder**

Elevator inside Chimney and caged ladder as indicated in drawing shall be provided.

The travel of the elevator shall be up to the last platform level. Caged ladder shall be provided from last platform up to top level of chimney.

iv) **Paintings**

Entire external surface of the windshield shall be painted at least two coats over prime coat in alternate band of signal red and white colour starting with signal red colour at the top and in line with aviation requirements. External painting shall have acid, UV and heat resisting properties conforming to IS-158. Total dry film thickness (DFT) shall be at least 150 microns. The top of shell and top of acid resistant bricks at the roof level shall be painted with two coats of 'EXPILUX 5 COAL TAR EPOXY PAINT' over a thin coat of the same paint as manufactured by M/s. Berger Paints (India). The overall DFT shall be at least 230 microns.

The inner surface of windshield from ground floor up to full height shall be painted with acid and heat resisting black bitumen paint (two coats) of approved make to give a paint DFT not less than 150 microns.

Surface preparation and paint application shall be in accordance with manufacturer's recommendation and as per specification.

v) **Flue Gas Sampling Ports on chimney**

- a) Gas sampling ports fabricated from stainless steel with flanged ends shall be provided for liner at platform levels, including proper insulation, blank plates, nuts, bolts etc. The location, orientation and levels of ports shall be as per the regulations of Central Pollution Control Board & Andhra Pradesh State Pollution Control Board.
- b) Flue gas sampling ports for on line Emission monitoring instruments & Test Ports for local sampling & testing, fabricated from MS pipes of standard schedule shall be provided on the liner at access platform level.
- c) The contractor shall provide one (1) nozzle made of 200 NB MS pipe and projected approximately 200 mm outside the flue wall with an upward inclination of 5 Degree with the horizontal plane of flue can for mounting of SOx, NOx & CO analyzer.

- d) The contractor shall provide two (2) nozzles in diametrically opposite position made of 200NB MS pipe and projected approximately 200 mm outside the flue wall for mounting of Opacity monitor.
- e) Location of the Sampling & Test ports, on the stack, shall be at least at a distance of $8D$ (D = Stack diameter) downstream along the direction of flue gas flow from ID fan duct connection to stack. Further the selected position shall be at least $2D$ before stack exit. The height of the test ports shall not be less than 82.5 metre from FGL, fulfilling all above the criteria.
- f) Temperature Test pockets with a stub of size M33 X2 for installing thermo-well shall be provided by Bidder for flue gas temperature measurement & correction for opacity measurement.
- g) In addition to the above sampling ports for instrumentation purpose there shall be four (4) gas sampling ports on the flue can at 90 degree apart with flanged ends for local sampling & testing. Contractor shall provide required counter flange, nuts, bolts and gaskets. The size of each nozzle shall be 100 NB and provided with blind flanges.
- h) Access platforms shall be provided for maintenance of the above analyzers and for local sampling.
- i) Power connection with 240V, 15A AC plug socket arrangement shall be installed at this platform level for operating the Test Instruments.
- j) Dimensions indicated above are tentative, which shall be finalized during detail engineering upon receipt of vendor data. The exact details of pipe & flange and their elevations will be furnished during detail engineering on receipt of data from analyzer supplier.

Bidder shall furnish the arrangement drawings for the sampling and test points for Owner's approval during detail Engineering.

ii) **Maintenance Provisions**

The outer face of the chimney wind shield shall be provided with adequate number of stain less steel insert plates of grade 316 L at the top to enable fixing and supporting painter's trolleys and other accessories. The insert plates shall be provided with suitable number of threaded holes and nuts welded at the rear end to enable bolting of the assembly when desired.

Similar arrangement shall be made at each platform level but to fix the painting trolley arrangement directly on the platforms for the purpose of painting the chimney.

A lifting beam shall be provided to cater for lifting of materials during maintenance and painting. The size and capacity of the lifting beams shall be as per requirements.

iii) **Louvres**

Air outlet louvres shall be provided as per requirement. The louvre fins shall be of Z-shape in cross section and made from anodised aluminium plates of a minimum thickness of 4 mm. The frame work supporting the louvre fins shall be made from extruded aluminium sections of minimum thickness 6 mm. The louvres shall be mounted in the form of panels. The fins shall be closely spaced to cut off any driving rain entering the chimney wind shield. All panels must be approved by the Owner before installation.

14.04.02 Design Criteria

Design and construction of various components and systems of the chimney shall be in accordance with relevant Indian Standard and where provisions are not covered in IS, reference shall be made to ACI, BS, CI CIND and other international standards. In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail.

A. Loading

a) Dead Load

- i) All permanent loads due to the weight of chimney shell, external platforms, insulated brick linings supported on corbels, ladders, other accessories etc.

b) Imposed Loads

- i) Imposed load on service platform around Chimney shell, shall be taken as 500 Kg/m^2 . Design live load during construction / erection shall be considered as 1000 Kg/m^2 .
- ii) Imposed loads from duct joining the Chimney shall be considered.

c) Wind Load

The wind loading shall conform to IS: 8755 (Part-3). Following parameters shall be considered for assessing wind loads:

Basic wind speed = 44 m/s at 10m above mean retarding surface

$k_1 = 1.08$ as per Table 1 of IS: 875 corresponding to 100 years return period

$k_3 = 1.0$

$k_2 =$ As per Table 2 of IS: 875 (Part – 3) corresponding to terrain (category 4)

k_2 (bar) = As per Table 33 of IS: 875 (Part – 3) corresponding to terrain (category 4)

Aerodynamic Interference Effect (proximity effect) due to presence of other tall structures and stacks in the vicinity shall be assessed based on wind tunnel test to be carried by specialized agency in this field acceptable to Owner and shall be incorporated in design.

Profile (diameter, thickness etc.) as well as wind forces (moment/shear etc.) at different sections/levels of chimney shall be calculated as per structural analysis conforming to requirements of IS:4998 and Contract Specification. Wind Tunnel study shall be carried out based on the profile of the chimney determined. Worst of the forces calculated as per structural analysis and obtained from wind tunnel study shall be considered as design forces for final design of shell and foundation.

d) **Seismic / Earthquake Load**

Calculation of earthquake forces acting on the Chimney and analysis for the same shall be carried out as per IS: 18 93 (Part 4) [Zone – III] using the Response Spectrum Method. Material damping factor and number of modes to be considered for the analysis shall be as per recommendation in the code referred above.

e) **Thermal Effect**

Thermal effect due to established thermal gradient shall be duly considered as per provisions in relevant IS code.

The temperature gradient ΔT across the shell thickness of wind shield shall be calculated as per IS : 4998 but subject to a minimum of 30°C. The temperature stresses shall be calculated according to the procedures given in ACI – 307 and IS : 4998.

f) **Local Loads**

The effect of following local loads shall be considered.

- i) Local moment produced by corbels (if any).
- ii) Local moment due to platforms.
- iii) Local moment due to occurrence of ovaling oscillation.
- iv) Local moment produced by thermal gradient.

B. **Load Combination**

Various load combination for calculation of stresses shall be as under.

- i) Dead load + Wind load.
- ii) Dead load + Earthquake effect.
- iii) Dead load + Temperature effect.

- iv) Dead load + Wind load + Temperature effect.
- v) Dead load + Earthquake force + Temperature effect.
- vi) Circumferential stresses due to temperature effect.
- vii) Circumferential tensile stresses due to wind induced ring moment.
- viii) Circumferential compressive stress due to wind induced ring moment combined with temperature.

In load combinations (i) to (viii) above, dead load considered with or without the weight of insulated brick lining, whichever condition is more critical shall be adopted for design. Across wind loads shall be combined with co-exiting along wind loads. The combined design moment at any section shall be taken as SRSS of the moments due to across wind loads and co-exiting along wind loads.

C. ~~Permissible Stresses For Chimney Shell~~

~~The Stress in Steel reinforcement and Concrete shall not exceed the limits as prescribed in clause 7.0 of IS: 4998 (Part-2) for various combination of loads. Except for case of dead load + wind load, the maximum permissible stress in concrete in this case shall not exceed $0.28 F_c$, where F_c = Characteristic compressive strength of concrete.~~

D. Analysis

- **Free Vibration Characteristics of Wind Shield**

Assessment of Natural Frequencies and mode shapes shall be carried out. For this purpose the Chimney shell shall be idealized as a vertical cantilever with Lumped masses at different nodes. The nodes shall also be provided at each platform level.

The number of modes to be considered in the analysis shall be such that at least 90% of the modal mass is excited.

- **Wind Analysis**

- a) **Along Wind Load**

Along wind load shall be assessed based on methods specified in IS: 4998 (Part-I) – 1992. For design, higher of the wind loads obtained from simplified method in A-4.1 and random response method in A-5.1 shall be used. Dynamic modulus of Elasticity of concrete as recommended in IS: 4998 (Part-1) – 1992 shall be used for evaluating the natural frequencies.

Drag coefficient ' C_D ' or Force coefficient ' C_f ' shall be taken as 0.8 (minimum) based on Fig 5 of IS: 875 for the concrete shell in general. It will be increased as required as per IS: 4998 over the portion covered with strakes, if required. It is to be noted that provision of steel strakes may not be feasible considering the elevator and caged ladder up to top of chimney. Requirement of strakes shall be determined as per wind tunnel study.

b) **Across Wind Load**

The across wind response of the Chimney shall be evaluated as per the method given in Section A-4 as well as A-5 of IS: 4998 (Part-I) – 1992. Peak Oscillatory Lift Coefficient C_L shall be taken as 0.16 and Strouhal Number S_n as 0.2. Higher of the two moments shall be considered for design of the Chimney.

c) **Ring Moments due to Wind**

The circumferential ring moment due to wind shall be calculated in accordance with clause 5.4 of IS: 4998 (Part-I) – 1992. The wind induced stresses in concrete and steel shall be checked in accordance IS: 4998 (Part-2).

• **Seismic Analysis**

The Seismic Analysis shall be carried out using the Response Spectrum Method according to IS: 1893 taking the first 5 modes (minimum) of vibration into account. 5% damping shall be considered for the analysis.

14.04.03 **Component Design Criteria**

A. **Wind Shield**

The design conditions for the concrete shell shall be as follows :

1. The concrete shell shall be designed for loads and load combinations as specified. Working stress method shall be used for design of shell. The modular ratio shall be calculated as per Annexure – B of IS – 456.
2. The concrete shell shall support all platforms as well as corbels, which in turn supports the brick flue.

3. The permissible stress in concrete and reinforcement shall be limited to as specified in clause 8 of IS 4998 (Part 2) and as per Cl. No. 10.02.00 of this section, whichever is critical.
4. The maximum deflection at the top of the chimney for both static and dynamic cases shall not be more than $H/500$ where 'H' is the total height of the windshield above top of the foundation.
5. The static modulus of elasticity of concrete for various concrete grades shall be taken as specified in IS: 456.
6. The dynamic modulus of elasticity of concrete for various concrete grades shall be taken as lower values in the range of values specified in IS : 4998 (Part-I) – 1992.
7. Reinforcement in the shell shall be provided as per IS: 4998 (Part-2). However, the maximum spacing of reinforcement shall not be more than 250 mm both ways in the shell and 300 mm for foundation raft.

Minimum 0.12% reinforcement shall be provided on either side of stack wind shield.

While providing vertical reinforcement steel in the shell, the total number of vertical bars shall be continued till such height when alternative bars can be discontinued. However, reduction of bar diameter along the height is permissible. At any section of the shell vertical bars shall be uniformly spaced. Non-uniform spacing of vertical bars is not acceptable.

One third of the vertical bars can only be lapped at one section.

8. Openings in the shell shall be provided for ductwork, access doors, ash channel and ventilation system etc. The maximum width of opening shall be limited to an angle of not more than 30° subtended at the center of the concrete shell. Openings for ventilation shall be provided along periphery of the wind shield just below top of ash hopper.

The total plan area of the openings at a particular section shall not be more than 15% of the plan area of concrete shell at that location. The opening size for the purpose of stress calculations shall be taken as 1.1 times the actual width of the opening. The extra reinforcement around opening shall satisfy the requirements given in the following documents and the highest shall be provided.

a) IS: 4998

b) ACI 307

c) Reinforced concrete chimney and tower by G.M. Pinfold.

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9. Embedment to support the caged ladder shall be provided as required.
 10. Caged ladder and elevator enclosures shall be provided keeping provision for a rack and pinion type electrically operated elevator.
 11. Minimum thickness of wind-shield at top of base raft level shall be 1000 mm. Minimum thickness of wind-shield at top of chimney shall be 400 mm. However, uniform thickness of shell shall be maintained from top of raft to 3.0 m above top of flue duct entry.
 12. Uniform Grade of concrete shall be adopted throughout the height of chimney shell.

- **Insulation**

- a) The flue shall be insulated externally. The slag/mineral wool shall be of resin bonded type conforming to IS:8183 in the form of slabs. The material shall have a minimum density of 1.75 kN/cu. m. Maximum coefficient of thermal conductivity shall conform to requirements of IS:3677 at a mean temperature of 150°C.
- b) The insulation thickness shall be chosen based on the maximum ambient temperature, insulation surface emissivity of 0.3 and the insulation cold face maximum temperature not exceeding 60 °C. However minimum 100 mm thickness of insulation shall be provided.
- c) The insulation shall be tightly secured to the exterior surface of the liner by impaling them on studs fixed to the bricks at 450 mm c/c both horizontally and vertically. The studs shall be plated and be of a minimum thickness of 10 gauge. The studs shall extend a minimum of 25 mm beyond the thickness of insulation and 63 mm. Circular or square metal plate, speed washers of standard thickness shall be placed on the extended portion of the studs to hold the impaled insulation material well in place. Further, 20 gauge galvanised wire mesh with a 25 mm hexagonal pattern conforming to IS:3150 shall be wrapped around. Where the wire mesh is jointed, a minimum 150 mm overlap shall be provided. The mesh shall be bound and tied in place with a 16 gauge GI wire at 300 mm centres. Any form of lacing the mesh fibres together shall not be permitted.
- d) The diameter of the asbestos rope conforming to grade 1 of IS: 4687 shall be 25 mm.
- e) Asbestos mill board shall be 12 mm thick, unless otherwise specified. It shall be plain, dense and have a homogeneous texture, without cracks, flaws or any other manufacturing defects. It shall be laid directly over the concrete after removing all loose materials but without any mortar / plaster bedding.

- f) The base for acid resisting brick lining in hopper portion shall be 75 mm thick vermiculite concrete.
- g) No air gap shall be provided between insulation and brick lining. Accordingly, openings/cut-out in RCC corbels (for blowing of hot air) and openings in RCC wind shield at top (for venting out of hot air) shall not be provided. The insulation shall be packed properly between wind shield and brick lining.

- **Chimney Cap Over Mini shell**

Chimney cap over mini shell shall be as per approved Drawing.

C.

Foundation

- Please refer provisions of Cl. No. 10.01.00 of this Section.
- The chimney foundation shall be designed for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions.
- Ground water table shall be considered at finished grade level for foundation design. The foundation shall be checked for overturning for minimum and maximum vertical loads. Loss of contact of foundation shall also not be allowed in any combination of loads.
- Increase in allowable bearing capacity of soil under wind/seismic loading/combinations shall not be permitted.
- Base raft of chimney shall be designed as continuous considering uniform thickness without tapering. Annular raft with hollow inside is not permitted. Thickness of raft shall not be less than 0.1 times the diameter of the raft nor 0.4 times the overhang of raft from the face of the shell.
- The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12.

- Minimum 0.12% reinforcement shall be provided on either face of foundation.
- One intermediate layer of reinforcement in raft shall be provided where the thickness exceeds 2000 mm. Two such intermediate layers of reinforcement shall be provided where the thickness of raft exceeds 4000 mm. Such reinforcement in each direction shall not be less than 0.06% of cross-sectional area of raft.
- Concrete pouring sequence shall be such that no cold joints occur. Pouring for raft concrete shall not be more than 3 segments.
- The shrinkage reinforcement shall not be less than 16mm deformed bars at 600 mm centres. In addition, vertical chair bars at 600 mm centres shall be provided to support these bars.

D. **Outer Platforms**

Outer platforms, shall be provided as per Directorate of Air Routes & Aerodromes (DARA) Circular for locating Aviation Warning Lights. The platforms shall be equally spaced at a spacing of 40 m (maximum). Top most platform shall be provided preferably 2.0 mts below the top of chimney. Additional platforms for sampling ports, access doors, clean out doors etc. shall have to be provided as per requirements.

The minimum clear width of the platforms shall be 1200 mm and a live load of 500 Kg/m² shall be considered for design in addition to the dead loads and other incidental loads, if any, including construction loads.

Hand railing shall be provided all around external platforms using 32 NB (medium duty) G.I. pipes. The spacing of railing posts shall not be more than 1500 mm center to center. The height of hand railing shall not be less than 1250 mm. There shall be three handrails at about 450 mm and 850 mm & 1250 mm respectively above platform level. The posts shall be embedded in RCC curb (150 x 200 high) at outside face of platforms.

150 mm dia GI pipe shall be provided to carry rainwater from all platforms to discharge point at ground level. The number of down take pipe shall be decided as per design.

E. **Doors**

i) **Access Doors**

Two access doors of size 3000 mm x 3500 mm (high) or allowable maximum size and 2000 mm x 2100 mm (high) shall be provided at ground floor level for truck and personnel access. Electrically operated roll up shutter of suitable size for truck entry access and hollow type

pressed steel doors for personal access shall all be provided. These doors shall be provided with minimum two coats of acid and alkali resistant paint conforming to IS:158 type-I to give a DFT of 100 microns on inside surface. The outside surface shall be provided with 2 coats of resin based zinc rich primer and two final coats of epoxy paint. The personal access door shall be hinged and provided with positive locking device. The hinges required for connecting the doors with door frames shall be heavy duty butt hinges conforming to IS : 1341 (latest).

16.00.00 **STATUTORY REQUIREMENTS**

The Civil Engineering and building work shall comply with all appropriate statutory requirements including all current Building Control regulations, and with all planning or other conditions as required by the relevant local, state, and National authorities.

16.01.00 The contractor shall provide full general arrangement drawing (Civil, Structural & Architectural) of all buildings, structures and facilities to the Owner for comment. The Contractor shall not proceed with these drawings further without such comment. Any work carried out by the Contractor using drawings unacceptable by the Owner shall be at the Contractor risk.

16.02.00 The Contractor shall seek and obtain all necessary approvals and detailed planning consents outstanding at the time of placing the contract and shall be responsible for all necessary liaison with such authorities to obtain the same and for the payment of due fees for such approvals.

16.03.00 The Contractor shall obtain approval from the appropriate authority regarding the safe means of escape in the event of fire or other hazard before relevant construction work proceeds. As a minimum, the Contractor is required to ensure that the work shall comply with all statutory requirements including:

- i) Central Government/State Government - for all building control regulation
 - ii) State factories act - For Safety, health & welfare, use of hazardous substance
 - iii) Central and State Pollution Board - For limits on pollution levels.
 - iv) Central Water Authority/State Irrigation Department - For Water obstruction/supply for withdrawal of water from local source, location of Intake pump house / Jack well.
 - v) State Water & Disposal Department - for waste & Foul Water disposal.
 - vi) Ministry of Environment - for all matters relating to environment.
 - vii) Ministry of Railway - for all matters for railway line construction.
 - viii) Tariff Advisory Committee - for regulation concerning fire safety/means of escape.
 - ix) Aviation Authorities - for clearance of tall structure like stack etc.
 - x) State Public Work Department - for regulations on Civil work/road work.
 - xi) Ministry of Forestry - for deforestation, if any, for site development.
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16.04.00 The Contractor shall make due allowance for all necessary negotiation/ administration required and the time needed to obtain these permission and approvals in his programme. Failure to obtain such approvals in a timely manner shall not be a reason for extension of the programme.

17.00.00 **DOCUMENTS TO BE SUBMITTED**

17.01.00 **Design Documents**

A. The Contractor shall be required to prepare a 'Basis of Design' for each Elements/Structures of Civil Work expanding on the information given in the specification. The 'Basis of Design' shall include the following:

- i) A concise description of the form of Structure considered.
- ii) A statement of salient assumptions made.
- iii) Codes of practice and references used
- iv) A description of the design approach
- v) Detail Calculations including Computer inputs & results with conclusion.
- vi) Design/working drawings showing necessary details

The design and drawings shall be addressed to Owner / consultant appointed by the Owner for scrutiny of the same at least 12 weeks prior to the commencement of the relevant construction activity. The comments of the consultants shall be considered for effecting further revision.

B. The submission shall be in accordance with dates set down in Contractors civil work design and construction programme.

C. The Contractor shall be required to carry out at his own cost, any rectification, alteration or replacement of work progressed within 12 weeks of submission of the design basis and drawings and resulting from engineers comments on the design submission.

D. Acceptance of the Contractor 'Basis of Design' calculations or drawings by the Owner shall not relieve the Contractor of any of his obligations to meet all the requirements of the Contract or relieve the Contractor's responsibility for the correctness of design and safety of the structure for the design life of the plant. The Contractor shall make any changes in the design/drawing in the form of DCN without any financial implication, which are necessary to make the work comply with the contract.

- E. The Contractor shall prepare detailed calculations for all structure / elements in accordance with cl. no.17.01.00 A. The Contractor shall also make available any additional calculations, other than routine structural calculation, as requested by the Owner during the period of Contract.
- F. In addition to Geotechnical investigation report, the Contractor shall arrange and make available any other reports and investigations the Owner deems necessary for safety & stability of plant. The investigations shall be carried out in any standard laboratory of repute and as recommended by the Owner. All laboratory tests shall be carried out in the presence of Owner's engineer.
- G. In the event, the Contractor adopts any patented method of design and Construction, not popular or practiced in this country; the Contractor shall sought prior approval of Owner in writing. The Contractor shall forward appropriate literatures, documents, certificates, case histories etc., to establish the viability of the method.
- H. The bidder shall submit the tender with a schedule of proposed sub contractors for different construction packages (if necessary), structural consultants, (if any), any hired personnel for expertise, along with their name address, etc. and shall obtain approval of the Owner before fixing up of sub-contractor with required credentials for a particular work.
- I. Each calculation document shall include the following
- i) Contractor's name
 - ii) Package identification (if any)
 - iii) Designer's name/initials
 - iv) Checker's name/initials
 - v) Reference No.
 - vi) Index
 - vii) Date & Revision No.
 - viii) Revision identification mark
 - ix) Detail calculations including computer input data and output.
- J. Calculation packages shall preferably be bound at A4 size sheets. All numerical analysis shall be done through computer. The bidder shall have either their own system or have access in other system outside their premises.

The Contractor shall be a bonafide license holder of any software package used in this project. Any in-house developed software may also be used subject to the approval of the Owner through validation with standard computer programme. Any pirated & unlawful use of software shall not be permitted. The Contractor shall furnish:

- i) Name of Software
- ii) Developing Agency
- iii) A write-up/overview of the programme. As supplied by the copyrighter.
- iv) Relevant documents verifying users right for using this software in this country.

K All construction drawings furnished by the contractor shall consist of total quantity of concrete (grade-wise), reinforcement steel (diameter-wise) and structural steel (section-wise).

17.02.00 **Construction Documents**

Based on approved design drawing, detailed drawings for construction will be prepared by the Contractor. For reinforced concrete structures and foundations detailed bar bending schedules in approved format shall accompany each detailed drawing. For structural steel work the Contractor will prepare detailed fabrication drawing along with bill of materials.

Six (6) copies each of selected or all detailed drawings/ fabrication drawings as decided by Engineer for all structures /bill of materials need be furnished to Owner/Consultants along with bar bending schedule.

17.03.00 All working & construction drawings shall be drawn by CAD system, and shall be issued in A0/A1 size. The drawing shall include:

- i) Name of Project, Owner, Consultant & Contractor.
- ii) Title of the Drawing
- iii) Drawing No. Issue Date, Revision No.
- iv) Statement for Revision
- v) Revision Identification Mark
- vi) Release Status
- vii) Designer/Checker's/Draughtsman's name/initial

17.04.00 The Contractor, who shall maintain an up to date drawing & document register, shall monitor drawing & document issue. This register shall list all drawings & documents used in the design and construction for civil and structural work. The drawing register shall be a controlled document and shall be kept updated/revised and shall be issued on A4 size sheets.

17.05.00 All drawings, design documents, reports, correspondence pertaining to civil structural work shall be in 'English Language'. Documents in any other language shall be translated in English before submitting to Owner.

18.00.00 **LAYOUT**

Before starting the work, the Contractor shall carry out the setting out of foundation and structures and provide levels, with reference to general existing grid and bench mark. If the Contractor uses the grid, bench mark and reference pillar made by other Contractors, he shall co-ordinate with the Contractor and shall satisfy himself of the accuracy of the reference marks. If he is required to set out the foundation afresh, he shall do so independently with reference to the one existing grid and bench mark which has been followed by other agency at the instruction of the Engineer. In case any discrepancy be found, it shall be immediately brought to the notice of the Engineer for any rectification/modification necessary. No complaint shall be entertained at a later stage. The Contractor shall accurately set out the position for holding down bolts and inserts.

If required, in the option of the Engineer, he shall construct and maintain pillars for grid, references and bench marks and maintain them till the completion of the construction. He shall also help the Engineer with instruments, materials and labours for checking the detailed layouts and levels. The Contractor shall be solely responsible for the correctness of the layout and levels, and Engineer's approval shall not be deemed to imply any warranty in carrying out the work correctly. The Tenders shall take into account the cost of these in quoting their price.

19.00.00 **WORKMANSHIP**

Workmanship shall be of the best quality and all work shall be carried out by skilled workmen except for those which normally require unskilled persons. Welding shall be done by experienced and certified welders in proper sequence using necessary jigs and fixtures. Fabrication shall be done in shops having proper equipment for accurate edge lanning and milling of column shaft ends, base plate surfaces etc., and shaping and dimensioning of anchor bolt assembly, inserts and other misc. items. In addition to the requirement specified above, if the bye-laws of the local Govt., Municipal or other authorities require the employment of licensed or registered workmen for various trades, the Contractor shall arrange to have the work done by such registered or licensed personnel. In case of manufactured materials, the Contractor shall have, with no additional cost to the Owner, the services of the supervisors of the manufacturers to ensure that the work is being done according to the manufacturer's specifications.

20.00.00 TEMPORARY WORK

All scaffold ings, staging , temporary br acing and other necessary temporary work required for proper execution of the Cont ract shall b e provided by the Contractor at his own cost and in clusive of all materials, labour, supervision and other facilities.

The layout and details of such Temporary work shall have the prior approval of the Engineer, but the Contractor shall be responsible for proper strength and safety of the same. All Temporary work shall be so constructed as not to interfere with any permanent work or with the work by other agencies. If it is necessary to remove any of the temporary work at any time to facilitate execution of the work or with the work of other agencies, such removal and re-erection, if required, shall be carried out by the Contractor at the direction of the Engineer without any delay and any extra cost on this account shall be borne by the Contractor.

21.00.00 **INTERFACE WITH STRUCTURES UNDER OTHER'S SCOPE OR
EXISTING STRUCTURES**

Modification in layout of foundation/structure during detail engineering stage may be necessary to avoid fouling with those under other's scope or existing structures. Necessary changes on this account will be made without any extra cost to Owner.

22.00.00 SEQUENCE OF WORK AND PROGRESS REPORT

The sequence in which the work are to be carried out shall be as approved by the Engineer in accordance with the construction method accepted by the Engineer and to be followed by the Contractor. Contractor shall furnish quality assurance and quality control plan. A programme of work is to be submitted for the Engineer's review and approval and this has to be periodically updated and modified as per actual progress to enable timely completion.

The Contractor shall regularly submit to the Engineer progress reports for periods of working as specified by the Engineer showing upto date progress on all important items of work.

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SECTION-XV

**TECHNICAL SPECIFICATION
FOR
CHIMNEY & ~~NATURAL DRAFT COOLING TOWER~~
- ELECTRICAL WORKS**

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SECTION : XV

**TECHNICAL SPECIFICATION
FOR
CHIMNEY
- ELECTRICAL WORKS**

1.00.00 SCOPE OF WORK

1.01.00 The scope of supply and services shall include but not be limited to the following for Chimney & ~~Natural Draft Cooling Tower~~ :

- a) Equipment and materials as required.
- b) All relevant drawings, data and instruction manuals.
- c) Erection, testing and commissioning of all electrical equipment and materials supplied under this specification.
- d) Obtaining statutory approvals for Aviation warning system from concerned authority.

1.02.00 Chimney & ~~Natural Draft Cooling Tower~~ shall be provided with but not be limited to the following :

- a) Normal and Emergency Power distribution and control system
- b) Electrical system for chimney Elevator
- c) Aviation Obstruction Lighting system
- d) Normal and Emergency Lighting system
- e) Cabling and conduit system
- f) Earthing system
- g) Lightning protection system
- h) All accessories, control devices, internal wiring, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary.

1.03.00 Power Supply

1.03.01 The following power supply arrangement is envisaged for the Chimney and NDCT electricals -

- a) One (1) 415 V $\pm$ 10%, 3 phase, 4 wire, 50 Hz +3% to -5% (fault level 50 KA) supply to AC Distribution Board for Normal AC Lighting and elevator for Chimney.
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Telangana State Power Generation Corporation Ltd
5X800 MW YADADRI TPS

- ~~b) One (1) 415 V $\pm$ 10%, 3 phase, 4 wire, 50 Hz +3% to -5% (fault level 50 KA) supply to AC Distribution Board for Normal AC Lighting for Natural Draft Cooling Tower.~~
- c) One (1) 415 V $\pm$ 10%, 3 phase, 4 wire, 50 Hz +3% to -5% (fault level 50 KA) supply from emergency source to Lighting board for Emergency lights and Aviation Warning Lights and elevator for Chimney.
- ~~d) One (1) 415 V $\pm$ 10%, 3 phase, 4 wire, 50 Hz +3% to -5% (fault level 50 KA) supply from emergency source to Lighting board for Emergency lights and Aviation Warning Lights for Natural Draft Cooling Tower.~~

Any other, supply voltage, if required for the electrical system, the same shall be arranged by the Contractor through suitable means as necessary without any price implication.

2.00.00 **DISTRIBUTION BOARD**

2.01.00 **AC Distribution Board**

AC distribution board (ACDB) shall be provided for feeding lighting distribution boards, elevator and power receptacles. This AC distribution board shall be located ~~at EL 0.0 m of Natural Draft Cooling Tower &~~ inside the concrete shell of the chimney. The incoming to the ACDB shall be suitable for 415V, 3 phase, 4 wire, 50 Hz supply. 10% spare feeders with minimum one (1) of each type and rating shall be provided.

2.02.00 **Lighting Board**

One (1) lighting board shall be provided for Normal A.C. Lighting and one (1) Lighting board shall be provided for Emergency A.C light and Aviation Warning lighting system for chimney. ~~Similarly One (1) lighting board shall be provided for Normal A.C. Lighting and one (1) Lighting board shall be provided for Emergency A.C light and Aviation Warning lighting system for Natural Draft Cooling Tower.~~ These lighting boards shall also be located at El. 0.0m. Each lighting distribution board shall be provided with an adequately rated dry type, delta/star, lighting transformer with Z not more than 5% and off circuit taps for variation from (-5%) to (+)5% in steps of 2.5% on the primary side. The star point of the secondary side shall be solidly grounded to get the 3 phase, 4 wire supply required for the lighting distribution board. The lighting distribution boards shall have 10% with minimum two (2) spare feeders of each type and rating.

The dry type transformer shall have the following properties :

- i) Insulation class of lighting transformer shall be "F"
- ii) Temperature rise shall be limited class "B".
- iii) The transformer shall be cast resin type.

2.03.00 **AC Distribution Board / Lighting Board Constructional Details**

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- 2.03.01 AC Distribution Board (ACDB) and Lighting Boards shall be metal enclosed, fabricated from CRCA sheet steel minimum 2 mm thick. AC Distribution Board shall be modular construction, fixed type module, floor-mounted and free-standing type. Each module of ACDB shall be provided with hinged door. Lighting Boards shall be suitable for either wall/column mounting on brackets or floor mounting on channel sills with hinged door on the front.
- 2.03.02 AC Distribution Board and Lighting Boards shall be dust and vermin-proof, IP-54 or better.
- 2..03.03 AC Distribution Board and Lighting Boards shall be so constructed as to permit free access to the terminal connections and easy replacement of parts. Front access doors shall have padlocking arrangements.
- 2.03.04 AC Distribution Board and Lighting Boards shall have provision of cable entry from bottom as required, with removable gland plates. Necessary double compression type brass cable glands, heavy duty tinned copper cable lugs (for aluminium and copper conductor) shall be furnished by the Contractor.
- 2.03.05 Two ground pads with M10 G.I. bolts and nuts shall be provided on AC Distribution Board and Lighting Boards for connection to 75mmx10mm G.I. flat.
- 2.03.06 AC Distribution Board shall be complete with designation and caution notice plates fixed at front and back side and feeder name plate fixed on the front cover. Each Lighting Board shall be complete with designation and caution notice plates fixed on front cover and a circuit directory plate fixed on inside of the front cover. Circuit directory plate shall contain details of the points to be controlled by each circuit including the location of the point controlled, rating of the protective units and loading of the circuit.
- The plates shall be of anodized aluminium with inscriptions indelibly etched on it.
- 2.03.07 Bus bar shall be electrolytic grade hard drawn aluminium, colour coded for easy identification and designed for a maximum temperature of 85 Deg.C.
- 2.03.08 Incoming and outgoing circuits shall be terminated in suitable terminal blocks.
- 2.03.09 AC Distribution Board shall consist suitable rated MCCB for over load and short circuit protection for incomer, voltmeter with selector switch and suitable PT, C.T. operated ammeter. Outgoing feeder from the AC Distribution Board shall also have MCCB with a over load and short circuit release. It is the Contractor's responsibility to ensure proper discrimination between outgoing MCCB of AC Distribution Board and downstream MCCB of Lighting Boards.
- 2.03.10 Each Lighting Board shall have an incoming triple pole MCCB with neutral link with over load and short circuit release., Lighting transformer and a number of outgoing miniature circuit breakers (MCB), 9 KA rating. The lighting transformer shall be dry type housed in the cubicle.
- 2.03.11 Access door of AC Distribution Board and Lighting Board shall be interlocked with incoming MCCB such that the door can be opened only when the MCCB is in OFF position. Means shall be provided to defeat this interlock.
-

2.03.12 MCBs (9 KA rating) in Lighting boards shall be suitable for manual closing and opening and also automatic trip on overload and short circuit.

2.03.13 AC distribution board and lighting boards, after application of primer, shall be finished with electrostatic or powder painting process (thickness not less than 50 microns). For exterior shade refer to clause no.1.16.00 of section E0, Volume V-A.

3.00.00 **~~AVIATION OBSTRUCTION LIGHTING FOR CHIMNEY AND COOLING TOWER~~**

3.01.00 **Illumination System for Chimney**

3.01.01 Aviation Obstruction Lighting System

Aviation obstruction lighting system will conform to requirements of the latest Indian Standard, the International Civil Aviation Organization (ICAO), the instruction issued by the Director General of Civil Aviation – India and the Directorate of Air Routes & Aerodromes' (DARA) Circular.

In confirmation to tender specifications and clause no. 6.3.8 of Annex-14 of ICAO, high intensity Type 'A' white flashing XENON lights will be provided. AWLs will be provided at 2 levels at E.L.271.0m (considering the Chimney height to be 275m) and 185.0m & Medium intensity type 'B' Red Flashing LED at 105.0m in conformation to the clause no. 6.3.19 of Annex-14 of ICAO, which says vertical intervals shall not exceed 105.0m. Three (3) nos. of lights will be provided at each level spaced 120° apart, confirming cl.no.6.3.11 & 6.3.22 of Annex-14 of ICAO. AWLs will be installed with the setting angles as specified in 6.3.21 of Annex-14 of ICAO i.e.2° at EL105.0m & 0° at other levels. A common flasher with flash frequency of 40 flashes per minute will be provided in aviation control panel, such that all AWLs flashes simultaneously as per cl. 6.3.35 of Annex-14 of ICAO.

AWLs at EL 271.0 are provided with 1.0m vertical projections and hence the light beam level is below the steel flue top by 3.0m in confirmation with cl.6.3.12 of Annex-14 of ICAO. Aviation painting is omitted as per cl.no.6.1.4c of Annex-14 of ICAO.

All AWLs are distributed over 3 phases such that failure of any one phase would not blank any face of chimney i.e R-Y-B, Y-B-R & B-R-Y arrangement.

Aviation control panel is provided with photoelectric switch that operates intensity step changer as under.

Ambient	North sky illuminance (Lux) Step changer operating range	AWL intensity Cd
Night to Twilight	21.5 < >53.6	From 2000 to 20000
Twilight to Day	377< >646	From 20000 to 200,000
Day to Twilight	377< >646	From 200,000 to 20000
Twilight to Night	21.5 < >53.6	From 20000 to 2000

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Temporary obstruction lighting will be provided during construction. Obstruction lights will be provided at the uppermost part of the stack or the surrounding scaffolding as construction proceeds upwards. As such level specified to have permanent obstruction lights is passed, that level will be provided with temporary lighting.

3.01.02 Temporary Obstruction Lights

The EPC Contractor shall provide at two (2) lights located at diametrically opposite points at the top of the chimney during the period of construction till the permanent obstruction lights are installed and energized, to serve as temporary obstruction lighting.

3.02.00 ~~Illumination system for Cooling Tower~~

3.02.01 Aviation Obstruction Lighting System

Aviation obstruction lighting system conforms to the requirements of the latest Indian Standard, the International Civil Aviation Organization (ICAO), the instruction issued by the Director General of Civil Aviation – India and the Directorate of Air Routes & Aerodromes' (DARA) Circular No. 3 of 1987.

White flashing high intensity LED lights of Type 'A' of table 6.3, Annex-14 of ICAO guide lines shall be provided on top of cooling tower. Six numbers of AOLs shall be provided. All AOLs are distributed over 3 phases.

Aviation control panel is provided with photoelectric switch that de-activates and activates the circuit depending on north sky luminance.

Temporary obstruction lighting will be provided during construction. Obstruction lights will be provided at the uppermost part of the tower or the surrounding scaffolding as construction proceeds upwards. As such level specified to have permanent obstruction lights is passed, that level will be provided with temporary lighting.

The aviation obstruction lights shall meet the recommendations of ICAO and all the requirement of Director General of Civil Aviation, India. Aviation lights shall be fixed only on top of cooling tower. Type of fixtures shall be as listed below.

3.03.00 The illumination system of chimney and cooling tower is governed by DCGA guidelines. In case of any changes in the guidelines in future, the same shall be adhered to.

3.04.00 Aviation Obstruction Light Fixtures (AOL Fixtures)

3.04.01 Each AOL fixture shall have 100% standby light i.e. twin type. In case of failure of one light, the standby should be activated automatically with auto changeover facility giving hooter feed back. AOL shall be L.E.D type for low and medium intensity and Xenon type for high intensity lights. The degree of protection shall conform to minimum IP 55 grade protection class. High intensity lights shall have intensity step changers.

The control panel for the AOLs shall be mounted near the main distribution board at ground level.

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3.04.02 ~~Photoelectric light detectors shall be furnished and installed for cooling tower to monitor the north sky. The detector shall cause the control unit to energize the aviation lighting system when the north sky luminance. The lighting system may be energized during short periods of decreasing illumination due to abrupt periods of shadow during daylight hours, but shall not be de-energized as the result of short periods of increasing illumination levels due to lighting flashes or stray light sources when overall illumination level is such that the system is operating.~~

4.00.00 **INTERIOR AND EXTERIOR LIGHTS**

4.01.00 Interior platforms and staircase shall be illuminated by PHILIPS type NDC 21 or equivalent industrial well glass luminaries with 150 W HPSV lamp and separate control gear box. The number of fixtures shall be selected based on an illumination level of 70 lux for the staircase and platform. Fixture and control gear shall conform to degree of protection IP55 (min.).

At least two (2) fixtures on each platform level shall be fed from aviation warning lighting board (emergency source). All staircase lights shall also be fed from emergency system.

4.02.00 Necessary junction boxes with MCBs shall be provided on each platform to control the platform and staircase lights.

4.03.00 One (1) 15A, 240V, single phase industrial, weatherproof type, suitable for wall/ column mounting, 3-pin receptacle with suitable interlock shall be provided on each internal and external platforms. At least two 63A, 415V, three phase industrial, weatherproof type, 5-pin receptacles shall be provided at the internal platforms.

4.04.00 **Chimney Elevator Machine Room**

Industrial fluorescent luminaries with 2X28W fluorescent lamps with reflector shall be provided for Elevator machine room. The lux level shall be 100 lux. Four (4) numbers of bulk head luminaries with 100 W GLS lamp and wire guard shall be provided in the elevator pit.

4.05.00 **Other Areas**

Distribution & Lighting Boards area

Industrial well glass luminaries with 150 W HPSV lamp and integral control gear shall be provided in the Distribution & Lighting boards area. The lux level shall be 150 lux.

5.00.00 **CABLES AND CONDUITS**

5.01.00 Power cables shall have stranded aluminium conductor, 1100 V grade XLPE insulated, extruded PVC inner sheath galvanized steel wire armoured, overall extruded PVC sheath.

Control cables shall have stranded annealed tinned copper conductor, 1100V grade PVC insulation, extruded PVC inner sheath, galvanized steel wire armoured, overall extruded PVC sheath. Minimum size of control cable shall be 2.5 sq. mm copper. The minimum sizes of LT cable to be chosen are as below:

AL - 16 sq.mm

CU - 2.5 sq.mm

Flexible trailing cable shall have annealed tinned copper conductor, EPR insulated, reinforced with nylon cord, cores laid up, HDCSP inner sheathed, cotton taped and HDCSP overall sheathed conforming to IS:9968.

Power, control and trailing cables shall be FRLS type.

Lighting wires shall have stranded copper conductor PVC insulated, 1100 V grade, laid in galvanized GI conduits and shall be of following minimum sizes:

- From Lighting panels to junction boxes : IC, 6 SQ.mm
- From junction boxes to lighting fixtures : IC, 2.5 SQ.mm
(Number of wires per lead as required)
- From Lighting panels to receptacles (15A) : IC, 6 SQ.mm
(A1)

- 5.02.00 Required number of GI pipe conduit of size not less than 32 mm dia shall be provided. Each conduit riser shall run from the lowest embedded pull box to the highest junction box. The lowest pull box shall be located 450mm above grade in the chimney / ~~Cooling Tower~~. Pull boxes shall be installed at every 10m intervals vertically. The conduit risers shall run adjacent to the stairs such that the pull boxes become easily accessible from the stairs.
- 5.03.00 Each conduit riser shall have one circumferential conduit at each platform level. The circumferential conduit at each level shall be provided with three (3) more junction boxes equally spaced at the locations of the aviation warning lights. Suitable conduits shall also be provided from the junction box to the respective light point. The GI pull boxes and junction boxes shall be of size atleast 150mm x 150mm x 100mm, 3mm thk, preferably embedded in the concrete shell.
- 5.04.00 The conduits shall be electrically connected to all circumferential reinforcing rods which are in turn connected to the down conductors.
- 5.05.00 Conduit joints and connections shall be made thoroughly watertight and rust proof by application of white lead for embedded portion or red lead for exposed portion.
- 5.06.00 Conduits shall be hot dip galvanised conforming to relevant IS.
- 5.07.00 Conduit system shall be electrically bonded to the grounding system.
- 6.00.00 **GROUNDING**
-

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- 6.01.00 The Contractor shall provide a complete grounding system including underground matas needed for the RCC chimney ~~& Cooling Tower.~~
- 6.02.00 The grounding installation work shall conform to the requirements of the Indian Electricity Rules and Code of Practice for Earthing (IS: 3043) as amended up-to-date and grounding notes & details. DWG No. 13A06- DWG-E-0600 attached with the specification. Each piece of electrical equipment/ structure shall be bonded to the grounding system at two (2) points min.
- 6.03.00 The main ground mat shall be of bare MS round bar of diameter identical to power house ground mat conductor, buried in earth at a min. depth of 1000 mm below finished grade level. Earth electrode of size 40 MM dia x 3 M length driven into the ground and connected to the ground grid conductor shall be provided, as required, to bring down the ground resistance.
- 6.04.00 Riser from the ground grid shall project 300 mm above grade / concrete floor level. All ground connections below grade shall be made by electric arc welding with low hydrogen content electrode. Above grade 75mmx10 mm galvanised mild steel (450 g/m² zinc coating min) flats shall be run as main ground conductors securely fixed at intervals not exceeding 1500 mm.
- One end of the galvanized mild steel flat shall be connected to the MS round bar riser by electric arc welding and the other end to the equipment by welding / bolting, as necessary. All welded portion shall be painted with bituminous paints against possible corrosion.
- 6.05.00 The chimney / ~~Cooling Tower~~ ground mat shall be connected to the nearest main plant ground mat by MS round bar at least at two distinct locations.
- 6.06.00 Ground grid resistance of the grounding system shall not be more than 0.5 ohm.
- 6.07.00 The ground conductor sizes for grounding of electrical equipment, lighting fixtures, junction boxes etc. shall be as follows :
- | | | | |
|------|---|---|----------------------|
| i) | Distribution Boards, Lighting Panels and motors above 90 KW | : | 50 mm x 6 mm GI Flat |
| ii) | Motors above 30 KW upto 90 KW | : | 35 mm x 6 mm GI Flat |
| iii) | Motors above 5 KW upto 30 KW | : | 25 mm x 3 mm GI Flat |
| iv) | Motors upto 5 KW | : | 8 SWG GI wire |
| v) | Lighting Fixtures, junction boxes, conduits, etc. | : | 16 SWG G.I. wire |
- 7.00.00 **CHIMNEY LIGHTNING PROTECTION**
- Lightning protection system shall conform to the requirements of IS: 2309 amended up-to-date And Lightning protection notes and details. DWG. No. 13Axx-DWG-E-1000 attached with the specification.
- 7.01.00 **Air Termination Rod**
-

The vertical air terminal rods shall be installed at the top of chimney to protect from lightning strokes.

Installation of air terminal at top the chimney for lightning protection shall be 20mm dia lead coated solid copper rod. The projected length of the rod shall be as required to protect the object from lightning stroke.

All the vertical air terminal rods shall be electrically connected together by means of horizontal conductors of size 75 x 10 mm galvanised steel flats.

The air terminal rod shall be properly fixed on the top of the chimney to withstand very high wind pressure.

7.02.00 Circumferential Band

The circumferential band shall be 75 x 10 mm galvanised steel flat fixed to the circumference of top of chimney at interval not more than 1.0 m. This shall be mounted with suitable anchors at such a height as to be accessible from the top of platform for maintenance. The anchors shall be embedded in concrete wall of the stack.

7.03.00 Down Conductors

Minimum four number of 75mm x 10mm GS flat down conductors shall be provided. These shall be not more than 15m apart on the periphery of the stack at the ground level. The down conductor shall be connected to circumferential band at the top portion of the stack and other end connected to the nearest mild steel rod riser from ground electrode. These conductors shall be continuous as far as practicable. Intermediate breaks shall be electrically bonded to form continuous circuit from top to bottom. Lapping of down conductor by bolting is not acceptable.

The down conductor shall be clamped along the surface at intervals of 1500mm by GS clamps. The connection between GS flat & GS clamps shall be done by arc welding.

At each chimney platform level, a circular band shall be provided which will be made of 75 x 10 mm GS flat and electrically connected to each down conductor.

7.04.00 Testing Points

Test joint shall be provided for each down conductor before termination on earth electrode at a height 1.5m from graded level. Test point shall be covered in 150 x 150 x 150 mm GS box. No sharp bends shall be formed in the down conductors and shall be kept as straight as possible.

7.05.00 Clamps, Anchors Etc.

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

7.06.00 Vertical and Horizontal Reinforcing Bars

All reinforcing bars shall be properly bonded and connected to earthing system which shall be separate than lightning protection.

The testing point of the down conductors shall be convenient for testing. Testing point shall be phosphor-bronze gunmetal or copper or other suitable.

7.07.00 Temporary Lightning Protection

During construction of chimney, temporary lightning protection shall be maintained by connecting the reinforcement bars to two earth electrodes by means of two 75x10mm GS conductors. These temporary protections shall be provided even after the completion of the chimney till such time the permanent protections are installed.

To avoid maleffect of highly corrosive atmosphere around the chimney due to flue gas and weather, the exposed conductors, connections, clamps, base plate etc. shall be protected by hot dip galvanizing. All site-welded joints conductors shall be coated with anti corrosive paints over a coat of primer.

~~**8.00.00 COOLING TOWER LIGHTNING PROTECTION**~~

~~Lightning protection system shall confirm to the requirements of IS: 2309 amended up-to-date and Lightning protection notes and details. DWG. No. 13A06-DWG-E-1000 attached with the specification.~~

~~**8.01.00 Air Terminations**~~

~~The vertical air terminal rods shall be installed at the top of cooling towers to protect these objects from lightning strokes.~~

~~The vertical air terminal except for chimney shall be made of 20 mm dia galvanised steel rod. The projected length of the rod shall be as required to protect the object from lightning stroke.~~

~~The air terminal rod shall be properly fixed on the top of the structure to withstand very high wind pressure.~~

~~All the vertical air terminal rods shall be electrically connected together by means of horizontal conductors of size 75 x 10 mm galvanised steel flats.~~

8.02.00 Down Conductors

The down conductors shall be 75 x 10 mm galvanised steel flats. One end of this shall be connected with air terminal rod/horizontal conductor at the top of structure and other end connected to the nearest mild steel rod riser from ground electrode.

Each down conductor shall have an independent earth termination. In no case conductors of the lightning protection system shall be connected with the conductor of grounding system above ground level.

The connection between each down conductor and rod shall be made via test link located at approximately 1500 mm above ground level.

The down conductor shall be laid straight and sharp bends shall be avoided as far as practicable. The down conductor shall be clamped along the surface at intervals of 1500mm by GS clamps.

The down conductors shall be protected at the ground level against mechanical injury by means of non-metallic pipes, viz. PVC pipes filled with bituminous compound.

8.03.00 **Testing Points**

Test joint shall be provided for each down conductor before termination on earth electrode at a height 1.5m from graded level. Test point shall be covered in 150 x 150 x 150 mm GS box. No sharp bends shall be formed in the down conductors and shall be kept as straight as possible.

8.04.00 **Clamps, Anchors Etc.**

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

8.05.00 **Temporary Lightning Protection**

During construction of cooling tower, temporary lightning protection shall be maintained by connecting the reinforcement bars to two earth electrodes by means of two 75x10mm GS conductors. These temporary protections shall be provided even after the completion of the chimney till such time the permanent protections are installed.

9.00.00 **TESTS**

9.01.00 **Type Tests**

The type tests for fire proof / penetration seal for floor and wall opening/ fire stop system for bottom of electrical switchgear/ panel base are as under:

- i) Fire rating test.
 - ii) Hose Stream test
 - iii) Accelerated aging test.
 - iv) Fire rating test on the penetration seal system built out of accelerated aged components followed by hose stream test.
 - v) Temp. rise test for cable in the fire stop.
-

- vi) Water absorption test followed by fire rating test.
- vii) Flame Resistance test for fire retardant coating material.
- viii) Anti-rodent test.

Illumination in different areas are as per designed lux level should be established.

9.02.00 Test Certificates

Certified copies of all tests carried out at works and at site shall be furnished in requisite number of copies.

Test reports shall be complete with all details and shall also contain limit values specified in the relevant standards, wherever applicable, to facilitate review of Test Report/ Certificates.

The fire proof sealing system shall be installed only after receipt of approval of the test reports.

10.00.00 DRAWINGS, DATA AND MANUALS

10.01.00 To be submitted with the Bid

10.01.01 Typical general arrangement drawing of Chimney / ~~Cooling Tower~~ showing location of lighting fixtures, lightning protection system, grounding system etc.

10.01.02 Typical general arrangement drawing of A.C. distribution board, lightning board.

10.01.03 Catalogue cuts of various types of lightning fixtures, major components, cables, conduits etc

10.01.04 Type Test Certificate of various equipment

10.02.00 To be submitted for Approval (A) / Reference (R) and subsequent Distribution

10.02.01 Dimensional general arrangement drawing of chimney / ~~Cooling Tower~~ showing disposition of aviation warning lights, interior lights on platforms and stairs, receptacles, A.C. distribution boards, lighting boards including their fixing arrangements (A).

10.02.02 Arrangement drawings for lightning protection and grounding system (A)

10.02.03 Single line drawing of A.C. distribution boards and lighting boards (A)

10.02.04 Cable and Conduit layout (A)

10.02.05 Technical data sheet of all equipment / components (A).

10.02.06 Instruction Manuals and Catalogue cuts of all equipment (R)

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The manuals shall clearly indicate the method of installation, check-up and tests to be carried out before commissioning of the equipment.

- 10.02.07 Any other relevant drawing or data necessary for satisfactory installation, operation and maintenance.
- 10.03.00 The Contractor may note that the drawings, data and manuals listed are minimum requirement only. The Contractor shall ensure that all other necessary information required to fully describe the equipment / system offered are submitted with his Bid.



SPECIFIC TECHNICAL REQUIREMENT

STACK ELEVATORS

SPECIFICATION NO. PE-TS-417-503-A-001

VOLUME II B

SECTION C

SUB-SECTION A6

REV. 0

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SECTION - C
SUB SECTION – A6
STACK ELEVATORS

	SPECIFIC TECHNICAL REQUIREMENT STACK ELEVATORS	SPECIFICATION NO. PE-TS-417-503-A-001	
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1.

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2.

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2.1.14

SYSTEM DESCRIPTION

The Rack and pinion type stack elevator is required for installation inside multi-flue or outside single flue chimney. The stack Elevator is normally used for the movement of the maintenance personnel and for materials such as refractory bricks, etc. for maintenance of chimney.

SCOPE OF SUPPLY AND SERVICES

The scope of supply and services covered under the specification are broadly described below:

Three (3) nos (one no. for each chimney) Rack and Pinion type stack elevator complete with all other accessories and associated steel work.

Drive motor and control panel for Stack elevator

Control Panel

Equipment earthing

All power and control cables, trailing cables

Limit switches

Over speed governor

Alarm push button in the cage connected to battery operated alarm at elevator base.

Reverse phase relay connected to prevent operation of the cab with improper phase rotation or failure in any phase of power supply.

Continuous duty electrical torque motor recoil cable reels or cable trolley or any equivalent arrangement to maintain electrical power service to all electrical components of the elevator for complete travel of stack elevator.

One auxiliary panel shall be provided and mounted on the graded level enclosure equipped with a main ON-OFF selector switch, main contactor, breaker, relays, control transformer and fuses, tone frequency transmitter or equivalent arrangement, , terminal blocks and all other accessories required for normal operation of the elevator.

One main control panel shall be furnished and mounted on top of the cab. Panel shall be in enclosure equipped with necessary equipment like rectifier, battery charger charger, tone frequency receiver, contactors, breakers, control transformer and fuses, thermal overload relays, and all other equipment and accessories required for normal operation of the elevator.

Cab shall be controlled by semi-automatic floor selection control system. Cab shall be furnished with 240 V grounding receptacle, emergency alarm push button with normally open contact, indicating light, limit switches, and all other necessary control devices required to ensure safe and continuous cab operation. One trailing cable shall connect the main control panel to aux. Panel at ground level. Cable shall supply the cab necessary power supply requirements. Cable guides shall be installed at every 6 m intervals to avoid entanglement of this cable. Control signal between the aux. Panel at ground level, the main control panel on the cab and the landings shall be provided with tone frequency receiver or any other equivalent arrangement by trailing control cable.

	SPECIFIC TECHNICAL REQUIREMENT STACK ELEVATORS	SPECIFICATION NO. PE-TS-417-503-A-001	
		VOLUME II B	
		SECTION C	SUB-SECTION A6
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2.1.15	Each landing assembly shall include a limit switch and push button control station installed and wired to a landing junction box.		
2.1.16	All power cable and race way shall be provided and installed by the bidder for interconnection of the main control panel, auxiliary panel and landing junction boxes. Trailing cables shall be as per relevant IS/IEC standard.		
2.1.17	Bidder shall provide, install and connect a system equipment ground to owner’s chimney grounding system. Equipment grounding system shall electrically connect panels and junction boxes which contain electrical devices, motors and elevator platform and structures. Raceway system shall not be considered as an equipment ground.		
2.1.18	All enclosures containing electrical devices shall be provided with 240 V, single phase heaters with adjustable thermostat control.		
2.1.19	Cab shall be equipped with a 240 V AC interior light and duplex outlet.		
2.1.20	Cable accessories as required to install the cables in bidder’s scope shall be provided by the bidders.		
2.1.21	Complete erection, testing and commissioning including all erection materials, consumables and other tools and tackles required for erection along with commissioning spares.		
2.1.22	All inserts, anchor bolts, sleeves, anchoring steel and any other items required to complete the job satisfactorily shall be in bidder’s scope.		
2.1.23	First fill of lubricant and consumables shall be in bidder’s scope.		
2.1.24	Satisfactory running and maintenance of elevator for a continuous period of 30 days including training of owner’s operators.		
2.1.25	Supply of One complete set of special maintenance tools and tackles shall be in bidder’s scope.		
2.1.26	Any other equipment or accessories not specified, but required for the satisfactory operation of chimney elevator shall be in bidder’s scope.		
2.1.27	Mandatory Spares: A complete unused and new set of Mandatory Spare parts shall be supplied. The items supplied shall be of the best quality and specially protected against rusting in tropical climate. The minimum requirement of mandatory spare parts is listed in Annexure –I section-C, of this specification.		
2.1.28	Recommended spares including instrumentation for 3 years of normal operation of stack elevator. (List to be furnished by the bidder and for which order shall be placed separately by owner as per their requirements)		

	SPECIFIC TECHNICAL REQUIREMENT STACK ELEVATORS	SPECIFICATION NO. PE-TS-417-503-A-001	
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3.

SPECIFIC REQUIREMENTS

3.1

The equipment supplied, erected and commissioned shall meet the technical requirements of respective Section –D and Data Sheet-A.

3.2

Bidder shall note that all QP and Field quality plans shall be subject to purchaser’s approval.

3.3

All equipment offered shall have suitable provision of termination and connection of power and control cables inclusive of cable boxes, lugs and glands, etc.

3.4

All the equipment shall be suitable for the power supply fault level and other climatic conditions as indicated in project information.

3.5

The bidder shall guarantee the rating and performance parameters of the system/equipment offered in accordance with specification requirements.

3.6

It is the responsibility of bidder to arrange license for operation of chimney elevator from statutory body of that area before handing over.

3.7

Bidder shall furnish deviation (clause wise) in the deviation schedule. In absence of dully filled deviation list, it will be presumed that offer is exactly in line with the technical specification.

3.8

Bidder shall furnish duly filled data sheet –B alongwith the offer. In absence of same, offer shall be treated as incomplete.

3.9

Bidder shall offer the stack elevator considering prevailing statutory and regulatory requirements of project location.

3.10

Bidder shall indicate degree of protection of various electrical equipment in the offer.

3.11

Makes of all bought out items shall subject to purchaser’s approval after award of contract.

3.12

All drawings/documents shall subject to purchaser’s approval after award of contract.

**SPECIFIC TECHNICAL REQUIREMENT****STACK ELEVATORS**

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DATA SHEET

1	Designation Elevator	:	Rack and Pinion type Stack
2	Type of loading	:	Passenger/goods
3	Quantity	:	Three (3) nos. (One no per chimney).
4	Carrying Capacity	:	400 Kg
5	Pay load	:	400 Kg minimum.
6	Operating Speed	:	40 m/min.
7	Dimension of lift and lift well/cut out	:	As per IS:3534
8	No. of landings	:	Eight (8) nos. including ground. (0.0 m, 35.0M, 65m, 105m, 145m, 185m, 225m, and 265m)
9	Total vertical travel	:	265m.
10	Electrical power supply system	:	415 V, 3 ph, 50 Hz
11	Other accessories	:	As required

**SPECIFIC TECHNICAL REQUIREMENT****STACK ELEVATORS**

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ANNEXURE-I**LIST OF MANDATORY SPARES.**

S. NO.	ITEM DESCRIPTION	QUANTITY	REMARKS.
1	Bearing for guide roller	2 sets	
2	Bearing for counter roller	2 sets	
3	Drive pinion	2 nos.	

SAMPLING PORT DETAILS IN FLUE LINER

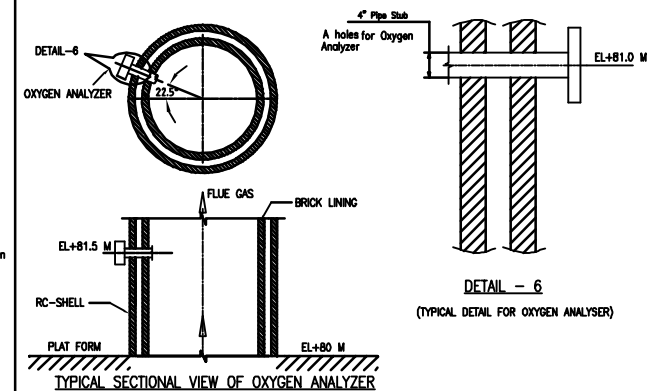
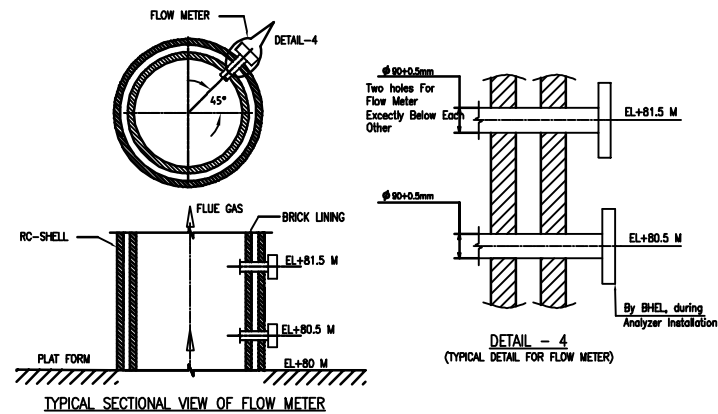
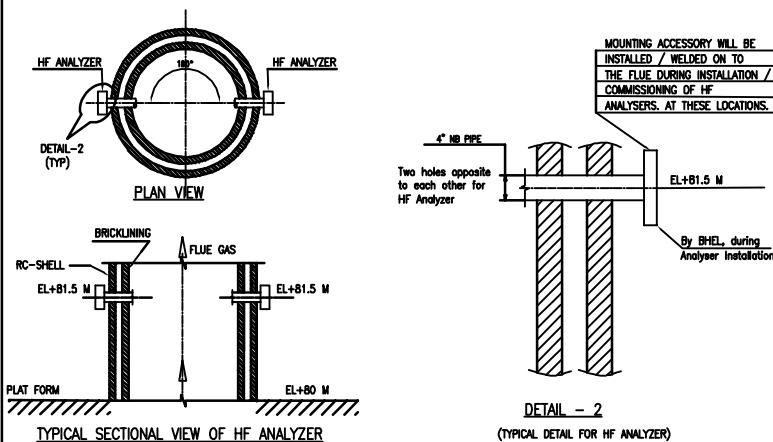
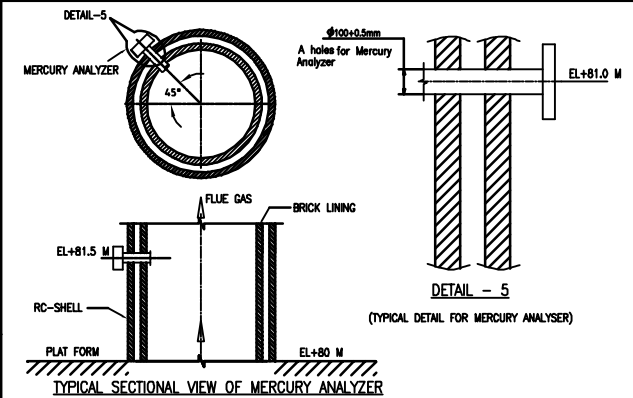
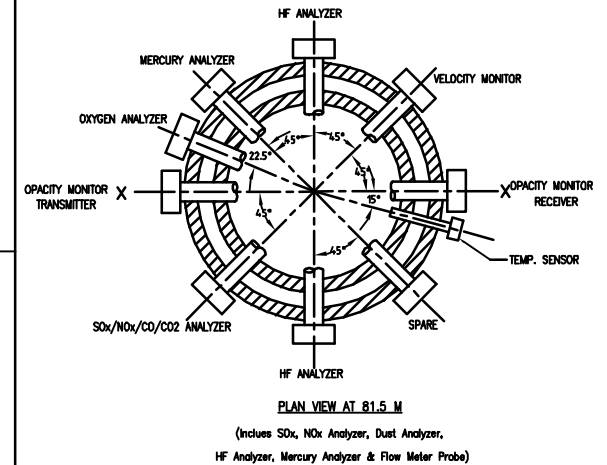
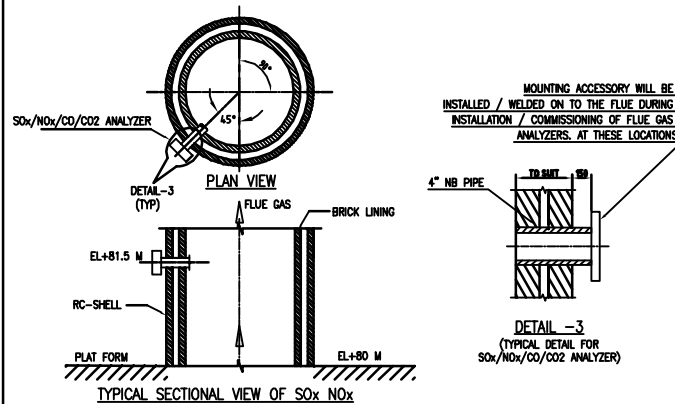
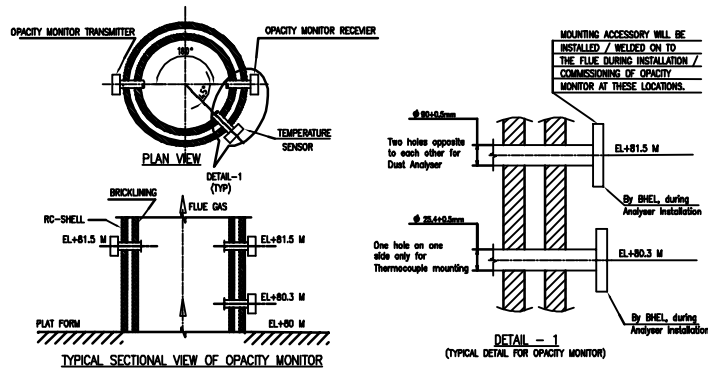
5X800MW YADRADRI TPS

Ref: CE/416/EDN/FGA/TAP/YADR

SO_x/NO_x/CO/CO₂ ANALYZER, OPACITY MONITOR,

FLOW METER, MERCURY ANALYZER, OXYGEN ANALYZER & HF ANALYZER

SAMPLING PORTS/TAPPING POINTS – TYPICAL





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TELANGANA STATE POWER GENERATION
CORPORATION LIMITED
[TSGENCO]



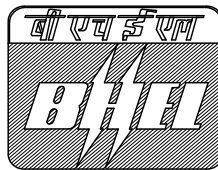
YADADRI THERMAL POWER STATION
5 x 800 MW

VOLUME – 7-D
CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-417-600-C001

SECTION - D
GENERAL TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATIONS FOR RCC CHIMNEY



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



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PREAMBLE

Standard technical details as indicated in specification shall be agreed upon between BHEL & Bidder. Technical requirements are stipulated in this Volume which comprises of

Section C : This section indicates the technical requirements specific to the contract not covered in Section D

Section D : This section comprises of technical specification(s)

The requirements mentioned in the Section C shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the Section D in the specification. In case on any conflict between technical specification and BOQ, BOQ shall prevail.



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**TECHNICAL SPECIFICATION
FOR
REINFORCED CONCRETE CHIMNEY**

1.0.0 SCOPE

This specification covers reinforced cement concrete works, including steel flue and insulation work, painting and protective treatment work, and other works associated with construction of RCC twin flue chimney.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

Work to be provided by the Contractor, or, unless specified otherwise, shall include but shall not be limited to the following :

- a) Furnish all labour, supervision, services, insurance, material, power, fuel forms, templates, supports, scaffolding, tools, plants, construction equipment, approaches, transportation etc. required for the entire work.
- b) Design and prepare working drawings for formworks, scaffoldings, supports, staging hoisting arrangement for men and material etc. and submit them for approval.
- c) Prepare and submit for approval, as per approved schedule, detailed drawings for RCC work in shell, platforms at various levels, roof and ground floor and bending schedules for reinforcement bars, showing the positions and details of spacers, chairs, supports, hangers, openings etc.
- d) If in scope, prepare detailed fabrication and erection marking drawings for steel flues including flue expansion compensators, steel flue supports and restraint arrangements along with fittings and accessories and submit them for approval.
- e) Prepare and submit for approval detailed shop drawings, with list of materials and material specifications for Load Bearing Insulation Blocks and Lateral Restraint Insulation Blocks.
- f) Prepare and submit for approval detailed schemes for operations like material handling, placement of concrete erection of steel flues, fixing of insulations, installation, dismantling and maintenance of flue expansion compensator etc. and for items like approaches, services etc.
- g) Design and submit for approval mix proportions for concrete to be



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adopted on job.

- h) Furnish samples and submit for approval the results of tests for various properties of the following materials :
 - i) Ingredients of concrete,
 - (ii) Concrete,
- ii
 - i) Acid/Chemical Resistant Tiles,
 - (iv) Castable refractories,
 - (v) Insulation materials,
 - (vi) Paints.
 - (vii) S/S liner.
- i) Provide all incidental items not specified or shown on drawings in particulars but reasonably implied or necessary for successful completion of the work in accordance with drawings and specifications.
- j) Produce, if directed by the Engineer, a guarantee, in approved proforma, for satisfactory performance, for a specified period, of material manufactured by specialist firms.

2.2.0 Work by Others

No work under this specification will be provided for by agency other than the Contractor for this Contract unless specifically mentioned otherwise in the Contract.

2.3.0 Codes and Standards

All works under this Specification, unless specified otherwise, shall conform to the latest revisions/replacements of the following Indian Standard Codes, Criteria, Specifications, along with those mentioned therein. In case any particular aspect of work is not covered by Indian Standards, other standard specification, as may be specified by the Engineer, shall be followed. "IS Specification" shall mean Codes, Criteria etc. of ISI.

IS:6	Moderate heat duty fireclay refractories, Group-A.
IS:104	Ready mixed paint, brushing, zinc chrome, priming.
IS:158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting for general purposes.
IS:195	Specification for fire clay mortar for laying fireclay refractory bricks.
IS:269	Ordinary, and low heat Portland cement.
IS:383	Coarse and fine aggregates from natural sources for concrete.
IS:432	Mild steel and medium tensile steel bars.
IS:456	Code of practice for plain and reinforced concrete.
IS:516	Methods of test for strength of concrete.



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IS:732	Code of practice for electrical wiring installations (System Voltage not exceeding 650 Volts).
IS:800	Code of practice for general construction in steel.
IS:813	Scheme of symbols for welding.
IS:814	Covered electrodes for metal arc welding of structural steel.
IS:816	Code of practice for use of metal arc welding for general construction in mild steel.
IS:817	Code of practice for training and testing of metal arc welders.
IS:818	Code of practice for safety and health requirements in electric and gas welding and cutting operations.
IS:822	Code of procedure for inspection of welds.
IS:875	Draft Standard for Code of practice for structural safety of buildings loading standards.
IS:1080	Code of practice for design and construction of simple spread foundations.
IS:1139	Hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcements.
IS:1161	Steel tubes for structural purposes.
IS:1199	Methods of sampling and analysis of concrete.
IS:1200	Methods of measurement of building works.
IS:1230	Cast Iron Rainwater pipes and fittings.
IS:1239 (Part-I)	Mild steel tubes.
IS:1367	Technical supply conditions for threaded fasteners.
IS:1526	Sizes and shapes for firebricks (230 mm. series).
IS:1554	Cables.
IS:1566	Hard-drawn steel wire fabric for concrete reinforcement.
IS:1608	Methods for tensile testing of steel products.
IS:1730	Dimensions for steel plate, sheet and strip for structural and general engineering purposes.



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IS:1731	Dimensions for steel flats for structural and general engineering purposes.
IS:1786	Cold-twisted steel bars for concrete reinforcement.
IS:1791	Batch type concrete mixers.
IS:1893	Criteria for Earthquake Resistant Design of Structures.
IS:1947	Flood light.
IS:1977	Structural steel (ordinary quality).
IS:2062	Weldable structural steel.
IS:2074	Ready mixed paint, red oxide - zinc chrome priming.
IS:2309	Code of practice for the protection of buildings and allied structures against lightning.
IS:2386 (Part-I)	Methods of test for aggregates for concrete. Particle size and shape.
IS:2386 (Part-II)	Estimation of deleterious materials and organic impurities.
IS:2386 (Part-III)	Specific gravity, density, voids, absorption and bulking.
IS:2386 (Part-IV)	Mechanical properties.
IS:2386 (Part-V)	Soundness.
IS:2386 (Part-VI)	Measuring mortar making properties of fine aggregate.
IS:2386 (Part-VII)	Alkali aggregate reactivity.
IS:2386 (Part-VIII)	Petrographic examination.
IS:2502	Code of practice for bending and fixing of bars for concrete reinforcement.
IS:2505	Concrete vibrators, immersion type.
IS:2506	Screed board concrete vibrators.
IS:2633	Methods of testing uniformity of coating on zinc coated articles.



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IS:2722	Portable swing weighbatchers for concrete (single and double bucket type).
IS:2750	Steel scaffoldings.
IS:2751	Code of practice for welding of mild steel bars used for reinforced concrete construction.
IS:2950	Code of practice for design and construction of raft foundations.
IS:3025	Methods of sampling and test (Physical and Chemical) for water used in industry.
IS:3043	Code of Earthing.
IS:3144	Methods of Test for Mineral Wool Thermal Insulation Material.
IS:3346	Method for the determination of thermal conductivity of thermal insulation materials (two slab, guarded hot- plate method).
IS:3495 (Part-I to IV)	Method of test for clay building bricks.
IS:3550	Methods of test for routine control for water used in industry.
IS:3558	Code of practice for use of immersion vibrators for consolidating concrete.
IS:3677	Unbonded rock and slag wool for thermal insulation.
IS:4014 (Part-I&II)	Code of practice for steel tubular scaffolding.
IS:4031	Method of physical tests for hydraulic cement.
IS:4457	Ceramic Unglazed Vitreous acidresistant tiles.
IS:4634	Method for testing performance of batch-type concrete mixers.
IS:4687	Gland packing asbestos.
IS:4832	Chemical Resistant mortars.
IS:4860	Acid-resistant bricks.
IS:4990	Plywood for concrete shuttering work.
IS:4998 (Part-I)	Criteria for design of reinforced concrete chimneys.



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- IS:5410 Cement paint, colour as required.
- IS:5445 Long fluted machine reamers with Morse taper shanks.
- IS:5495 Sizes and shapes for firebrick (300 mm. and higher series).
- IS:6911 Stainless Steel plate, sheet and strip.
- IS:8112 High strength ordinary portland cement.
- IS:8183 Bonded Mineral Wool.
- IS:9595 Recommendation for Metal Arc Welding of Carbon and Carbon Manganese steels.
- CP326 - British Standard - Protection of structures against lightning.
- NEPA NO. 78 Code of protection against lightning.
- The Indian Electricity Rules.
- The requirements of Department of Civil Aviation, Govt. of India.

2.4.0 **Conformity with Drawings and Specifications**

The Contractor shall carry out all the work in strict accordance with the drawings stamped "Released for Construction" and specification issued to him and as per Contractor's detailed drawings approved by the Consulting Engineer. Prior to concreting, the Contractor shall prepare a checklist on a set format of all items of work involved, and inform the Engineer well in advance so that the Engineer shall have the opportunity of satisfying himself if the work mentioned in the format are done according to drawings and specification, and he can allow the Contractor in writing to start pouring of concrete. The entire operation of concreting shall be carried on as per specification, to the complete satisfaction of the Engineer. No deviation from the drawings will be allowed unless otherwise directed by the Engineer in writing.

For Load Bearing Thermal Insulation block assembly and lateral restraint insulation block assembly, Contractor shall design sizes of all components of the blocks and details of their connections, supply and fabricate the same in accordance with the approved shop drawings prepared by him.

For steelwork and metal work, the Contractor shall design all connections, inserts for scaffolding, supply and fabricate all steelwork and metal work and furnish all connection materials in accordance with approved shop drawings prepared by him and/or as instructed by the Engineer, keeping in view the maximum utilization of the available sizes and shapes for metal components.

2.5.0 **Materials to be used**

2.5.1 **General Requirement**

All materials, whether to be incorporated in the work or to be used temporarily for the construction, shall conform to the relevant IS specifications unless stated otherwise and shall be of the quality approved by the Engineer.



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2.5.2 Cement

Ordinary Portland cement of grade 43, as per the requirements laid down in IS:8112, shall be used, until otherwise stated elsewhere in the specification.

2.5.3 Coarse Aggregate

Coarse aggregate shall be graded crushed or broken stone from approved sources, free from impurities and shall be screened free of dust and other deleterious matter. It shall conform to IS:383 or IS:515 and shall be washed clean, if necessary. The maximum size of coarse aggregate for stack superstructure shall be 25 mm down graded, unless otherwise stated (vide serial 5(b) of clause 3.03.06). Grading for a particular size shall conform to relevant IS Codes and shall be such as to produce a dense concrete of specified proportion and strength and shall be of consistency that will work readily into position without segregation.

2.5.4 Fine Aggregate

Fine aggregate shall be river or pit sand, free from any clay, earth, vegetable matters, salt or other impurities and shall be clean and fit for use, to the satisfaction of the Engineer. Sand acceptable for the work shall normally have a grading falling within the limits of one of the three grades, mentioned in the relevant IS Specifications.

2.5.5 Water

The water for both mixing and curing of concrete shall be clean, free from oil, acid, alkali, organic or other deleterious substances. Contractor shall test the water as and when required by the Engineer.

2.5.6 Reinforcement

Mild steel or Medium or High Tensile steel deformed bars specified for reinforcement shall conform to the latest relevant IS Specifications and shall be of tested quality under ISI Certification Scheme. The reinforcement shall be free from any oil, foreign material or mill or rust scales.

2.5.7 Steel Flue

- a) All mild steel material to be used in construction of steel flue shall comply with IS:2062, IS:1239, IS:1367, IS:1608, IS:800 and with other relevant IS Specifications. The ultimate tensile strength of this steel shall not be less than 410 N/Sq.mm.
- b) Stainless steel liners shall be fabricated using materials conforming to the requirements of relevant IS Specifications and/or AISI 316L or BS:1449 Part -2. Grade of Stainless steel shall be equivalent to BS:1449 (Part-2) 316 S.12.
- c) Materials to be used for fabrication of Flue expansion compensators shall be suitable for the flue gas temperature and shall be acid resisting.

The Expansion compensator shall comprise several layers of materials given below in order from the gas side.



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- i) Two layer of insulation, each consisting of heavy weight texturized glass cloth impregnated with graphite suspension, having an approximate weight of 1.00 Kg/Sq.m
- ii) A continuous flame resistant glass cloth coated both sides with a fluoro-elastomer having an approximate weight of 1.5 Kg/Sq.m.
- iii) Two layers of PTFE (Poly Tetra Fluoro-Ethylene) film of minimum thickness 0.15 mm each.
- iv) A layer of glass felt of minimum thickness 10 mm and an approximate weight of 1.5 Kg/Sq.M.

2.5.8 Paints

Paints to be used for shop coat of fabricated steel shall conform to the IS:2074. Paint for treatment of outside face of Chimney with Cement water proof paint shall conform to IS:5410.

2.5.9 Acid Resistant Tiles and Castable Refractories

Acid resistant tiles to be provided over roof of stack should conform to IS:4457. Matching mortars to be used for tiles. Castable refractories shall be of hydraulic setting, rapid hardening type. It shall have refractory properties similar to Fire bricks conforming to IS:6, Group-A and working temperature shall be upto 1350 Deg.C.

2.5.10 Insulations

a) On Exterior Surface of Flues

The normal flue gas temperature inside the flue shall be 145 Deg.C with momentary rise upto 400 Deg.C (Maximum) occasionally. The insulation material shall be able to withstand this temperature without any deterioration in thermal properties or breakdown. The thermal conductivity of the insulating material shall not exceed 0.06 W/M Deg.C at a mean temperature of 150 Deg.C. The insulation shall also not be affected by any acid condensation from flue gas and shall be free from any impurities which may cause corrosion to the flue material.

For steel flues 65 mm thick semi rigid resin bonded fibrous mineral wool of density not less than 96 Kg/Cu.m as per IS:8183 or resin bonded fibrous crown glass wool (high temperature) of same thickness and density not less than 36 Kg/Cu.m capable of sustaining temperature to the tune of 540 Deg.C without any loss of material thermal property, may be used. The mineral wool for exposed top portion of flue shall be semi-rigid with minimum density of 200 Kg/Cu.M or the glass wool for exposed top portion of flue shall have minimum density of 75 Kg/Cu.M.

Slag wool insulation shall not be accepted.

The insulation free from shots should be supplied in the form of mat to



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be fixed with staggered joints on outer surface of the flue with suitably spaced stud by galvanised wire mesh. Insulation on the top portion of flue shall be covered by stainless steel cladding.

b) At Load Bearing and Side Restraints of Flues

Load bearing insulation assembly to have (i) a properly machined mild steel plate with recess at its top for seating PTFE (Poly Tetra Fluoro Ethylene) sheets conforming to BS:5400 (ii) saddle plate (MS) in the middle having stainless steel plate fixed at its bottom surface and lead/elastomeric sheet at top, and (iii) top plate formed of two numbers insulation blocks each made of minimum 50mm thick rigid, non-combustible asbestos fibre reinforced lime-silica board (SINDANYO BLOCKS NATURAL GRADE CS-51) bonded to mild steel plates at top and bottom. For side restraints assembly of insulation blocks of SINDANYO Natural Grade CS-51 and stainless steel plate shall be used. All stainless steel in these assemblies shall conform to AISI-316L and Mild steel to IS-2062. SINDANYO BLOCKS shall be suitable for operation at 320 Deg.C and shall primarily satisfy the following physical properties :

- i) Minimum compressive stress prior to onset of compression yield of not less than 12 N/Sq.mm.
- ii) Minimum shear strength of 30 N/Sq.mm when tested in accordance with BS:3497-1979.
- iii) Thermal conductivity shall not exceed 0.67 W/m Deg.C at a mean temperature of 200 Deg.C and its coeff. of linear expansion not to exceed 1.2×10^{-5} per Deg.C.
- iv) Adhesive used for bonding purposes shall be of material with equivalent high temperature properties as approved by the Engineer. It may be of "Fortafix Fiborclad Adhesive" as manufactured by Fortafix Ltd., England.

2.6.0 Storage of Materials

2.6.1 General

All materials shall be so stored as to prevent deterioration and intrusion of foreign matter and to ensure the preservation of their quality and characteristics for the work. Any material, which is deteriorated or is damaged or is otherwise considered defective by the Engineer, shall not be used for construction and shall be removed from site immediately, failing which the Engineer shall be at liberty to get the materials removed. The Contractor shall maintain an upto date accounts of receipt, issue and balance of all materials issued by the Owner.

2.6.2 Cement

Contractor shall store cement in water-tight and properly designed stores so that the Cement can be kept dry and the stock can be handled in rotation. The doors of stores shall



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be at least 30 cm. above G.L. Deteriorated cement shall be removed immediately from the site. Not more than ten bags of cement shall be stacked one above the other.

2.6.3 Aggregate

Different materials shall be transported, handled and stored separately in such a manner as to prevent damage, deterioration or contamination. Stock piles of fine and coarse aggregates shall be allowed to drain, so that aggregates do not contain too much water.

2.6.4 Reinforcement

Reinforcement shall be stored preferably under cover and stacked off ground in size and grade-wise separate stacks for easy identification.

2.6.5 Steel, Metal and Fittings

All steel, metal and fittings to be used for fabrication and erection shall be stored section wise and lengthwise in separate stacks, off ground, so that they can be handled, inspected, measured and accounted for easily at any time. If required by the Engineer, the materials may have to be stored in a covered shed.

2.6.6 Paints

Paints shall be stored under cover, in air-tight containers. Paints supplied in sealed containers shall be used as soon as possible once the container is opened. Left over paints shall be kept in air-tight containers.

2.6.7 Steel Flue

Fabricated pieces of steel (flue) liner shall be stored systematically for ease of handling.

2.6.8 Insulation Material

All insulation materials like bearing insulation blocks, restraint insulation blocks, glass or mineral wool, asbestos ropes etc. shall be stored in packing boxes, under covered shed, avoiding their coming in contact with objectionable matter.

2.7.0 Quality Control

Contractor shall establish and maintain quality control for different items or work and materials as may be directed by the Engineer to assure compliance with contract requirement and submit to the Engineer records of the same. The Contractor shall submit all records and test results in original to the Engineer for his approval, if so desired by him.

The quality control operation shall include but shall not be limited to the following items of work:



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- a) Cement : Test to satisfy relevant IS Specifications if supplied by the Contractor.
- b) Aggregate : Physical, Chemical and Mineralogical qualities, grading, moisture contents and impurities.
- c) Water : Impurities Test.
- d) Reinforcement: Material tests or certificates to satisfy relevant IS Specification if supplied by the Contractor.
- e) Structural : Material tests or certificate to satisfy Steel relevant IS Specification if supplied by the Contractor.
- f) Steel flue : Material tests or certificate to satisfy relevant IS Specification if supplied by the Contractor.
- g) Stainless : Material tests or certificate to satisfy Steel relevant IS Specification if supplied by the Contractor.
- h) Acid Resistant : Compressive and tensile strength, acid tiles & mortar resistance and water absorption test.
- i) Mortar : Compressive and tensile strength, adhesion and acid resistance test.
- j) Insulation : Thermal conductivity, density, heat and acid resistance tests. Bearing capacity will be tested for bearing/restraint insulation blocks.

3.0.0 EXECUTION

3.1.0 Concrete

3.1.1 Trial Mix, Grades of Concrete

At least three weeks before commencing any concreting in the work the Contractor shall make trial mixes using samples of coarse aggregates, sand, water and cement, typical of those to be used in the work. A clean dry mixer shall be used for mixing and the first batch shall be discarded.

For guidance in designing the mix, standard tables for maximum allowable water-cement ratio, minimum cement content, maximum proportion of aggregates and limits of consistency may be used by the Contractor. The Contractor's design mix shall fall within limits of the following tables :

- i) Strength requirements of concrete : Table-2 of IS:456-2000.
- ii) Concrete Mix Proportion : Table-3 of IS:456-2000.



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- iii) Minimum cement content/Cu.m. of finished concrete shall be as per Table 5 of IS 456-2000.
However, it should be noted that minimum cement content for concrete of chimney shell of grade M30, M35, M40 shall be 400kg, 430 kg and 450 kg respectively.
- iv) Limit of consistency : Refer Table in Item 3.1.4 of this specification.
- v) Cement/Total Aggregate Ratio : As per the following table.



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**MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFERENT DEGREES
OF WORKABILITY WITH DIFFERENT VALUES OF WATER - CEMENT RATIO
(FOR GUIDANCE)**

3.1 CEMENT/TOTAL AGGREGATES RATIOS

Workability	Water/ Cement Ratio	Ratio by Weight of Cement to Gravel Aggregate		Ratio by Weight of Cement to Crushed Stone Aggregate	
		20 mm. Size	38 mm. size	20 mm. size	38 mm. size
Very Low	0.4	01:04.8	01:05.3	01:04.5	1:05
slump 0.5		01:07.2	01:07.7	01:06.5	01:07.4
0-25 mm.	0.6	01:09.4	1:10	01:07.8	01:09.6
	0.7	1:10	1:12	01:08.7	01:10.6
Low 0.4		01:03.9	01:04.5	01:03.5	1:04
slump 0.5		01:05.5	01:06.7	1:05	01:05.5
25-50 mm					
	0.6	01:06.8	01:07.4	01:06.3	1:07
	0.7	1:08	01:08.5	01:07.4	1:08
Medium 0.4		01:03.5	01:03.8	01:03.1	01:03.6
slump 0.5		01:04.8	01:05.7	01:04.2	1:05
50-100mm.	0.6	1:06	01:07.3	01:05.2	01:06.2
High 0.4		01:03.2	01:03.5	01:02.9	01:03.3
slump 0.5		01:04.4	01:05.2	01:03.9	01:04.6
100 -	0.6	01:05.4	01:06.7	01:04.7	01:05.7
175 mm.	0.7	01:06.2	01:07.4	01:05.5	01:06.5

NOTE-1

: Notwithstanding anything mentioned above, the cement / Total aggregate ratio is not to be increased beyond 1:9 without specific permission of the Engineer.

It should be noted that such high aggregate cement ratios will be required for concretes of very low slump and high water-cement ratios which may be required to be used in mass concrete work only.

NOTE-2 : The above figures are for guidance only, the actual cement/ aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes. For each grade of concrete, a set of eighteen cubes shall be made. Of these not more than six may be made on any day and further, of the six cubes made in one day not more than two cubes may be made from any single batch. Nine of these cubes each representing a different batch of concrete shall be tested at the age of seven days and remaining at twenty eight days. The making of the cubes, their curing, storing, transporting and testing shall be in accordance with the relevant IS Specifications. The test shall be carried out in laboratory approved by the Engineer. If the average strength of the concrete cubes falls below the requirement, the method described above shall be repeated till acceptable results are obtained. The method may have to be repeated whenever there is a



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significant change in the quality of any of the ingredients for concrete, at the discretion of the Engineer.

3.1.2 Batching of Concrete

For controlled concrete, only weigh batching shall be allowed. All concrete ingredients, except water, shall be batched by weight, using an approved make of weigh batcher. Batching shall be accurate to 1/2 Kg. The batcher shall be tested for accuracy of calibration, first before commencement of work and at least once a fortnight or as directed by the Engineer thereafter. Water shall be batched by weight or by volume measures, as approved by the Engineer.

3.1.3 Mixing of Concrete

Materials for concrete shall be emptied in rotation into the mixer. When all the ingredients are in the drum, the drum will rotate for one minute for dry mixing. After that water shall be added in measured quantities in the manner specified. The mixer shall then rotate for at least two minutes, or at least forty revolutions or until there is apparent uniform distribution of the materials and till the mass is uniform in colour. The entire content of the drum shall be discharged before the ingredients for the succeeding batch are fed into the drum. The mixer shall be thoroughly cleaned to the satisfaction of the Engineer, before a different quality of concrete is put through the mixer and also at the end of day's work.

3.1.4 Workability of Concrete

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments, and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. 120 mm to 150 mm, where concrete is pumped, otherwise, 100mm-120mm slump in chimney shell works shall be adopted subject to Engineer's approval unless stated otherwise (vide serial 1(d) of clause no. 3.3.6). The usual limits of consistency for various types of structure are given below:



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LIMITS OF CONSISTENCY

Degree of Workability	Slump in mm. with Standard Concrete		Use for which Concrete is suitable
	Min.	Max.	
Very Low	0	15	Large mass concrete work with heavy compaction equipment.
Medium	35	65	Deep and wide RCC structures with congestion of reinforcement and inserts.
High	65	100	Very narrow and deep RCC structures with congestion due to reinforcement and inserts.

NOTE: The above table is for guidance only. Notwithstanding any thing mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer.

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately, to keep the ratio of water to cement same, as adopted in trial mix design, for each grade of concrete.

The workability of concrete shall be checked at frequent intervals by slump tests. Alternatively, where facilities exist or if required by the Engineer, the compacting factor test, in accordance with IS:1199, shall be carried out.

3.1.5 Placing and Compaction of Concrete

Concreting shall proceed in a manner directed by the Engineer, concrete shall be placed in forms as soon as possible but in no case later than twenty minutes, after mixing.

The height of any single lift of concrete, for different structural members, shall be decided by the Engineer. The concrete shall be placed in the forms gently and not dropped from a height which may cause segregation of aggregates. Each layer of concrete shall be compacted fully before the succeeding layer is placed and separate batches shall follow each other so closely that the succeeding layer shall be placed and fully compacted before the layer immediately below has taken an initial set.

The concrete, after placing, shall be consolidated only by power driven vibrators. The vibrators shall be of a make and size, approved by the Engineer. In using the vibrator, the standard practice and the Engineer's directions, shall be followed.

Vibration shall begin as soon as one batch of concrete has been placed and shall continue till the entire section being poured has been thoroughly consolidated.

To secure even and dense surfaces, free from aggregate pockets, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form



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surfaces while the concrete is plastic, without damaging or endangering the stability of the formwork.

A sufficient number of spare vibrators including petrol vibrators shall be kept readily accessible to the place of deposition of the concrete to assure adequate vibration in case of breakdown of those in use.

3.1.6 Curing of Concrete

Curing of exposed surface of concrete shall commence immediately after the concrete has set. Exposed sides shall be covered with canvas etc. immediately after stripping of forms, and curing shall be continued for a period of not less than 14 days, reckoned from the date and hour of completion of concreting. All surfaces of the pour shall be kept wet with water at all times after concreting and till the curing period is over. The Contractor shall plan and employ proper equipment and sufficient labour considered adequate by the Engineer under able supervisor for curing.

3.1.7 Construction Joints

In concreting the chimney shell one full ring lift shall be completed in a day's pour. Before the formwork for the following pour starts the horizontal surface of the Chimney shell shall be chipped, cleaned and washed with water, and when the formwork is complete, the surface shall be cleaned and washed again and covered with 1:2 sand cement slurry before fresh concrete is placed. The horizontal construction joints shall be so arranged and made that they are regular and neat. No vertical joint shall be allowed. No separate payment shall be allowed to the Contractor for forming joints or chipping and cleaning the form or cover with slurry prior to concreting. The number of construction joint shall be kept minimum and the spacing should not exceed three (3) meters. The Contractor shall submit to the Engineer, any proposal of providing construction joints to facilitate his work, for the study and approval of the Engineer well in advance.

3.1.8 Ordinary Concrete

Ordinary concrete like lean concrete shall be of nominal mix as per relevant clauses of IS:456.

3.2.0 Reinforcement

3.2.1 Bending of Reinforcement

All bars shall be carefully and accurately bent by the Contractor in accordance with approved Drawings and bar bending schedules. Special care shall be taken to ensure correct lengths of laps. The bars shall not be bent or straightened in any manner that will injure the bars or impair the bond between reinforcement & concrete. Bends and hooks are to be provided as laid down in the IS:2502.

3.2.2 Placing

All reinforcement shall be placed and maintained in the position shown in the drawings. Contractor shall provide approved type of cover blocks to suit the requirement of the Drawings. Where reinforcement is to be provided on two faces of the shell, the Contractor shall provide adequate number of separators, with the approval of the Engineer. Any additional support to the reinforcing cage, if required at the time of concreting, shall also be



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provided, to the satisfaction of the Engineer. Lapping of reinforcement as specified in the drawings or as directed by the Engineer, shall be provided. Laps shall be staggered and too many laps shall be avoided. Welded laps shall be provided only when directed or approved by the Engineer.

3.2.3 Fixing of Reinforcement

18 SWG annealed steel wire shall be used as binding wire. Bar crossing one another and contact laps shall be bound with this wire twisted tight to make the skeleton or network rigid so that the reinforcement is not displaced during placing of concrete.



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3.10 Forms

Construction by Slip-form Method

Slip-form construction shall be for construction of the wind shield. Type of Slip-form proposed should be indicated in the offer with sketches, drawings and construction statement as explained hereinafter. Number, type and capacities of jacks, the control system and achievable rate of progress in mm/hour should also be indicated. The chosen scheme shall be of a past proven design. A certified performance record of the scheme should be submitted with the offer to guarantee workability of the scheme both from execution time and safety point of view.

The Tenderer should furnish a brief but comprehensive statement indicating the planning & programme and method of work to be followed, for the approval of Owner at the time of submitting Tender. This statement shall include the following items:

- i) Type and description of Slip-form equipment and its accessories.
- ii) Design of scaffolding and staging.
- iii) Description of materials including admixtures to be used for construction.
- iv) Manpower planning, construction spaces required, standby arrangement.
- vi) Rate of Slip-forming.
- vii) Proposed workability requirement of concrete and type of cement & admixture to be used.
- viii) Quality assurance programme.
- ix) Method of Transportation of material
- x) Method of curing and rectification of defects.
- xi) Planned interruption, if proposed, and activities during planned interruption. Treatment of construction joint.
- xii) Contingency solution for unplanned interruptions.
- xiii) Time of completion.

While selecting the Contractor, due consideration will be given to the merit of the above mentioned statement proposed by the Tenderer.

Notwithstanding what have been specified in earlier clauses, following guide lines are being presented which should be kept in view by intending Tenderers, while quoting for Slip-form method of construction:



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1. Care to be taken to prevent dragging of concrete along with upward movement of the shuttering. For this purpose following steps are advisable:
 - a) Shutter plates have to be smooth and should be thoroughly clean. Before fixing them in position all the surfaces which will be coming in contact with concrete to have a coat of epoxy paint.
 - b) In areas where concrete thickness is 750 mm or more, rate of pouring should be such that minimum slipping of shuttering is maintained to avoid initial set of concrete before slip form movement.
 - c) Mix design should be so done that it will be self-lubricant at the contact face of shutter and concrete and thus reduce friction. Suitable cement of approved manufacturer (conforming to relevant I.S. Specification) may be used for the purpose. An optimum ratio of coarse/fine aggregate should be established to suit the purpose depending on availability of aggregates.
 - d) Mix design also should be so done that it has a slump of around 100mm-120mm, at the point where concrete is placed under an ambient temperature of around 40 Deg.C. This will also keep vibration by needle vibrators to required minimum. Slump should not drop down to zero in less than 45 minutes. Suitable retarding agent and plasticizer of approved manufacture may be added in mix to achieve this purpose. These admixtures to be properly identified by preliminary tests both for performance and for compatibility with particular type of cement proposed to be used.

Additional steps like spraying of water over the shutters and keeping down the temperature of coarse aggregates by continuous spraying of water over those may be resorted to if ambient temperature is more than 40 Deg.C.
2. Care must be taken to prevent twist, which predominantly occur in the initial stages because of low slipping rate, in the horizontal plane of Slip-form assembly. A thorough check on this aspect must be kept at every 15 minutes interval. One person should exclusively be assigned this work together with rectifying any defect.
3. Every endeavour has to be made so as not to occur any tilt in the shutter assembly. To achieve this following steps need be taken:
 - a) Performance of jacks has to be closely observed and any defective one needs immediate replacement. Difference in levels of opposite jacks at any instant of time should not exceed 5 mm.
 - b) Loading on Slip-form truss/yokes has to be fairly equal.



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- c) Sleeve through which jacking rod passes has to be of sufficient length so that later gets an uniform clearance and does not get any chance to tilt. Sleeves should have a minimum wall thickness of 3.25 mm and should be such that jacking rod gets a maximum clearance of 1 mm to 1.5 mm around.
4. For taper walled chimneys overlapping of shutters which are kept to effect the tapering, needs careful attention otherwise these may be filled with concrete slurry.
5. In designing the mix following aspects should be borne in mind:
- a) Cement used should have an initial setting time of not less than 50 minutes and preferably should have a specific surface around 3600 Sq.Cm.per gram.
- b) Coarse and fine aggregates should be well graded and rounded aggregates offer better performance in Slip-form technique. These help to keep down water/cement ratio and also offers better lubrication between concrete and shutter surface. 40 mm down size of coarse aggregates should preferably be used unless reinforcement detailing calls for lesser size aggregates.
- c) From the point of view of creep, shrinkage as well as initial setting property of concrete, cement content should not preferably be more than 450 Kg. per Cu.M of concrete.
- d) Minimum compressive strength (after 4 to 6 hours of mixing) of concrete immediately below the shutter as slipform proceeds should be between 0.1 to 0.2 Newton/ Sq.mm.
- e) It is advisable to use cement from a single source during the entire operation of slipform technique since once the system starts, there might not be any time left for conducting trial mixes if the source of procurement of cement changes.
6. Large diameter vibrator needles should not be used for vibrating concrete. Sizes of these needles should preferably be restricted to 25 mm diameter and to 40 mm diameter - only in exceptional cases. At least two nos. standby vibrator units should always be maintained on top of working deck at all time during the entire period of slipform operation.
7. It is preferable to have membrane curing compounds sprayed on fresh surfaces emerging out of shutter panels for ensuring proper curing at great heights.

In case such spraying is not envisaged then elaborate arrangement has to be made for adequate supply of water both on inside and outside vertical surfaces with spraying arrangement, necessary length of pipelines and pump of adequate head to serve the purpose. It is



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always advisable to have a stand-by pump for effective utilisation of the system.

8. Rate of slipping should be around 100 mm – 150mm per hour, subjected to a maximum limit of 3.0 m per 24hrs.
9. Exact number and capacity of jacks as well as spacing of yoke frames are to be determined taking into account various loadings including self weight of the system, dead and live loads on working and other platforms, horizontal load on formwork, wind load etc.

It is desirable that jacking system, based on which the entire slip form system works, should consist of jacks 3 Tonne/ 6 Tonne capacity and a hydraulic pump with necessary pipe connections.

Spacing of yoke legs should preferably be kept within 2 metres to prevent overloading on jacks and consequent failure resulting in twist of the formwork.

Jacking rods should be of 25 mm diameter for 3 Tonne Jacks and 32 mm diameter for 6 Tonne Jacks.

10. At least 30% spare jacks and jacking rods should be kept ready during the entire operation. It is obligatory to maintain spare hydraulic pump along with a set of loose pipes in perfect working condition on top of working deck.
11. In sections where thickness is 500 mm or more it is prudent to go in for two nos. of jacks for each slip form yoke.
12. For effective utility of this technique following areas need careful attentions at the very conceptual stage:
 - a) Detailed quality assurance programme.
 - b) Advance Planning and preparations.
 - c) Arrangement for on site supervision and adequate access facilities.
13. Construction methods including description and types of different equipment proposed to be used, structural arrangement and analysis of the system, description and type of different materials, planned interruptions, description and frequency of various checks and tests for Slipform technique as well as for material, method of preparing, transporting and pouring of concrete, solution for probable defects during slipping, sequence of operations during planned interruptions etc. should be prepared beforehand by executing agency and to be approved by Engineer before starting the actual work.
14. Placing and binding of reinforcement is also a very critical item and needs special attention. From practical considerations not more than



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two or three layers of horizontal steel can be tied at a time and this causes a definite limitation in placement of reinforcement.

Vertical reinforcements should be kept vertical by providing suitable holders within the slipform system.

15. It is desirable to have a break of at least one day for every two weeks of continuous operation. Such break should be utilised for various maintenance activities, removal of jack rods etc.

16. Numbers and locations of hoists for lifting concrete, reinforcement and other materials have to be planned well in advance. Capacity of hoists should be such as to match with hourly requirement of concrete and reinforcement. If felt necessary one hoist may be exclusively earmarked for transporting concrete.

For movement of personnel supervising the work a separate hoist must be arranged for.

17. The system being operative round the clock it is obligatory to have adequate lighting arrangement both on various platform levels as well as on ground below. Arrangement has to be made for facilitating continuous upward movement of the entire system alongwith slipform.

18. Winches for lifting men and material and mixers, if located within unsafe area around chimney, should be protected by adequate shelter from possible damage.

19. Proper tele-communication system has to be established between the personnel working on top of Chimney and control room below.

20. A small laboratory should be maintained at site for testing different materials like cement, coarse and fine aggregates. A cube testing machine may also be installed at site for getting quick feed back results.

Apart from using plumb bobs, level and theodolite instruments for survey purpose arrangement should also be kept for lasers.

21. In case of interruption in the course of slipping of formwork following measures should be taken:

- Provision of a key and additional reinforcement at the junction of new and old concrete.
- Slip form system should be brought up freely to have a minimum overlap of 100 mm or so over previously cast concrete.
- Washing of old concrete surface with compressed air and water jet and thereafter pouring a layer of neat cement grout.



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- d) Clearing of shuttering panels of loose materials, concrete etc. by compressed air and applying a coat of epoxy paint, if felt necessary by Engineer.
- e) Neatly finishing the interface of old or new concrete as soon as it comes out of shutter panel.
22. It is preferable to suspend the construction work under high wind condition.
23. It is of utmost importance that for effective implementation of this system an Engineer fully conversant with Slip form technique with enough experience in planning and control of formwork should be in overall command of the site and he should be ably supported by well trained mid level supervisory staff, skilled workers and operators, having experience of similar construction in past. It is to be noted that enough manpower (as agreed by owners engineer at site) of a above mentioned quality, is always ensured at site for smooth and uninterrupted work of slip form.
24. Operation of slip form method of construction is a continuous one and it demands continuous/intermediate inspection of accuracies in line, level, dimensions and position and immediate rectification of any noticed deviation. All these ask for personnel of high quality having constant vigilance over the construction activity.
25. While all the activities in effective implementation of the work needs utmost care keeping safety of men and material in mind it is obligatory that all activities should be carried out under the guidance of a qualified and trained safety Engineer.
26. For smooth and unhindered supply of concrete, while the slip form is in operation, it is desired that batching plant for concrete of chimney shell be placed in close proximity of chimney shell. However, all the safety measures required for placing batching plant close to shell must be ensured.
- Safety measures as listed below must be adhered to but should not be limited to only these:
- a) Safety helmets and belts to be provided to all supervising staff and workers.
- b) Safety nets to be provided below both inside and outside platforms as instructed by Engineer.
- c) Hand railing and toe guard to be provided around all openings and platforms.
- d) Regular maintenance of equipment, checking of hoists, scaffoldings etc.



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- e) Passenger hoist must have multiple ropes with adequate factor of safety.
- f) Emergency lights, coloured lamps to be provided in accordance with relevant Indian Standards and as supplemented in the Specification and to be operative in case of sudden power failure. Emergency standby generator must be kept ready during the entire period of slipform method of construction.
- g) Emergency vehicles, first aid facilities must be kept ready during the entire period of work.

26. Permissible construction tolerances should be limited to the following:

Variation in wall thickness	:	(-) 5 mm, (+) 25 mm
Variation from Design Diameter	:	(+) 25 mm or (+) 2.5 mm per 3 m dia. whichever is larger, but in no case more than (+) 5 mm.
Out of Plumb in General	:	1 in 1000 of height subject to a maximum of 200 mm.

3.4.0 Steel Flues

3.4.1 General

Fabrication and erection of Steel Flues shall conform to "Technical Specification for Fabrication and Erection of Structural Steelworks" furnished in this Specification.

3.4.2 Fabrication

Plates out of which flues will be fabricated, should be bent to the required shape on an appropriate machine. No smithy process shall be adopted for the purpose. Plates are to be prevented from distorting by more than the tolerances specified during transportation, storage, handling, erection and jointing. All components should be correctly located and brought into correct alignment and level within specified erection tolerances, before adjacent pieces are jointed or secured.

3.4.3 Assembly

Each flue would be assembled from its Component "Cans" near to ground level within the wind-shield. Incomplete flue would be hung only from the flue support platform during assembly, and progressively hoisted to enable connection of further cans at its lower end. Upon completion of the initial sectional length, this length will be hoisted and supported in its final position at the flue support floor as indicated in the drawing. It is envisaged that each



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flue will be assembled and hoisted in three sectional lengths; site joints between sectional lengths being located just above a steel floor level.

Joints between individual cans should be flanged and bolted on outside and to have sealed welded joints on inside in accordance with clause 3.3.0 - "Welded Construction" under Technical Specifications for Fabrication of structural steel work. The Contractor shall submit a drawing showing proposals for erection and indicating locations of all site joints which should be kept to minimum.

3.4.4 Flue Expansion Compensator

For installation of Expansion Compensators, the manufacturer's instruction should form the basis of the Contractor's method. This method, in a statement, should be submitted to the Engineer for approval. Once approved it has to be followed throughout the installation sequence. Expansion Compensators should be prevented from distortion during transportation, handling, erection and jointing, by more stringent tolerances than specified by the manufacturer.

3.4.5 Tolerances

Permissible tolerances in the fabrication and erection of steel flues are given below :

- a) Internal diameter shall not vary by more than : $\pm 12 \text{ mm}$
- b) Centre of any section shall not be eccentric from vertical centre line by more than : 10 mm in any 15 metre height
- c) Centre of any section at height 'h' is in mm. above GL shall : $(h/2500 + 10) \text{ mm}$, not be vertical centre where line by more than
- d) Local deviation from a true circular form should not exceed the shell thickness (Measurement should be made from a segmental circular template having radius of flue shown in drawing and a chord length equal to 0.15 of that radius).
- e) Peaking or stepping at welded horizontal seams shall not exceed 4 mm. (Measurement shall be made with a straight edged template long enough to contact the straight shell on either side of the peaked area).

3.4.6 Erection

Erection of Steel Flues and C.I. Chimney caps shall be done as per requirement of IS:800. The Contractor shall submit to the Engineer a programme of erection for his approval. All plant, equipment, tools, tackle and any other accessories required for the erection shall be



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provided by the Contractor. Storing and handling of fabricated materials for erection, setting out of members, providing temporary supports, bracing, fasteners, bolts, nuts etc. shall be the responsibility of the Contractor and shall be taken into account in quoting the rate.

3.5.0 Insulation and Protective Treatment

3.5.1 Acid and Heat Resistant Paint

Top 15 meters of the outside face of R.C.C. windshield horizontal surface at the top of windshield and inside face from the top of the windshield to the top of roof slab or as specified in the drawing shall receive a protective treatment of three coats of acid and heat resistant black paint. The quality and type of the paint shall have the prior approval of the Engineer. For this, a small area shall be painted and a sample of paint shall be shown to the Engineer.

The surface to be painted shall be prepared and primary coat, if required as per the paint manufacturer's specification and direction of the Engineer, shall be applied. The paint shall conform, unless otherwise stated, to the requirement of IS:158. Necessary samples, test certificates and manufacturer's literature shall be submitted to the Engineer for his approval. The surface to be painted shall be completely dry before the paint is applied and the drying time between consecutive coats shall not be less than 5 hours. The overall combined thickness of paint shall be a minimum of 230 microns.

3.5.2 Cement Paint

The outside face of the Chimney shell, unless specified otherwise, shall be painted with Cement water proof paint. The quality shall be approved by the Engineer. Necessary samples shall be submitted to the Engineer for his approval. The surface of the shell shall be prepared as per paint manufacturer's specification. In addition, care shall be taken that the surface is free from stain, honey comb and any rough and uneven surface. The joints between two shuttering and two lifts of shuttering shall be so prepared that any unevenness, if by chance exists, shall be removed. If one coat of paint is not sufficient to give the required finish, the Contractor shall repaint the surface, until the Engineer is satisfied with the workmanship. The paint shall conform, unless otherwise stated, to IS:5410. Necessary samples, test certificates and manufacturer's literature shall be submitted to the Engineer for approval.

3.5.3 Insulation and Packing

All insulation material should be of dimension and type, shown in the drawing. Load bearing insulations at supports and side restraints of Steel liners should be an assembly of M.S. Plates, Stainless Steel Plates, PTFE (Poly Tetra Fluoro Ethylene) sheets and or/asbestos fibre reinforced boards (SINDANYO BLOCKS). Insulation to be fixed on outer surface of steel flues should be made of glass or mineral wool.

a) Load Bearing Insulation Block

Load bearing assembly should consist of three units and be fabricated according to approved drawings. It would be fabricated from mild steel



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units with a stainless steel sheet bearing plate and load bearing insulation blocks as indicated in drawing.

The first unit is bolted to the supporting beam. It consists of a M.S. base plate with bolt holes on which a machined M.S. plate is welded. This plate is provided with recess for PTFE sheet (conforming to BS : 5400) to seat, being lubricated with silicon grease.

The second unit also consists of a M.S. plate having adequate size & thickness as shown in drawing. While one surface of the plate is provided with a stainless steel bearing plate the other surface has a thin layer of lead/ elastomeric sheet. The side having stainless steel surface is placed on PTFE surface of First unit.

The third unit consists of two layers of load bearing insulation blocks each having a minimum thickness of 50 mm and factory bonded to top & bottom M.S. plates. These are separated by 100 mm. long load bearing insulation dowels as shown in the drawing. These plates are in turn welded to two additional M.S. plates. Of the two surfaces thus created one shall be welded to bracket assembly while the other should rest on the lead sheet of second unit. Bearing assembly, thus formed, should be levelled by using suitable M.S. shims.

Support arrangement typically consists of flue support shoe (a part of flue), flue support bracket connected to the shoe by precision bolted connection. The bracket in turn is welded to the bearing assembly, which in turn is bolted to available supporting beams.

Support brackets and bearing assembly are welded to locally thickened area of flue. These support the flue on support platform at suitable locations indicated on the drawing.

The arrangement described above should cater for easy and smooth thermal movements of linear element. Suitable restraint brackets and M.S. stop plates need be provided as shown in drawings to prevent excessive movement and thus keeping different units of bearing assembly in proper position.

b) Insulation Block at Lateral Restraints

At flue restraint platforms, necessary restraint arrangement with load bearing insulation blocks and stainless steel bearing plates fixed to the insulation blocks should be provided as indicated in drawings.

Restraint and support brackets need be provided for the bottom supported portion of the flue which rests on the support platform provided at the base to cater for bearing and restraint requirements.

c) Glass or Mineral Wool

Insulation thickness of 65 mm as is specified in clause 2.05.10 shall be built up using two (2) layers composed of 40mm and 25 mm thick



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insulation blocks. Thicker layer shall be put as first layer around the flue on its exterior surface.

The insulation on the flue shall be fixed using chicken G.I. wire mesh, G.I. wire ties, insulation retaining studs, washers etc. All joints shall be staggered. The insulation shall be tightly secured to the exterior surface of the flue by impaling on the studs and fixing in place by means of 63mm round or square metal plated speed washers. 20 gauge galvanized wire netting shall be wrapped continuously over the entire exterior of insulation. The wire mesh shall be 25mm hexagonal pattern conforming to IS:1566. All joints in the mesh shall be tapped a minimum of 150 mm tied by 16 gauge soft annealed wire at 300 mm spacings. Lacing at joints shall not be used. The Contractor before application of insulation, shall take prior approval of actual fixing arrangement from the Engineer.

The insulation shall be able to sustain structural vibrations and shall not settle under such conditions during erection, construction & operation. The insulation shall be suitably tied to prevent dislocation under adverse conditions.

The cladding of stainless steel sheet over the insulation shall be well secured using pins, fasteners etc.

d) **Vermiculite Concrete**

Vermiculite concrete shall be made by mixing exfoliated vermiculite, portland cement and water. It shall be of Grade-B, having a density of 210 Kg./Cu.M. The vermiculite aggregate size shall be maximum 6 mm. The mix shall be 1 cement and 8 vermiculite by volume.

3.6.0

Acid-Proof/Chemical Resistant Protection to Roof Slab

Acid-Proof/Chemical Resistant tiles bedded on acid proof/chemical resistant mortar shall be provided for the protection of roof slab. The intervening space between the tiles shall also be filled up by chemical resistant/acid-proof epoxy mortar grouts. The mortar shall be used immediately after mixing.

Tiles shall be made of clay, feldspar or quartz and vitrified at a high temperature in ceramic kilns. These should be unglazed, free from deleterious materials and should conform to IS:4457. Iron oxide in the raw materials used, shall not exceed 2 percent. They should show a fine grained, dense and homogenous fracture when broken. They shall be sound, true to shape, flat and free from flaws and other manufacturing defects. Dimensions of the tiles shall be 198.5 x 198.5 x 35 mm. Depth of the groove on the underside shall not be more than 3 mm. Compressive and tensile strengths of the tiles shall not be less than 70 N/Sq.mm and 3.5 N/Sq.mm respectively.



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3.7.0

Flue Acid Drains and Manholes

Flue acid drainage system, where provided, will comprise of collection sumps, dilution manholes, conveying pipes including connection to main drainage system.

Stainless steel pipes, bends, collection sumps, fixing straps, bolts etc. conforming to the relevant Indian Standards (or in absence of which British Standard BS:3605) shall be used in work. Pipes should be cut and joined as per manufacturer's instructions so as to leave the surface clean and square to the axis of pipe.

Manhole should be constructed as per drawing. However, for general guidance it may be noted that pit of required dimensions should be excavated, lean concrete (1:2:4 mix) of required thickness to be laid, Acid-proof/Chemical resistant brick masonry in 1:4 acid resistant cement mortar of necessary thickness be built and both sides plastered by 12mm thick acid proof plaster (1:3 mix) having waterproof admixtures.

Manholes should be covered by reinforced concrete slab on which a heavy duty (HD) manhole cover with frame having diameter 560mm and total weight 255 Kg (140 Kg for manhole and 115 Kg for cover) is to be fixed. For additional safety another inner cover or other approved methods may be adopted. The manhole cover shall be distinctively coded to indicate the type of drainage involved.

Inside manholes necessary channels and benchings finished smooth by neat cement in cement concrete (1:2:4) and foot rungs made from 20mm round bars at 300mm centres and staggered should be provided. Rungs should project 100mm from wall face and be embedded 200mm inside cement concrete block made in that location of brick work. These foot rests shall be painted with coal tar in the projected portions and cement slurry in the embedded part. Joint of any pipe with brick work shall be rendered perfectly leak proof.

Pipes and fittings in the connection pipe to the main drainage system shall be vitrified clayware conforming to relevant IS and laid to the line and level indicated in the drawings.

3.8.0

Roof Drainage

3.8.1

General

Rainwater outlets and down comers to run along inner face of stack wall, shall be made of standard cast iron rainwater pipes conforming to IS:1230. The brackets used to hold the pipes alongside the walls shall be wrought iron clevis type, split ring type or of perforated strap iron as approved by the Engineer. Each vertical pipe shall hang freely on its bracket fixed just below the socket. Suitable spacer blocks are to be kept in between the pipe and wall surface for fixing the pipe. All bends and junctions shall be provided with water tight clean-outs.



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3.8.2 Pipe Joints

All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and water tight when under ground. Method of pipe cutting and jointing shall be as per instruction of the pipe and fittings manufacturer or as approved by the Engineer. However following guidelines may be followed in absence of any instruction available from the manufacturer.

Socket and Spigot pipes shall be joined by cast lead joints. Spigot of the following pipe should be centred in the socket of the preceding pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. After the gasket or hemp yarn has been caulked tightly, a jointing ring shall be placed round the barrel and tightened against the face of the socket to prevent air lock. Molten lead shall then be placed round the barrel and tightened against the face of the socket. Thereafter molten lead should be poured in to fill the remainder of the socket and caulked with suitable tools tight round the joint to make up for shrinkage of the molten metal on cooling and should be finished 3mm behind the socket face. If any joint is suspected to be damaged it has to be opened out & redone. Joints in cast iron pipes with special jointing arrangements like "Tyton" joints etc. shall follow the instructions of the manufacturer.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 General

The Contractor shall carry out all sampling and testing in accordance with the relevant IS Specifications and as supplemented herein, for the following items or any other item as may be required by the Engineer unless otherwise specified in this specification. The Contractor shall get the specimens tested in laboratory, approved by the Engineer and shall submit to him, the original test results in triplicate, within seven days after the completion of the test. Engineer may present himself while such tests are being carried out.

4.2.0 Cement

Representative samples shall be taken as per the relevant IS Specification from each consignment of Cement received from the Purchaser/Manufacturer/Supplier for carrying out the tests for fineness (by hand sieving), setting time, compressive strength and soundness tests, and the Contractor shall carry out the above tests as per relevant Indian Standard. If the cement is supplied by the Contractor the test shall be carried out by him. The Contractor shall carry out any or all the tests on aggregates as may be required by the Engineer, in accordance with IS:2386 Parts-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant IS specifications.

4.3.0 Water

Sampling and testing of water being used for concrete works shall be carried out as per IS:3550, by the Contractor, at regular intervals and whenever



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directed by the Engineer. The final acceptance criterion in case of doubt shall be as per IS:3025.

4.4.0 Concrete

The Contractor shall take cubes for works test as per requirement laid down in IS:516 regularly from the day's pour. The number of test cubes to be taken shall be as per IS:456. The Engineer may also use his discretion in deciding the rate of cubes to be taken. The acceptance criteria is to meet the requirement of IS:456. If the cube test results indicate that some portions of the work is below the required strength, the Engineer may order demolition of that portion of work which is below strength and ask the Contractor to rebuild, provided a satisfactory method of load testing is not possible. Such testing or demolishing and rebuilding shall be carried out by the Contractor.

4.5.0 Steel Flue

All site and shop welded joints shall be inspected and tested in accordance with clause 4.00.00 of Technical specification for Fab. and Erection of structural steel work.

4.6.0 Insulations

The insulating materials shall be tested for its stipulated characteristics and properties in accordance with the latest editions of IS:3144 and IS:3346 and/or as directed by the Engineer.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 With Tender

The following technical information are required with the tender:

- Source and arrangement of processing of aggregates proposed to be adopted.
- Type of plant and equipment proposed to be used.
- Names of firms with which association is sought for to execute the special items of work e.g. flue expansion compensator, load bearing insulation blocks etc. in the contract.
- Types of formwork proposed to be used. All details as per clause no. 3.03.06 to be submitted, if slip form method is proposed to be used.
- Shop proposed for fabrication of steel (flue) liners. Detailed write-up on procedure of erection of complete liner system including details of equipment proposed for the same.
- For insulating material tests to be offered for inspection & tests for which test certificates will be submitted. A drawing showing the details of fixing insulation on the flues at bearings, lateral restraints and exterior surface.
- Proposal for lifting of men and material in constructing the chimney.



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5.2.0 After Award

The following information and data including samples where necessary, shall be submitted by the Contractor, progressively during the execution of the Contract.

5.2.1 Programme of Execution and requirement of Materials

Within 30 days of the award of the Contract, the Contractor will submit a Master Programme for completion of the work giving monthwise requirement of materials, particularly mentioning in details the materials which are to be supplied by the Owner and for the procurement of which the help of the Owner is required as per the terms & conditions of the Contract. In case the Contractor proposes to take on hire any machinery or tools and plants from the Owner, the detailed phased out programme of such hire is also to be submitted.

The master programme may have to be reviewed and updated by the Contractor quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.

Detailed day to day programme of every month is to be submitted by the Contractor before the commencement of the month.

5.2.2 Samples

Samples of all materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities, for approval. All samples shall be submitted well in advance of starting work at site. Approved samples will be preserved by the Engineer for future reference. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying material of specified quality.

5.2.3 Design Mix

Design mix as per details of this specification giving proportions of ingredients, sources of aggregates and cement along with accompanying test results of trial mixes as per relevant IS Specifications shall be submitted to the Engineer, for his approval, before it can be used on the work.

Further, the mix design for concrete of shell to be validated from a third party agency of national repute, as agreed upon by the owner.

5.2.4 Detail Drawings

Following items shall be provided by the Contractor which are to be approved by the Owner and Consultant.

- a) Detail drawings and designs of form work including scaffolding to be used. If slipform method of construction is adopted, then detail drawings showing all the arrangements for slipform technique including methods for reducing internal diameter and providing required slopes on outer diameter.
- b) Detail drawings and bar bending schedules for concrete components.



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- c) Shop drawings for structural steel and metal work, including inserts etc. The Contractor shall submit his proposal for testing site and shop joints provided in steel members.
- d) Detail drawings for templates and temporary supports for embedments.
- e) Category wise requirements of MS, tor and structural steel including GI flats of various sizes for procurement.
- f) Detailed drawings of steel flues indicating details of joints, supports and restraints including insulation blocks, and details of expansion compensator.
- g) Detailed drawing of hoisting arrangement for men and material satisfying statutory regulations laid down for safety purpose.

5.2.5 Reports

Following Test Reports shall be furnished by the Contractor :

- a) Mill Test Report for cement and reinforcing steel if the materials are supplied by the Contractor.
- b) Inspection Report of bought out items.
- c) Inspection Report of formwork and reinforcement, insulations etc.
- d) Reports of tests of various material and concrete.
 - e) Radiographic tests on welded joints in steel flues.
 - d) Any other data or report or test result required by the relevant IS Specifications and if required by the Engineer for satisfactory quality control of the workmanship.



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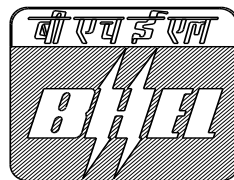
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GENERAL TECHNICAL SPECIFICATION

EARTHWORK IN EXCAVATION AND BACKFILLING



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



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**TECHNICAL SPECIFICATION
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1.0.0 SCOPE

This specification covers excavation in all types of soil, soft and decomposed rock not requiring blasting and rocks requiring blasting, shoring, dewatering, filling around foundations and to grade, compaction of fills and approaches, protective fencing, lighting, etc. relevant to structures and locations covered under the scope of 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) Furnish all labour, supervision, services including facilities as required under statutory labour regulations, materials, scaffolds, equipment, tools and plants, transportation, etc. required for the work.
- b) Prepare and submit working drawings showing the approaches, slopes, berms, 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 carry out sampling and testing and submit to the Engineer, results of soil compaction tests whenever required by the Engineer to assess the degree of compaction.
- d) Construction, maintenance and removal after completion of magazine of proper capacity as well as design for storing of explosives required for blasting work to be carried out under the scope of this tender including procurement of necessary licenses from proper authorities.

2.2.0 Work to be provided for by others

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the Contract.

2.3.0 Codes and Standards

All works under this specification, unless specified otherwise, shall conform to the latest revision and/or replacement of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular aspect



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of work is not covered specifically by Indian Standard Specification any other standard practice as may be specified by the Engineer shall be followed :-

IS:1200 Method of Measurement of Building and Civil
(Part-I) Engineering work; Part - I Earthwork.

IS:2720 Determination of Moisture Content
(Part-II)

IS:2720 Determination of Moisture content / Dry Relation
(Part-VII) using Light Compaction.

IS:2720 Determination of Density Index (Relative Density)
(Part-xiv) of cohesionless soils.

IS:2720 Determination of Dry Density , in place, by core
(Part-xxix) cutter method.

IS:2720 Determination of Dry Density of soils, in place,
(Part- xxviii) by sand replacement methods.

IS:3764 Safety code for Excavation work.

IS:4081 Blasting and Related Drilling Operations

IS:4701 Earthwork on canals

2.4.0 Conformity with Designs

The Contractor is to carry out the work as per the drawings issued to him and/or Contractor's drawings which are approved by the Engineer and/or the Engineer's instructions.

2.5.0 Materials to be used

2.5.1 General

All materials required for the work shall be of best commercial variety and approved by the Engineer.

2.5.2 Borrow Material

Borrow material required for back-filling shall be excavated from approved locations and levels, and shall consist of material, approved by the Engineer, free from roots, vegetations, 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.



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2.6.0

Quality Control

The Contractor shall establish and maintain quality control for the various aspects of the work, method, materials 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

2.7.0

Information regarding site conditions

Surface and Sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawing or otherwise furnished to the Contractor shall be taken as a guidance only and variation therefrom shall not affect the terms of the contract. The Contractor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and / or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction likely to come up during the execution of the contract so that he may evolve a realistic programme of execution.

3.0.0

EXECUTION

3.1.0

Setting Out

The Contractor will prepare and submit to the Engineer, detailed drawings of the excavation work as proposed to be executed by him showing the dimensions as per drawings and specification adding his Proposals of slopes, shorings, approaches, dewatering sumps, berms, etc. On receiving the approval from the Engineer with modifications and corrections, if necessary, the Contractor will set out the work from the control points furnished by the Engineer and fix permanent points and markers for ease of future checking.

These permanent points and markers will be fixed at intervals prescribed by the Engineer and checked by the Engineer and certified by him after which the Contractor will proceed with the work. Engineer shall be provided with necessary men, material and instructions for such checking. It should be noted that this checking by the Engineer prior to start of the work will in no way absolve the Contractor of his responsibility of carrying out the work to true lines and levels and grades as per drawing and subsequent corrections, if necessary, in case any errors are noticed in the Contractor's work at any stage.



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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, etc.

The area to be excavated or filled shall be cleared out of fences, trees, logs, stumps, bush, vegetation, rubbish, slush, etc. and levelled up. Trees upto 300mm girth shall be uprooted. Trees above 300 mm girth to be cut, shall be approved by the Engineer and then marked. Felling of trees shall include taking out roots upto 600 mm below ground level or 150 mm below formation level whichever is lower. After the tree is cut and roots taken out the pot-holes formed shall be filled with good earth in 250 mm layers and consolidated unless directed by the Engineer otherwise. The trees shall be cut in suitable pieces as instructed by the Engineer.

Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burnt or removed from the site to approved disposal areas as may be specified. Ash shall be spread or removed. Useful materials, saleable timber, firewood, 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



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This shall include :

- i) stiff heavy clay, hard shale, or compact moorum requiring grafting tool or pick or both and shovel, closely applied ;
- ii) gravel and cobble stone having maximum diameter in any one direction between 75 and 300 mm ;
- iii) soling of roads, paths, etc., and hard core ;
- iv) macadam surfaces such as water bound, and bitumen/tar bound;
- v) lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar, below ground level ;
- vi) soft conglomerate, where the stones may be detached from the matrix with picks ; and
- vii) generally any material which requires the close application of picks, or scarifiers to loosen and not affording resistance to digging greater than the hardest of any soil mentioned in (i) and (vi) above.

c) **Soft and Decomposed Rock**

This shall include :

- i) limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with crowbars ;
- ii) unreinforced cement concrete which may be broken up with crowbars or picks and stone masonry in cement mortar below ground level ;
- iii) boulders which do not require blasting having maximum diameter in any direction of more than 300 mm, found lying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin ; and
- iv) any rock which in dry state may be hard, requiring blasting, but which when wet becomes soft and manageable by means other than blasting.

d) **Hard Rock (requiring blasting)**

This shall include :

- i) any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is required ;



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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 excavations shall be done to the minimum dimensions as required for safety and working facility. Prior approval of the Engineer shall be obtained by the Contractor, in each individual case, for the method he proposes to adopt for the excavations including dimension, side slopes, shoring, dewatering, 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 line, slopes and grades shown on the drawing or directed by the Engineer. No material shall project within the dimension of minimum excavation lines marked. Boulders projecting out of the excavated surfaces shall be removed, if in the opinion of the Engineer they are likely to be a hindrance to the workers.

Method of excavation shall be in every case subject to the approval of the Engineer and the Contractor shall ensure the stability and safety of the excavation, adjacent structures, services and works.

The Contractor shall have full responsibility of the stability of the excavation and safety of the workmen. If any slip occurs, the Contractor shall remove all slipped material from the excavated pit.

All loose boulders, semi-detached rocks, not directly in excavation but so close to the area to be excavated as to be liable, in the opinion of the Engineer, to fall or otherwise endanger the workmen, equipment of the work, etc., shall be stripped off and removed away from the areas of excavation. The method used shall be such as not to shatter or render unstable or unsafe the portion which was originally sound and safe. Any materials not requiring removal as contemplated in the work, but which, in the opinion of the Engineer, is later to become loose or unstable shall also be promptly and satisfactorily removed as directed by the Engineer.

Prior to starting the excavation, the ground level at the location shall be checked jointly with the Engineer.



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The rough excavation may be carried 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 is done to a depth greater than that shown on the drawing, or directed by the Engineer, due to the Contractor's fault, the excess depth shall be filled up to the required level (with cement concrete not leaner than 1:4:8 ordinary concrete or richer) as directed by the Engineer in each individual case.

In formation of rock requiring blasting, those overcuts which are unavoidable will be made up by ordinary cement concrete 1:2:4. All excavated materials such as hard rock, boulders, bricks, dismantled concrete blocks, etc. shall be stacked separately as directed by the Engineer and shall be the property of the Owner.

3.5.2 Excavation in Ordinary Soil, Hard Soil and Soft and Decomposed Rock

The excavation in ordinary soil, hard soil, soft and decomposed rock will be carried out as per the approved proposal, modified and corrected where necessary by the Engineer. The work will be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to other activities in the area. As the excavation reaches the required dimensions, lines, levels and grades, the work will be checked by the Engineer thoroughly and the balance work will be carried out carefully to avoid any over-excavation. On completion, the work will 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 carry out the balance work just before the foundation work of the structure can be started.

3.5.3 Excavation in Hard Rock

In case where excavation, both in ordinary soil and hard rock, are involved, the ordinary soil comprising of soft, hard and dense soils (including laterite formations) and rock including weathered rocks, lateritic rocks, etc. which can be excavated without blasting, shall be completely stripped off. Further work in hard rock shall be resumed after clearance from the Engineer.

Personnel deployed for rock excavations 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 such that it is not stable against sliding, necessary supports, props, bracings or bulkheads shall be provided and maintained during the period of construction. Where danger exists of loose rock/boulder falling from the excavated surfaces deeper than 2 metres, steel mesh anchored to the lower edge of



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excavation and extending over and above the rock face, adequate to retain the dislodged material shall be provided and maintained.

In case where blasting, though otherwise required, is prohibited for any reasons, the excavation shall be carried out by chiselling, wedging or any other approved method.

3.5.4 **Blasting**

3.5.4.1 **General**

Storage, handling and use of explosives shall be governed by the current explosive rules laid down by the Central and the State Governments. The Contractor shall ensure that these rules are strictly adhered to. The following instruction, wherever found in variance with the above rules, shall be considered as superseded by the above rules.

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.

3.5.4.2 **Storage of Explosive**

Storage of explosives shall be governed by the current Explosive Rules, Explosives shall be stored in a clean, dry, well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400 m of the actual work site or any source of fire. A space surrounding the magazine shall be fenced in. The ground inside the fence shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be by one gate only and no person shall be allowed inside this fence without permission of the Officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The mezzanine shall be perfectly well drained.

Two lightning conductors shall be provided to the magazine, one at each end. The lightning conductors shall be tested once in every year.

Fuses and detonators shall be stored in separate magazines. However, detonators can be kept in an annexe adjoining the magazine provided that their number does not exceed 25,000 and that the annexe is so constructed that not less than 60 cm masonry and 100 cm of air space shall intervene between any detonators in such annexe and the interior of the main magazine. Cases containing explosives are not to be opened in a magazine. Explosive in open cases are not to 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 destroyed.

Artificial light is not to be allowed in any magazine. No smoking shall be allowed within 100 m of a magazine.



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Magazine shoes without nails shall be used while entering the magazine.

The mallets, levers, wedges etc. for opening barrels or cases are to be of wood. Inside a magazine the cases of explosives are to be carried by hand and shall not be rolled or dragged. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been longest in store are to be issued first.

Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides, special care is to be taken to keep the floor free from grains of powder or portions of explosive matter fallen on the floors due to leakage of cases etc.

The magazine shall not be opened during any duststorm or thunderstorm nor any person shall be allowed in the vicinity of the magazine.

All magazines shall be officially inspected at definite intervals and a record kept of the results of such inspections.

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 the direct rays of the sun, naked lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each cage or package is to 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 a vehicle conveying explosives. No carriage or vessel shall be used for transporting explosives unless all iron or steel therein with which a package containing any explosive is likely to come in contact is effectually covered with lead, leather, wood, cloth or other suitable material. No lights shall be carried on the vehicle carrying explosives.

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 the responsibilities imposed on him.

Holes for charging explosives shall be drilled with Pneumatic drills, the drilling pattern being so planned that the rock pieces after blasting will be suitable for handling.

The hole diameter shall be of such a size that cartridges can easily pass down them and undue force is not required during charging. Charging operations shall be carried out by or under the personal supervision of the shotfirer. Wrappings shall never be removed from explosive cartridges. Only



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wooden rods shall be used for loading and stemming shotholes. Only one cartridge at a time shall be inserted and gently passed home with the wooden tamping rod.

Only such quantities of explosives as are required for the particular amount of work to be done shall be brought to the works. Should any surplus remain when all the holes have been charged, it shall be carefully removed to a point at least 300 m from the firing point.

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 shotfiring 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 and to keep the lead wires short circuited until ready to fire. Any kinks in detonator leading wire shall be avoided.

For simultaneous firing of a large number of shotholes, use of cordtex may be done. Cordtex shall be initiated by an electric detonator attached to its side with adhesive tape, connecting wire or string.

All connections shall be made by the authorised shotfirer himself. The shotfiring cable shall not be dragged along the ground to avoid possible damage to the insulation. The shotfiring cable shall be tested for continuity and possible short circuiting before it is used each time.

The shotfirer shall always carry the exploder handle on his person until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits.

Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the Engineer.

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 300 metres radius from the firing point, or as required by statutory regulations, at least ten minutes before the time of firing by sounding a warning siren. The area shall be encircled by red flags.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations the authorised shotfirer shall return to the blast area and inspect carefully the work and satisfy himself that all charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole not less than 600 mm from the misfired hole and by exploding a new charge. The authorised shotfirer shall be present during removal of the debris liable to 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.

When blasting is conducted in the neighbourhood of roads, structures, buildings etc. controlled blasting has to be carried out by drilling shallow shotholes and filling the same with light charge of explosives.



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Adequate safety precautions as per building bye-laws, safety code, statutory regulations etc. shall be taken during blasting operations.

3.5.5 Disposal

The excavated spoils will be disposed of in any or all the following manners :

- a) By using it for backfilling straightway.
- b) By stacking it temporarily for use in backfilling at a later date during execution of the Contract.
- c)
 - i) By either spreading, Or
 - ii) spreading and compacting at designated filling areas and / or disposal areas.
- d) By selecting the useful material and stacking it neatly in areas designated by the Engineer for use in backfilling by some other agency.

3.5.6 Disposal of Surplus

All surplus material from excavation shall be carried away from the excavation site to designated disposal area selected by the Engineer.

All good and sound rock excavated from the pits and all assorted materials of dismantled structures shall be the property of the Owner.

3.5.7 Protection

The Engineer shall be notified by the Contractor as soon as the excavation is expected to be completed within a day so that it may be inspected by him at the earliest. Immediately after approval of the Engineer, the excavation must be covered up in the shortest possible time. But, in no case the excavation shall be covered up or worked on before approval and measurement by the Engineer. Excavated material shall be placed beyond 1.5 metres from the edge of the pit or trench or half the depth of the pit or trench whichever is more or further away if directed by the Engineer.

Excavation shall not be carried out below the foundation level of structure close by until required precautions have been taken.

Adequate fencing is to be made enclosing the excavation.

The Contractor shall protect all under-ground services exposed by excavation. The Contractor shall also divert all surface drains, etc. affected by the excavation to maintain the working area neat and clean.

3.5.8 Dealing with Surface Water



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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 excavations shall be kept free of water and slush. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The Contractor shall remove by pumping or other means approved by the Engineer any water inclusive of rain water and subsoil water accumulated in excavation and keep the trench dewatered until the construction of foundation structure and backfilling are complete in all respects. (except where such dewatering would need installation of well points or deep wells for which separate payment will be made) Sumps made for dewatering must be kept clear of the foundations. Method of pumping shall be approved by the Engineer but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping.

3.5.10 Timber Shoring

Timber Shoring made out of approved quality of timber shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench and the type of timbering shall be determined by the Engineer. 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 minimum 250 x 40 mm sections as directed by the Engineer. The boards shall generally be placed in position vertically in pairs, one board on each side of cutting, and shall be kept apart by horizontal walers of strong wood at maximum 1.2 metres spacings, cross strutted with ballies or as directed by the Engineer. The length of the bally 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 the 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



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into the ground. No portion of the vertical side of the trench or pit shall remain exposed, so that the earth is not liable to slip out.

The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started at 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 the case of open timbering, the entire surface of the side of trench pit is not required to be covered. The vertical board of minimum 250 mm width and minimum 40 mm depth shall be spaced sufficiently apart to leave unsupported strips of maximum 500 mm average width. The detailed arrangement, sizes of the timber and the distances apart shall be subject to the approval of the Engineer. In all other respects, specification for close timbering shall apply to open timbering.

3.6.0 Treatment of Slips

The Contractor will take all precaution to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides. These precautions along with proper slopes, berms, shoring and control of ground water should cause no slips to occur. If however slips do occur due to causes beyond the control of the Contractor, the same shall be removed by him and payment shall be made to him on appropriate item rate of earthwork. Slips caused due to negligence of the Contractor will be cleared and back-filled later by him.

3.7.0 Back-filling

3.7.1 General

The material used for backfilling shall consist of material, 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.

3.7.2 Filling and Compaction in Pits and Trenches around Structures

As soon as the work in foundations has been accepted and measured, the spaces 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 achieve a dry density of not less than



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90% of proctor's dry density at optimum moisture content as per IS-2720 (Part-VII) where backfilling with cohesive soil and sandy silt containing high percentage of silt. For back filling with sand having little or no silt, each layer shall be compacted to a relative density of 75% as per IS-2720 part XIV. Earth shall be rammed with approved mechanised compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the Engineer. The final surface shall be trimmed and levelled to proper profile as shown in the drawing and 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 optimise the moisture content.

3.7.3

Plinth Filling

The plinth shall be filled with earth in layers not exceeding 250 mm in loose thickness, watered and compacted as stated under clause no. 3.7.2 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 slope intended to be given to the floor.

3.7.4

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. The types of bedding & pipe surround material shall be as specified in the drawings.

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. Filling of trenches shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur.

In case of excavation of trenches in rock, the filling upto a depth of 300 mm or the diameter of the pipe whichever is more, above the crown of pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock or ash according to the availability at site. The remaining filling shall be done with rock filling of boulders of size not exceeding 150 mm mixed with fine material as available to fill up the voids, watered, rammed and compacted.



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3.7.5

Filling in Disposal Area

Surplus material from excavation which is not required for backfilling will be disposed of in designated disposal areas. 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 will 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.

3.8.0

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 Project. Sturdy and elegant fencing is to 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.

3.9.0

Lighting

Full scale area lighting is to be provided if night work is permitted or directed by the Engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the fill.

4.0.0

TESTING AND ACCEPTANCE CRITERIA

4.1.0

Excavation

On completion of excavation, the dimensions 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 filled back to required lines, levels and grades by placing ordinary concrete of 1:4:8 proportion and/or richer and/or by compacted earth, as directed by the Engineer. The choice of grade of concrete will be a matter of unfettered discretion of the Engineer. Over excavation of the sides will be made good by the Contractor while carrying out the back-filling. The excavation work will be accepted after the above requirements are fulfilled and all temporary approaches encroaching inside the required dimension of the excavation have been removed.

4.2.0

Back-filling

The degree of compaction shall be sufficient to achieve a dry density of not less than 90% of proctor's dry density at optimum moisture content as



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per IS-2720 (Part - VII) or a relative density of 75% as per IS-2720 (Part-XIV) as applicable depending on the nature of back filling material as stated in clause no. 3.7.2 of this specification. The work of back-filling will be accepted after the Engineer is satisfied with the degree of compaction achieved.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 With Tender

Details of Equipment proposed to be used for excavation, back-filling and compaction have to be submitted along with the tender.

5.2.0 After Award

After award of the Contract the successful tenderer shall submit the following for approval and adoption :

- a) The Contractor shall submit a detailed programme of the work as proposed to be executed giving completion dates of excavation of the various foundations and the time required for back-filling and compaction after completing the foundation for structures.

The programme should show how the excavation and back-filling quantities will be balanced, minimising temporary stacking of spoils. It is to be noted that the Engineer even after initial approval of the programme, may instruct to enhance or retard the progress of work during the actual execution, in order to match with the progress of foundations without attracting any claims from the Contractor. The initial programme being submitted by the Contractor should have sufficient flexibility to take care of such reasonable variations.

- b) The Contractor shall submit drawings showing details of slopes, shorings, approaches, sump pits, dewatering lines, fencing etc. for approval of the Engineer for adoption.



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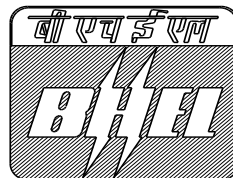
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GENERAL TECHNICAL SPECIFICATION

CEMENT CONCRETE (PLAIN & REINFORCED)



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



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**TECHNICAL SPECIFICATION
FOR
CEMENT CONCRETE (PLAIN & REINFORCED)**

1.0 SCOPE

1.1 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.

1.2 This specification shall also apply to the extent it has been referred to or applicable with the special requirements of structures covered in SCOPE of IS:456.

1.3 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 IS 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.

2.0 GENERAL

2.1 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) Except where it is excluded from the Scope of Contract, Contractor shall prepare progressively and submit for approval detailed drawings and Bar Bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.
- c) Design and prepare working drawings of formworks, scaffolds, supports, etc. and submit for approval.
- d) Submit for approval shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedments, hangers, openings, frames etc.
- e) Submit for approval detailed drawings of supports, templates, hangers, etc. required for installation of various embedments like



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inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.

- 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.
- h) 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 proforma for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the Contractor, jointly and severally.

2.2 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.

2.3 Information to be submitted by the Tenderer

2.3.1 With Tender

The following technical information are required with the tender :

- a) Source and arrangement of processing of aggregates proposed to be adopted.
- b) Type of plant and equipment proposed to be used.
- c) Names of firms, if any, with which association is sought for to execute the special items of work in the contract.



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- d) Types of formwork proposed to be used.

2.3.2

After Award

The following information and data including samples where necessary, shall be submitted by the Contractor progressively during the execution of the contract.

a) **Programme of Execution and Requirement of Materials**

The Contractor will submit a Master Programme for completion of the work giving monthwise requirements of materials for the procurement.

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 for approval. Approved samples will be preserved by the Engineer for future reference. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying materials of specified qualities :

- i) Coarse and fine aggregates.
- ii) Admixtures.
- iii) Plywood for Formwork.
- iv) Embedded and anchorage materials as may be desired by the Engineer.
- v) Joint sealing strips and other waterproofing materials.
- vi) Joint filling compounds.
- vii) Foundation quality Rubber Pads.

c) **Design Mix**



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Design mix as per Clauses 2.1 (g) & 3.4 of this specification giving proportions of the ingredients, sources of aggregates and cement, along with accompanying 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) **Detail Drawings and Bar Bending Schedules**

Detailed working drawings and Bar Bending Schedules in accordance with Clause 2.1(b) and 3.16.1 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 2.1 (c).

f) **Detailed Drawings for Templates & Temporary Supports for Embedments**

As per Clause 2.1 (e).

g) **Mill Test Reports for Cement & Reinforcing Steel**

h) **Inspection Reports**

Inspection Reports in respect of Formwork and Reinforcement and any other item of work as may be desired by the Engineer in accordance with Clause 2.4 of this specification.

i) **Test Reports**

Reports of tests of various materials and concrete as required under Clause 4.0 : SAMPLING & TESTING of this specification.

j) **Any other data which may be required as per this specification.**

2.4

Conformity with Design

The Contractor will prepare check lists in approved proforma 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 Card' 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. These sheets, termed as 'Progress Cards', will be prepared by the Contractor on approved proforma. The Pour Cards along with accompaniments will be



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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.

2.5 Materials to be used

2.5.1 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.

2.5.2 Cement

Generally cement shall be 33 grade ordinary Portland Cement conforming to IS-269. In special cases any of the following type of cement may be permitted or directed to be used with prior approval by the Engineer :

- a) 43 Grade ordinary Portland Cement conforming to IS-8112
- b) 53 Grade ordinary Portland Cement conforming to IS-12269
- c) Rapid hardening Portland Cement conforming to IS-8041
- d) Portland slag cement conforming to IS-455
- e) Portland Pozzolona Cement (flyash based) Conforming to IS- 1489 (Part -1)
- f) Portland pozzolona Cement (calcined clay based) conforming to IS-1489 (Part-2)
- g) Hydrophobic Cement conforming to IS-8043
- h) Low heat Portland Cement conforming to IS : 12600
- i) Sulphate Resisting Portland Cement conforming to IS-12330

2.5.3 Aggregates

Aggregates shall be natural or crushed gravel or crushed rock and free from deleterious material. It shall comply with the requirements of IS-383. All fine and coarse aggregate shall be tested for susceptibility to Alkali Silicate reaction in a laboratory approved by the Engineer.

- a) **Coarse Aggregate**



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Aggregate of sizes ranging between 4.75 mm and 150 mm will be termed as Coarse Aggregate. Only Coarse Aggregate from approved quarries and conforming to IS:383 will be allowed to be used on the works. Aggregates shall be washed to make it free from deleterious materials, if necessary.

The grading of coarse aggregates by sieve analysis shall be as per IS:383. If by the analysis the deficiency of a particular grain size is found, which could affect the density of the concrete, the Engineer may ask the contractor to avoid such quantities of aggregate of the particular size or and such quantity of aggregate of any particular size to achieve the required grading as per IS:383.

b) 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 will be allowed to be used on works.

In certain cases there may be two types of sand, one very fine and the other very coarse. In such cases, the two types shall be combined to meet the requirements of a particular zone of IS:383. In all cases, the preferred zone is Zone - II.

In certain cases crushed stone sand may be added to natural sand in order to achieve the required grading. Crushed stone sand alone may be used only with the approval of the Engineer.

2.5.4 Water

Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts or other impurities. Normally potable water is found to be suitable. Generally, IS:3550 will be followed for routine tests. Acceptance test for water shall be as per IS:3025, and Table-1 of IS:456.

In case of doubt regarding development of strength, the suitability of water for making concrete shall be ascertained by compressive strength and initial setting time tests as per method of tests in accordance with the requirements of IS-516 & IS- 4031 respectively. The PH value of water shall generally be not less than 6.

2.5.5 Admixture

Only admixture 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 the following I.S. Standards :

IS : 2645 - Integral cement water proofing compound



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IS : 9103 - Indian standard specification for Admixtures for Concrete or equivalent American Codes (ASTM C494 and ASTM C260) or British Codes (BS 5075 , Part 1 to 3) and may be one of the following :

a) Accelerating admixtures :

- Set accelerating admixtures like "Sigunit Powder" or "Sigunit LN10" .

b) Retarding admixtures :

- Modified ligno sulphonate based set retarding concrete admixture like , "Plastiment R".

c) Water reducing admixtures :

- Modified sulphonated melamine formaldehyde based water reducing concrete admixture like, "Sikament" .

d) Air entraining admixtures :

- Modified ligno sulphonate based air entraining concrete admixture like "FLOMO AEP " or surface - active agents like "Sika AER".

e) **Water proofing admixtures**

- Modified ligno-sulphonate based waterproofing admixture like "Plastocrete Super".

However, the Contractor shall furnish following technical information about the admixtures (alongwith the manufacturer's Catalogue) which he is planning to use in different areas within the scope of work for the approval of the Engineer :

- Type of admixture
- Mix proportion & mode of application in concrete/mortar
- Manufacturer's specification & necessary quality assurance certificates (mainly on chloride & sulphate content , PH value infra red analysis & solid content.)

2.5.6 Reinforcement

Reinforcement shall be as per relevant IS Specification as mentioned in the Contract/Drawing/Instructions. All bars shall be of tested quality.



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2.6.0 Storage of Materials

2.6.1 General

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, failing which, the Engineer shall be at liberty to get the materials removed and Storage of materials shall conform to IS:4082.

2.6.2 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 ware-houses 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.

Different types of cement shall be clearly marked with the Type and different types of cement shall not be intermixed.

2.6.3 Aggregates

Aggregates shall be stored on planks or 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 separate stacks and sufficient care shall be taken to prevent the material at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the Engineer.

2.6.4 Reinforcement

Reinforcing steel shall be stored consignment-wise and sizewise 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. The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

2.7 Quality Control



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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 affect 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 (only association with Owner's tests, if the supply is made by Owner).

e) Formwork : Material, shapes, dimensions, lines, elevations, surface finish, adequacy of form, ties, bracing and shoring and coating.

f) Reinforcement : Shapes, dimensions, length of plices, clearances, ties and supports. Quality and requirement of welded splices.

Material tests or certificates to satisfy relevant IS Specification (If Contractor's supply).

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.



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- 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 & Beaming 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.

3.0

INSTALLATION

All installation requirements shall be in accordance with IS:456 and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification do not cover all the aspects to the full satisfaction of the Engineer.

3.1

Washing and Screening of Aggregates

Washing and Screening of coarse aggregate shall be carried out to remove fines, dirt or other deleterious materials.

Washing of fine aggregate shall not be allowed, Fine aggregates shall be screened only to remove dirt or other deleterious materials.



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However, all washing & screening of aggregates shall be carried out by approved means to ensure compliance with the aggregate specification.

3.2 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 may be permitted to be used 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 other 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.

3.3 Grades of Concrete

Structural concrete shall be of M30 grade and for other part of the work shall be as shown on the drawing as per grade classification of IS-456. In case of liquid retaining structures, IS:3370 will be followed.

3.4 Proportioning and Works Control

3.4.1 General

Proportioning of ingredients of concrete shall be made by any of the two following methods as directed by the Engineer.

- With preliminary tests by designing the concrete mix. Such concrete shall be called 'Design Mix Concrete'.
- 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 permitted in accordance with IS:456, may be used if shown on drawings or approved by the Engineer. In all cases the proportioning of ingredients and works control shall be in accordance with IS:456 and shall be adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.

3.4.2 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 :



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- 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) Chemical admixtures may be used to modify the rate of hardening, to improve workability (maintaining low water - cement ratio) or as an aid to control concrete quality.
- e) 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.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete by the Engineer. The Contractor will strictly abide by the same in his design of concrete mix installation. Notwithstanding anything mentioned in various tables given in IS:456 giving specific values and degrees of workability for different condition of concrete placing, minimum cement content and maximum water-cement ratio for concrete exposed to sulphate attack and for concrete to ensure durability under different condition of exposure, strength requirement for different grades of concrete, proportion for nominal mix concrete, values given in the tables in IS:456, shall be followed.

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.



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TABLE - I

STRENGTH REQUIREMENT OF CONCRETE

Specified Characteristic Compressive Grade of concrete strength of 15 cm Cubes at 28 days conducted in accordance with IS:516 (All values in N/Sq.mm)

M - 10	10
M - 15	15
M - 20	20
M - 25	25
M - 30	30
M - 35	35
M - 40	40

Note -1: Nominal mix concrete of proportions 1:4:8 or 1:3:6 may be used as lean concrete for simple foundations for masonry walls, below the reinforced concrete foundations and mass filling. These mixes need not be designed.

TABLE - II

**MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE
DIFFERENT DEGREES OF WORKABILITY WITH DIFFERENT
VALUES OF WATER - CEMENT RATIO**

(FOR GUIDANCE)

CEMENT/TOTAL AGGREGATE RATIOS

WORKABILITY	WATER/CEMENT/RATIO	RATIO BY WEIGHT OF CEMENT OF GRAVEL AGGREGATE		RATIO BY WEIGHT OF CEMENT OF CRUSHED STONE AGGREGATE	
		20 mm size	38 mm size	20 mm size	38 mm size
Very low	0.4	01:04.8	01:05.3	01:04.5	01:05.0
Slump	0.5	01:07.2	01:07.7	01:06.5	01:07.4
0-25 mm	0.6	01:09.4	1:10	01:07.8	01:09.6
	0.7	1:10	1:12	01:08.7	01:10.6
Low	0.4	01:03.9	01:04.5	01:03.5	01:04.0
Slump	0.5	01:05.5	01:06.7	01:05.0	01:05.5
25-50 mm	0.6	01:06.8	01:07.4	01:06.3	01:07.0
	0.7	01:08.0	01:08.5	01:07.4	01:08.0



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Medium	0.4	01:03.5	01:03.8	01:03.1	01:03.6
Slump	0.5	01:04.8	01:05.7	01:04.2	01:05.0
50-100 mm	0.6	01:06.0	01:07.3	01:05.2	01:06.2
High	0.4	01:03.2	01:03.5	01:02.9	01:03.3
Slump	0.5	01:04.4	01:05.2	01:03.9	01:04.6
100-175 mm	0.6	01:05.4	01:06.7	01:04.7	01:05.7
	0.7	01:06.2	01:07.4	01:05.5	01:06.5

NOTE : 1 - Notwithstanding anything mentioned above, the cement/Total aggregate ratio is not to be increased beyond 1:9.0 without specific permission of the Engineer.

NOTE : 2 - It should be noted that such high aggregate cement ratios will be required for concretes of very low slump and high water- cement ratios which may be required to be used in mass concrete work only.

NOTE : 3 - The above figures are for guidance only, the actual cement/aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes.

3.5 Strength Requirements

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.

3.6 Minimum Cement Content

The minimum cement content for each grade of concrete shall be as per Table-5 of IS : 456.

3.7 Water-Cement Ratio

The choice of water-cement ratio in designing a concrete mix will depend on -

- The requirement of strength.
- The requirement of durability.

3.7.1 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.



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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, proportions 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.

3.7.2

Durability Requirement

Table-5 of IS:456 gives 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. 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. It will be preferable to use Melamine based plasticizer.

3.8

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 :



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**TABLE - III
LIMITS OF CONSISTENCY**

Degree of workability	Slump in mm with Standard Cone as per IS:1199		Use for which concrete is suitable.
	Min.	Max.	
Very low	0	25	Large Mass concrete structure with heavy compaction equipment, roads and like.
Low	25	50	Uncongested wide and shallow R.C.C. structures.
Medium	50	100	Deep but wide R.C.C. structures with congestion or 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. 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.

3.9

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
Mass concrete in very large structure	- 150 mm



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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 :

150 mm to 80 mm, 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.

3.10

Mixing of Concrete

Concrete shall always be mixed in mechanical mixer unless specifically approved by the Engineer for concrete to be used in unimportant out of the way locations 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 at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case shall mixing be done for less than 2 (two) minutes and at least 40 (forty) revolutions after all the materials and water are in the drum. When absorbent aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement 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.

Ingradients for design mix concrete shall be measured by weight. For small jobs portable swing weigh Bachers conforming to IS:2722 may be used.

Batching plant conforming to IS:4925 shall be used for large jobs. The accuracy of the measuring equipment shall be within + 2% of the quantity of Cement, water or total aggregates being measured and within + 5% of the quantity of any admixture being used. The batching equipment shall be fitted with an accurate mechanism for weighing separately the cement, fine



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aggregate and coarse aggregate. Water may be measured by volume or by weight. All measuring equipment should be maintained in a clean serviceable condition, and their accuracy shall be checked periodically.

Mechanical / electrical control shall be provided on the mixing equipment to ensure the batch cannot be discharged until approved mixing time has elapsed and the entire batch shall be discharged before the mixer is recharged.

Where admixtures are employed, separate containers & measuring devices shall be used.

For minor concreting works, batching by volume according to specific weight may be permitted by the Engineer. In that case the whole bags of cement shall be used and gauge boxes used for measuring aggregates.

When hand mixing is permitted by the Engineer, 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.

3.11

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, segregation 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

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 the relevant I.S. Code for any particular aspect of work, any other standard Code of practice, as may be specified by the Engineer, will be adopted. Concrete may have to be placed against the following types of surfaces :

- a) Earth foundation



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- 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. All excavated areas for foundations, ring beams, plinths, pile caps etc. shall be rammed & consolidated properly before blinding with nominal mix plain concrete, as per drawing and / or direction of the Engineer and shall be allowed to cure prior to setting out steel fixing, shuttering and concrete pouring for the main structural element.

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 and cement slurry will be spread thoroughly on the rock foundation or construction joint just prior to placement of concrete. The cost of application of such cement slurry and mortar will be deemed to be included.

After concrete has been placed, it shall be spread, if necessary and thoroughly compacted by approved mechanical vibration to maximum subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant IS Code of Practice. In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibrators the contractor may have to employ form vibrators conforming to IS:4656. For slabs and other similar structures, the contractor will additionally employ screed vibrator as per IS:2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures,



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reinforcement and formwork are not displaced or distorted during placing and 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.

The size of the concrete pours must be carefully considered prior to commencement to ensure the structural elements are poured in on continuous shift to avoid cold joints.

Slabs, beams and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Moulding, 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 therefrom shall be set right by the Contractor 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.

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 Construction Joints and Cold Joints

3.13.1 Construction Joints

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete at 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



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embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12. For water retaining structures and leak-proof buildings suitable approved water bars will be installed at the construction joints.

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 within the middle third of the span.
- c) A joint in a suspended floor slab shall be vertical and within the middle third 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 sub-mitted well in advance to the Engineer for study and approval without which no construction joint will be allowed.

3.13.2

Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it :

- a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systemetically 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



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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 rise 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

Repairs, Finishes and Treatment of Concrete surfaces

3.14.1

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. 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. All concrete work shall be inspected by the Contractor immediately after the forms are removed and 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 and shape.
- c) Cleaning of reinforcement and embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement.
- d) Roughening by sand blasting or chipping.
- e) Installing additional reinforcement/welded mesh fabric.
- f) Dry packing with stiff mortar.
- g) Plastering, guniting, shotcreting etc.
- h) Placing and compacting concrete in the void left by cutting out defective concrete.
- i) Grotting with a cement sand slurry of 1:1 mix.
- j) Repairing with a suitable mortar either cement or resin modified mortar.



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- k) Polymer modified patching and adhesive repair mortar for beams & columns.

3.14.2

Finishing Unformed Surface

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 reinforcement 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 overtrawelling, 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 by hand or by rotary power float is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes, ripples and trowel marks. A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface.

To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowelling.

b) Beams, 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

Protection and Curing of concrete



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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, polythene sheet, 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.

If permitted by the Engineer, curing compound like "ANTISOLE (WP)" 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 thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall comply with ASTM requirements for acceptance.

The curing compound shall be applied following the final finishing operation and immediately after disappearance of water sheen from concrete surface.

It is important not to apply the curing compound when standing water is still present on concrete.

The contractor shall arrange for the manufacturer's supervision.

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 any lapse on the part of the Contractor is noticed by the Engineer, 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 entirely at the discretion of the Engineer.

3.16

Reinforcement

Mild steel round bars, cold twisted and deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc., will be



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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.

3.16.1 Bar Bending Schedules

The Contractor shall submit to the Engineer for approval Bar Bending Schedules with working drawings in triplicate, showing clearly the arrangements proposed by the Contractor to match available stock of reinforcing steel, within one month of receipt of the Letter of Intent or of the receipt of the relevant design drawings, whichever is later. Upon receipt of the Engineer's final approval of the Bar Bending Schedule and drawings, the Contractor shall submit 6 (six) prints of the final drawings with one reproducible print after incorporating necessary modifications or corrections, for final record and distribution. 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.

3.16.2 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete.

3.16.3 Cutting & Bending of Reinforcement

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 to the approved Bar Bending Schedules. Bar Bending Schedules 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. Rebending can be done only if approved by the Engineer. Reinforcing bars above 16 mm diameter shall be bent by machine producing a gradual and even motion. Bars of 16 mm or below may be bent by hand. 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.

Reinforcing bars, whether high yield or mild steel shall be cut using either hand held shears, guillotines or foot operated pneumatic cutters. Cutting bars using cold chisels may be allowed by the Engineer at exceptional cases.

3.16.4 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



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mild steel chairs and/or concrete spacer blocks irrespective of whether such supports are payable or not. 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. Tack welding of bars should not be done unless permitted 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.

3.16.5 Welding

Normal bond laps in reinforcement may be placed by lap or butt welding reinforcement bars, if asked 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. Welded mesh fabrics conforming to IS:1566 may also be used if specified in the Schedule of Items and Drawings.

3.16.6 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. 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 and as directed by the Engineer. 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 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 Cold Weather Concreting

When conditions are such that any operation of concreting may be expected to be done at 5 Deg.C atmospheric temperature or below the work shall conform to the requirement of Clause 14 of IS:456 and IS:7861. (Part. II).



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3.18 Hot Weather Concreting

When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS:7861 (Part-I) 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 40 Deg.C while placing. Positive temperature control by precooling, postcooling or any other method, if required, will be specified.

3.19 Concreting under water

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of clause 14 of IS:456.

3.20 Form Work

3.20.1 General

Formwork shall conform to the shape, grade, lines, levels and dimension as shown on the drawings. The contractor shall prepare design & working drawings for formwork & temporary support system for important structures and get them approved by the Engineer prior to commencement of actual work.

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 except when specifically permitted otherwise by the Engineer.

The centering shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Reckers 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 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 or concrete of adequate strength shall be used. Alternatively, except in case of water retaining structures through rods and the tie bolts shall be sleeved with PVC conduits to allow retraction of the ties on removal of the shutters. Where required, the annulus of the conduits will be filled with expanding mortar to seal the void. Bolts passing



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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 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 metres span. Unless specifically described on the drawings or elsewhere to the contrary, bevelled forms 25 mm by 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, 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.

3.20.2 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 based shutter release agent like "Siparol/Sika form oil/ Siparol Concentrate" 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.

3.20.3 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



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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.

The design of formwork shall take into account all vertical and lateral loads that the forms will carry or be subjected to during the construction process. Besides weight and pressures of reinforced concrete and weight of the forms themselves, the design shall consider loading due to unsymmetrical placement of concrete ; impact from dumping of concrete ; movement of men and construction equipment ; wind action and any other imposed load during construction. The contractor shall assess the magnitude of vertical live load to be taken for design of formwork duly considering his method, sequence and rate of pour of concrete. However, minimum design vertical live load to be considered shall be 750 kg/sqm excluding weight of concrete.

3.20.4 Inspection of Forms

Casting of Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

3.20.5 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 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 therefrom 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. The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

Forms for various types of structural components shall not be removed before the minimum periods specified herein and the removal after the minimum periods shall also be subject to the approval of the Engineer in each case.



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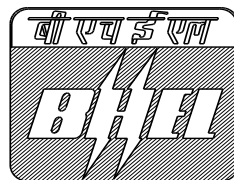
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GENERAL TECHNICAL SPECIFICATION

FORMWORK



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



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TABLE - IV
SCHEDULE OF REMOVAL OF FORM

Part of Structure	Ordinary Portland Cement Concrete				Rapid Hardening Portland Cement Concrete			
	Temperature Deg.C				Temperature Deg.C			
	Above 40 Deg.C	40 Deg.- 20 Deg.	20 Deg.- 5 Deg.	Below 5 Deg.	Above 40 Deg.	40 Deg.- 20 Deg.	20 Deg.- 5 Deg.	Below 5 Deg.
	Days	Days	Days	Days	Days	Days	Days	Days
a) Columns & Walls	2	1	1	Do not remove forms until site cured test specimen develop at least 50% of the specified 28 days strength	1	1	1	Do not remove forms until site cured test specimen develop at least 50% of the specified 28 days strength
b) Beam sides	3	2	3		2	1	1	
c) Slabs, 125 mm	10	7	8		7	4	5	
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 40 Deg.C can be reduced to those of the temperature range of 20 Deg.C to 40 Deg.C subject to approval of the Engineer.

Construction joints in beams, if required to be provided, will be located within the middle third of span according to clause 3.13.1(b) of this specification. 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, is due and so approved by the Engineer.

If any type of cement other than ordinary portland cement and Rapid hardening portland cement is used the time of removal of forms shall be revised as approved by the Engineer such that the strength of this cement at the time of removal of forms match with strength of portland cement at



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the time of removal of form as mentioned above . This has to be supported by regular tests.

3.20.6

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 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 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.

3.20.7

Re-use of Forms

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used if declared unfit or unserviceable by the Engineer.

3.20.8

Classification

Generally, the 'ordinary' class formwork shall be used unless otherwise directed by the Engineer :

- 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 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



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by the Engineer. He may also permit utilisation 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 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 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 directed and secure the same as may be required. The materials, if required to be supplied by the Contractor, 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 be painted with one coat of approved anti-corrosive paint and/or bituminous paint. If welding is to be done subsequently on the exposed surface of embedded material the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Engineer. Items to be embedded.

- a) Inserts, hangers, anchors, frames 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) Lugs or plugs for door and window frames occurring in concrete work.
- e) Flashing and jointing in concrete work.
- f) 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 Expansion and Isolation Joints



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3.23.1

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. 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.

3.23.2

Bitumen Board/Expanded Polystyrene Board

a) Bitumen Board

Bitumen impregnated fibre board 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.

3.23.3

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 non-metallic like rubber or P.V.C.



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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 vulcanised.

Non - metallic sealing strips 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, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer.

The method of forming these joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Engineer taking particular care to match the central bulbs and the edges accurately.

a) 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 of items and/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



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Maximum Safe
Continuous
Temperature : 75 Deg.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/schedule of items and/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 80A

Tensile Strength : 10 - 15 N/Sq.mm

Maximum Safe
Continuous
Temperature : 70 Deg.C

Ultimate Elongation : Not less than 275%

3.23.4 **Joint Sealing Compound**

When directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS:1834.

Alternatively, when directed, the expansion Joints may be filled with joint sealing compound like "Sikalastic" or approved equivalent and shall be applied as per manufacturer's specification.

3.23.5 **Isolation Joints**



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Strong and tough alkathene or PVC sheet 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.

3.23.6

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 or as directed by the Engineer. 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

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 stonechips 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 desired by the Engineer, admixtures like Aluminium powder, 'Ironite' etc. may have to be added with the grout in proportions to be decided by the Engineer. Admixture, if directed to be added, will be measured and paid separately.

Alternatively non-shrink, free flow, cementitious grout like "Sikagrout 214/ Ankor NSG" or approved equivalent specifically selected for the type of equipment to be located (vibrating, static etc.) may also be used for grouting as per manufacturer's specification with necessary approval of the Engineer.

3.25

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 as well as well drained surface to prevent excessive uneven settlement due to softening of soil during casting & curing. 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



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will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 10 (Ten) 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 and must be rigid enough to prevent distortion during placing and compaction of the concrete.

Other than normal curing by applying water through spray nozzles or perforated hose curing by high pressure steam, steam vapour or other accepted processes may also be employed to accelerate the hardening of the concrete and to reduce the curing time.

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.

All members shall be indelibly marked with a unique identification mark on a surface which will not be permanently exposed to show on which production line they were manufactured, their type, the class of concrete, the date of casting and if they are of a symmetrical section the face which will be uppermost when the member is in its correct position 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 directed by the Engineer. If centerings 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 Waterproofing of Concrete Structure

3.26.1 General

Waterproofing of concrete structures shall be done by either suitable extraneous treatments like applying waterproofing paints like "Sikatop Seal" fixing bitumen felts etc. or internally by suitable design of the concrete mix, addition of suitable admixtures conforming to IS:2645 and equivalent American or British codes in the concrete or mortar at the time of mixing and/or installing water bars at the joints.



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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. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

3.26.2

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 rubber or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction joint should be provided as per clause 3.13.1 with or without water bar / Seal as shown on the drawing. In case of water bars being used at the construction Joint, fixing of the same has to be done carefully so that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods :

Method 1 : A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting in case of walls. The above bonding agent will be mixed with water which will be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor joint, however, after washing of retarder a solvent free two component epoxy resin bonding agent will be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days :

Compressive strength	-	55 to 60 N/Sq. mm
Flexural Strength	-	25 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. mm (approx)

The whole operation shall be done as per manufacturer's specification. The contractor shall provide manufacturer's supervision.

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



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waterproof expanding grouting admixture of approved quality shall be done through the nozzles after 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.

3.26.3

Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar / plaster shall conform to relevant IS code. The admixture shall not cause decrease of strength of concrete / plaster at any stage and it is 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 resistant concrete admixture shall be used to provide a waterproof concrete around 410 Kg/ Cm.m a melamine based super plasticizer will be preferable.

a) In concrete : The approved admixture shall be based on modified lignosulphonate like "Plastocrete - N/Super" or approved equivalent. 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 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 like "Noleak CP/Sika Latex" or approved equivalent 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. On completion, the plastered surface shall be cured continuously for a minimum period of 14 days like concrete.



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3.26.4

Bituminous or Tar Coating on External Surface

The surface to be waterproofed shall be rendered absolutely dry, clean and dust free. The surface shall be sand papered, cleaned and completely coated with hot coal tar pitch of approved manufacturer and quality as per IS:216 (not heated above 375 Deg.F) using not less than 2 Kg. per Sq.M. or with hot asphalt i.e., bitumen according to IS:73 (not heated above 400 Deg.F) using not less than 1.5 kg. per Sq.M. When the first coat has completely dried up and approved by the Engineer, the second coat shall be applied in the same manner using not less than 1.25 Kg. per Sq.M. in case of coal tar and 1 Kg. per Sq.M. in case of asphalt. Immediately after application of the second coat and before it is dried up, sand shall be spread on the surface to cover it completely. Sufficient time shall be allowed after spreading of sand before backfilling is done in order to allow the final coat to dry up completely. In place of hot application by coal tar / asphalt the coating of the outside surfaces of walls may be carried out using a ready to use liquid, bituminous emulsion/rubber protective coating of approved manufacturer.

3.26.5

Protective Coating on Inside Surface

Two coats of cement based to 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.

3.26.6

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 shall be hessian base and/or fibre base as specified in Drawing/Schedule of Items. If required by the Engineer, tests as specified in relevant IS Codes shall be arranged by the Contractor.

The Contractor shall execute this work in direct collaboration with one of the well known specialised approved by the Engineer.

Cleaning the surface, keeping it dry, providing necessary corner fillets and cement rendering and cutting chases, etc. shall be included in the rate for this item. If any protective brickwork on/against concrete sub-bases or walls are required, these will be paid extra under suitable items in the contract. A 20 (twenty) years' guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub-contractor jointly and severally, for this item of 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.

3.26.7

Polyethelene Films : Application in Walls or base of Structures



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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 polyethelene film 250 micron (IS:2508-1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed, taking care not to puncture the film.

Alternatively, the overlaps shall be heat sealed by an electric iron having three parallel sealing bars. A long piece of plywood is to be placed below the polyethelene 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 celophane tape is to be spread and on this the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another celophane 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 celophane 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 bitument 80/100 grade (IS:73-1961) at 1.0 Kg/Sq.m minimum.
- vi) Lay 250 micron polyethelene film as second layer similar to (iii) above.
- vii) Lay second layer of 100 gm. brown craft paper laminated similar to (iv) above.
- viii) Apply hot bitumen (straight run grade) to IS:73-1961 at 1.0 Kg/Sq.m dusted with fine sand.
- ix) Protecting with a layer of 75 mm plain cement concrete M-100, 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 Protective coating on Concrete Surface

3.27.1 On Foundation

The outside faces of foundation of important structures will be protected from adverse effect of soil/ underground water, if shown on drawing or instructed by the Engineer, by using bitumen emulsion protective coating of approved manufacturer.



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3.28

Waterproofing by Pressure /Chemical Grouting

Where required, waterproofing for underground concrete structure shall be done by injecting high polymer based non-shrink waterproof grouting compound through nozzle under pressure as per manufacturer's recommendation. The pressure during injection shall not be less than 2.5 kg/Sq.cm and the thickness of epoxy resinous emulsion waterproof paint (to be applied on the external surface of walls/slabs) shall not be less than 700 microns.

4.0

SAMPLING AND TESTING

4.1

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.

4.2

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. Soundness Tests may also be required to be carried out if required by the Engineer. The tests shall be carried out free of charge by the Owner if cement is supplied by him. In case the Contractor is directed to arrange for the supply of cement as per the terms and conditions of the Contract the tests shall be carried out by him. In case due to any circumstances, the agency of supply is changed in the middle of the Contract, the party who bore the original contractual obligation will carry on with the test, free of charge to the other, till the end of the job. 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 Owner, Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the Owner 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.

4.3

Aggregates

The Contractor shall carry out any or all the tests 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.

4.4

Water



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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 final acceptance criteria in case of doubt will be as per IS:3025 & IS:456.

4.5 Admixture

4.5.1 Air Entraining Agents (A.E.A)

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the 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 then, 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.

4.5.2 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.

4.6 Concrete

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS:516 and IS:1199 the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed but under special circumstances the Engineer may require other tests to be performed in accordance with IS:516.

Sampling procedure, frequency of sampling and test specimen shall conform to Clause 14 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 mentioned in Clause 3.6 of this Specification 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 Clause 15 of 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. No payment for the dismantled concrete, the relevant formwork and reinforcement, embedded fixtures, etc. wasted in the dismantled portion shall be made. In the course of dismantling, if any damage is done to the



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embedded items or adjacent structures, the same shall be made good to the satisfaction of the Engineer.

5.0 ACCEPTANCE CRITERIA

5.1 Standard Deviation

Standard deviation shall be based on test results and determination of Standard deviation shall conform to clause 16 of IS:456.

5.2 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to Clause 16 of IS:456.

5.3 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to Clause 17 of IS:456.

5.4 Load Test

Load tests of structural members may be required by the Engineer, 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 is to be decided by the Engineer. Load tests shall not be made until the structure is at least 56 days old.

If the member shows evident failure, such changes as are necessary to make the structure adequately strong shall be made by the Contractor. Alternatively, if permitted under Statutory Regulations and at 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.

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.

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.

If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same will be made good by the Contractor to the satisfaction of the Engineer.



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6.0

LIST OF I.S. 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 : 269	-	Indian Standard Specification for 33 grade Ordinary 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 - Part 1 & 2
IS : 455	-	Indian Standard Specification for Portland Slag Cement
IS : 456	-	Indian Standard Code of Practice for Plain and Reinforced Concrete
IS : 457	-	Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive Structures
IS : 516	-	Indian Standard Specification for Methods of Test for Strength of Concrete
IS : 737	-	Indian standard specification for wrought Aluminium and Aluminium Alloy sheet and strip for general Engineering purpose. IS : 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete
IS : 1200	-	Indian Standard Specification for Method of (Part-II) Measurement Cement Concrete Works.
IS : 1200	-	Indian Standard Specification for Method of (Part-V) Measurement of Formwork
IS : 1322	-	Indian Standard Specification for Bitumen Felts for Waterproofing and Damp-proofing

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IS : 1489		-	Indian Standard Specification for Portland - Pozzolona Cement - Part 1 & 2			
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 Bars & wires for Concrete Reinforcement			
IS : 1791		-	Indian Standard Specification for Batch Type Concrete Mixers			
IS : 1834		-	Indian standard specification for hot applied sealing compound for joint in concrete.			
IS : 2062		-	Steel for general structural purpose.			
IS : 2185		-	Indian Standard Specification for Hollow and solid / solid light wt. Cement Concrete Blocks - Part - 1 & 2			
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 : 2430		-	Indian standard specification for method of sampling of Aggregate for concrete.			
IS : 2502		-	Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement			
IS : 2505		-	Indian Standard Specification for Concrete Vibrators Immersion Type			
IS : 2506		-	Indian Standard Specification for Screed Board Concrete Vibrators			
IS : 2514		-	Indian Standard Specification for Concrete Vibrating Tables			
IS : 2645		-	Integral Cement water proofing compound			
IS : 2722		-	Indian Standard Specification for Portable Swing Weigh Batchers for Concrete (Single and Double Bucket type)			
IS : 2751		-	Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction			

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IS : 2770		-	Indian Standard Specification for Method of Testing Bond in Reinforced Concrete. Part - 1 : Pull out Test			
IS : 3025		-	Indian Standard Specification for Methods of Sampling and Test (Physical and Chemical) for Water & waste water - art - 1 to 37			
IS : 3201		-	Indian Standard Specification for Design and Construction of Precast Concrete Trusses and purlins.			
IS : 3370		-	Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids Part 1 to 4			
IS : 3384		-	Indian standard specification for / Bitumen primer for use in waterproofing and Danp proofing			
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 Part-1 : Scaffolding and Part 2: Ladders			
IS : 3812		-	Indian Standard Specification for Fly Ash for Use as Pozzolone & Admixture			
IS : 4031		-	Indian Standard Specification for Method of Tests for Hydraulic Cement - Part - 1 to 14			
IS : 4082		-	Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at site			
IS : 4090		-	Indian Standard Specification for Design of Reinforced Concrete Archs			
IS : 4634		-	Indian Standard Specification for Method of Testing Performance of Batch-type Concrete Mixers			
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			



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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 (Part-I of Reinforced Concrete Bins for the Storage & II) of Granular and Powdery Materials
IS : 4998	-	Indian Standard Specification for Design of (Part - I) Reinforced Concrete Chimneys
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
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



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IS : 7861	-	Indian Standard Specification for (Part-I Recommended Practice for hot and cold & II) Weather Concreting
IS : 7969	-	Safety Code for Storage and Handling of Building Materials
IS : 8041	-	Indian Standard Specification for Rapid Hardening Portland cement
IS : 8043	-	Indian standard specification for hydrophobic cement
IS : 8112	-	Indian Standard Specification for 43 grade 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.
IS : 9417	-	Recommendation for welding cold worked bars for reinforced concrete construction
IS : 10262	-	Recommended Guideline for concrete Mix Design
IS : 12269	-	Indian standard specification for 53 grade ordinary portland cement
IS : 12330	-	Indian standard specification for sulphate resisting portland cement
IS : 12600	-	Indian standard specification for low heat portland cement



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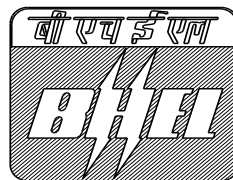
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GENERAL TECHNICAL SPECIFICATION

FABRICATION OF STRUCTURAL STEELWORK



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



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TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEELWORK

1.00 SCOPE

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

2.00 GENERAL

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following :

- a) Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on contractor's design drawings approved by the Owner / Consultants.
- b) To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made.
- c) To submit design calculations for joints and connections developed by the contractor along with detailed fabrication drawings.
- d) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary bolts, nuts, washers, tie rods and welding electrodes for field connections. The field connection materials supplied by the contractor shall be in adequate quantity to avoid delay in erection.
- e) Furnish shop painting of all fabricated steelwork as per requirements of this Specification.
- f) Suitably mark, bundle and pack for transport all fabricated materials.
- g) Prepare and furnish detailed Bill of Materials, Drawing Office Despatch lists, Bolt List and any other list of bought out items



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required in connection with the fabrication and erection of the structural steelwork.

- h) Insure, load and transport all fabricated steelwork field connection materials to site.

2.2.0 Work by others

No work under this specification will be provided for by any agency other than the contractor, unless specifically mentioned otherwise elsewhere in the contract.

2.3.0 Codes and standards

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

LIST OF I.S. CODES - RELEVANT TO FABRICATION OF STRUCTURAL STEEL WORK

IS Codes	Description
IS : 800 -	Code of practice for general construction in steel.
IS : 801 -	Code of practice for use of cold formed light gauge steel structural members in general building construction.
IS : 806 -	Code of practice for use of steel tubes in general building construction.
IS : 808 -	Dimensions for rolled steel beams, channels and angle sections.
IS : 812 -	Glossary of terms relating to welding & cutting of metals.
IS : 813 -	Scheme of symbols for welding.
IS : 814 -	Covered electrodes for metal arc welding of carbon and carbon manganese steel.
IS : 815 -	Classification coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel.



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



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- IS : 1852 - Rolling and cutting tolerances for hot-rolled steel product.
- IS : 1977 - Structural steel (Ordinary quality)
- IS : 2016 - Plain washer
- IS : 2062 - Steel for general structural purposes.
- IS : 2629 - Recommended practice for hot-dip galvanising of iron and steel.
- IS : 2633 - Method for testing uniformity of coating on zinc coated articles.
- IS : 3644 - Code of practice for ultrasonic pulse echo testing by contact and immersion method.
- IS : 3757 - High Strength Structural Bolt
- IS : 4000 - High strength bolts in steel structure
- IS : 4759 - Specifications for hot-dip zinc coatings on structural steel and other allied products.
- IS : 4923 - Hollow steel sections for structural use.
- IS : 5334 - Code of practice for magnetic particle flaw detection of weld.
- IS : 5369 - General requirements for plain washers and lock washer.
- IS : 6005 - Code of practice for phosphating of iron and steel.
- IS : 6649 - Specification for hardened and tempered washers for high strength structural bolts and nuts.
- IS : 6623 - Specification for high strength structural nuts.
- IS : 7215 - Tolerances for fabrication of steel structures.
- IS : 7280 - Bare wire electrode for submerged arc welding.
- IS : 8500 - Structural steel micro alloyed (medium & high strength quality).
- IS : 8629 - Code of practice for protection of iron and (Part - I to III) steel structures from atmospheric corrosion.
- IS : 9595 - Recommendation for metal arc welding of carbon manganese steels.

PAINTING



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- 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 ferrons metal
(Part - I & II) in building.
- IS : 2074 - Ready mixed paint, air-drying red-oxide zinc chrome priming.
- IS : 2339 - Specification for aluminium paints for general purposes in dual container.
- IS : 2932 - Specification for enamel, synthetic exterior type - I.
- IS : 2933 - Specification for enamel, synthetic exterior type - II.

2.4.0

Conformity with Designs

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

2.5.0

Materials to be used

2.5.1

General

All steel materials shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair their strength, durability and appearance. All materials shall be of tested quality only unless otherwise permitted by the Engineer and/or Consultant. If desired by the Engineer, Test Certificates of materials supplied by the contractor in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Engineer, a random sample shall be tested at an approved laboratory from each lot of 50 tonnes or less of any particular section.

The arc welding electrodes shall conform to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each



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container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and ampereage (Polarity in case of D.C. supply) for which the electrodes are suitable.

2.5.2

Steel

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

- 1) IS : 801 - Cold formed light gauge steel structural member.
- 2) IS : 806 - Steel tubes in general building construction.
- 3) IS : 1161 - Steel tubes for structural purpose.
- 4) IS : 1977 - Structural steel (Ordinary quality)
St-42-0
- 5) IS : 2062 - Steel for general structural purpose
- 6) IS : 8500 - Structural steel-microalloyed (Ordinary & high strength quality)

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

2.5.3

Electrodes

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

- 1) IS : 814 - Covered electrodes for metal arc welding structural steel
- 2) IS : 815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel.
- 3) IS : 7280 - Base wire electrode for submerged arc welding.

2.5.4

Bolts and Nuts

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

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

- a) Mild Steel : All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less



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than 44 Kg/mm² and a minimum elongation of 23 per cent on a gauge length of 5.6 /A, where 'A' is the cross sectional area of the test specimen : -

1) IS:1367 - Technical supply conditions for threaded fasteners.

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

b) High
Tensile
Steel

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

2.5.5

Washers

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

- 1) IS : 1977 - Structural steel (Ordinary Quality) St-42-0
- 2) IS : 2062 - Steel for general structural purpose
- 3) IS : 8500 - Structural steel - microalloyed (medium & high strength quality)
- 4) IS : 6623 - High Strength Structural Nuts
- 5) IS : 6649 - Hardened and tempered washers for high strength structural bolts & nuts.

2.5.6

Paints

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

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

2.6.0

Storage of Material

2.6.1

General

All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material which has deteriorated or has been damaged shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed. The Contractor shall maintain upto date



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accounts in respect of receipt, use and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks.

2.6.2 Steel

The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground sectionwise and lengthwise so that they can be easily inspected, measured and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather.

2.6.3 Electrodes

The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating.

2.6.4 Bolts, Nuts and Washers

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

2.6.5 Paints

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

2.7.0 Quality Control

The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall co-operate with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor.

Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work.



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The quality control procedure shall cover but not be limited to the following items of work :

- 1) Steel : Quality, manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.
- 2) Bolts, Nuts & Washers : Manufacturer's certificate, dimension checks, material testing.
- 3) Electrodes : Manufacturer's certificate, thickness and quality of flux coating.
- 4) Welders : Qualifying Tests
- 5) Welding sets : Performance Tests
- 6) Welds : Inspection, X-ray, Ultrasonic tests
- 7) Paints : Manufacturer's certificate, physical inspection reports
- 8) Galvanizing : Tests in accordance with IS : 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products.

2.8.0 Standard dimensions, forms and weights

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

2.9.0 Shop Drawings

The Contractor shall submit to the Engineer the Schedule of Fabrication and delivery of structural steelwork for approval. He shall start to submit progressively for approval the shop drawings based on the approved Design Drawings and before proceeding with the fabrication work, shall get the said shop drawings approved in accordance with the contract.

The sequence of submission of shop drawings for approval shall match with the approved fabrication and delivery schedule. The approval for the shop drawings will be accorded only towards the general conformity with the design requirements as well as specification and will ensure the correctness



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of general arrangement for centreline dimensions and levels, Section sizes, and adequacy of connections including splice joints as to the no. of bolts, weld length, size of gusset/end plates.

The correctness of all other details like cutting lengths, matching of holes, notch dimensions, match markings, bill of materials, bolt list etc. will be entirely the contractor's responsibility. The approval of the drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents.

The shop drawings shall include but not be limited to the following :-

- a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.
- b) Dimensional drawings of base plates, foundation bolt location etc.
- c) Details of all connections with supporting calculations.
- d) Comparison sheets to show that the proposed alternative section, if any, are as strong as the original sections shown on the Design Drawings.
- e) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.
- f) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof.

The shop drawings shall give all the necessary information for the fabrication, erection and painting of the steelwork in accordance with the provisions of this Specification. Shop drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Shop drawings shall give complete information necessary for fabrication of various components of the steelwork, including the location, type, size and extent of welds. These shall also clearly distinguish between shop and field bolts and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately.

Notes on the shop drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked-up stresses and distortion.

Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification --IS:813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length.

The Contractor shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors or omissions on the drawings or



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other particulars supplied by him, whether such drawings or other particulars have been duly approved or not in accordance with the Contract.

3.0.0 WORKMANSHIP

3.1.0 Fabrication

3.1.1 General

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

3.1.2 Straightening Material

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

3.1.3 Cutting

Cutting shall be effected by shearing, cropping or sawing. Use of a mechanically controlled gas cutting torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Engineer.

To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges. Occasional notches or gauges not more than 4 mm deep will be permitted. Gouges greater than 4 mm, that remain from cutting, shall be removed by grinding. All re-entrant corners shall be shaped notch-free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion.

3.1.4 Planning of edges

Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer.



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3.1.5

Clearances

The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams without web cleats shall be not more than 3 mm at each end, but where, for practical reasons, greater clearance is necessary, suitably designed cleatings shall be provided.

3.2.0

Bolted construction

3.2.1

Holes

Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of H8 as specified in IS:919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

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

3.2.2

Assembly

Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the bolts shall be reamed. Poor matching of holes shall be cause for rejection. The component parts shall be so assembled that they are neither twisted 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 connections as may be specified. In special cases, however, shop bolt connections may be allowed if directed by the Engineer.



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Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project out through the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer, one spring washer or lock-nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified on the Drawings.

3.3.0 Welded Construction

3.3.1 General

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

3.3.2 Preparation of Material

Surface to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign material except that mill scale which withstands vigorous wire brushing may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas-cutting shall, wherever practicable, be done by a mechanically guided torch.

3.3.3 Assembling

Parts to be fillet welded shall be brought in as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces which are not completely sealed by welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2 Deg.).

The work shall be positioned for flat welding whenever practicable.

3.3.4 Welding Sequence

In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses. Where it is impossible to avoid high residual stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shop splicing not more than three sub-sections, each made in accordance with this paragraph. When required by the Engineer, welded



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

Welding technique

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

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

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

3.3.6

Temperature

No welding shall normally be done on parent material at a temperature below (-) 5 Deg.C. However, if welding is to be undertaken at low temperature, adequate precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40 mm thick and the temperature is between (-) 5 Deg. C and 0 Deg. C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is handwarm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20 Deg. C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard.

3.3.7

Peening

Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool. Peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening.

3.3.8

Equipment

These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and



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capacity as recommended by the manufacturers of electrodes or as may be approved by the engineer.

3.4.0 Finish

Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butted over the whole section with a clearance not exceeding 0.2 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc., after welding together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 2.0 mm.

3.5.0 Slab bases and caps

Bases and caps fabricated out of steel slabs, except when cut from material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face which is to be grouted direct to a foundation need not be machined if such face is true and parallel to the upper face. To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.

3.6.0 Lacing bars

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

3.7.0 Separators

Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.

3.8.0 Bearing Plates

Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.

3.9.0 Architectural Clearances

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

3.10.0 Shop connections

- a) All shop connections shall be welded as specified on the Drawings.
- b) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the Contractor will have to make the desired changes.



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3.11.0 Castings

Steel castings shall be annealed

3.12.0 Shop erection

The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before despatch. The parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in such a way as will facilitate the check of interchangeability.

3.13.0 Shop painting

3.13.1 General

Unless otherwise specified, steelwork which will be concealed by interior building finish need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer.

After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other mechanical cleaning methods to remove loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by through sweeping with a fibre brush.

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

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

3.13.2 Inaccessible parts

Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

3.13.3 Contact surfaces



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

3.13.4 Finished surfaces

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

3.13.5 Surfaces adjacent to field welds

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

3.14.0 Galvanizing

3.14.1 General

Structural steelwork for switchyard or other structures as may be specified in the Contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS : 2629 - Recommended practice for Hot-Dip Galvanising of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.

3.14.2 Surface Preparation

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, dirt, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

3.14.3 Procedure

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

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



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The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after having been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surfaces during transport and handling. Damages, if occur, shall be made good in accordance with the provisions of this Specification or as directed by the Engineer.

4.0.0 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

4.1.0 Inspection

Unless specified otherwise, inspection to all work shall be made by the Engineer or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification.

The Contractor shall provide such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract.

The Contractor shall guarantee compliance with the provisions of this Specification.

4.2.0 Testing and Acceptance Criteria



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4.2.1

General

The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost, unless otherwise specified in the Contract. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.

4.2.2

Steel

All steel supplied by the Contractor shall conform to the relevant Indian Standards. Except otherwise mentioned in the Contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T. or less of any particular section for tests to conform to relevant Indian Standards.

All material shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair their strength, durability and appearance.

4.2.3

Testing Criteria for checking Lamination in raw steel plates

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

- a) Ultrasonic testing along the edge of specified points of the plates shall be carried out to delete lamination in the plates, if any.
- b) If the results of the tests in (a) are not satisfactory, the whole area of the plates shall be checked by ultrasonic testing at specified nodal points formed at equidistant grid locations. The spacing of the grids shall be determined from tests in (a) or as directed by the Engineer.

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

4.2.4

Welding

All electrodes shall be procured from reliable manufacturers with test certificates. The correct grade and size of electrode which has not deteriorated in storage shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tonnes of welded fabrication, the Engineer may ask for at least 1 (one) test-destructive or non-destructive including X-ray, ultrasonic test or similar. In the event of



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further tests as may be desired by the Engineer, if the results are found to be unsatisfactory; and if the test shows no defect. In cases of the test results showing deficiency, the Engineer shall have option to reject or instruct any remedial measures to be taken.

4.2.5 Bolts, nuts and washers

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

4.2.6 Shop painting

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

4.2.7 Galvanizing

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

4.3.0 Tolerance

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

4.4.0 Acceptance

Should any structure or part of a structure be found not to comply with any of the provisions of this Specification, the same shall be liable to rejection. No structure or part of the structure, once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check the test results obtained at the Contractor's works by independent tests at an approved laboratory and should the items, so tested, be found to be unsatisfactory.

When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue an acceptance certificate,



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upon receipt of which, the items will be shop painted, packed and despatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract.

4.5.0 Delivery of materials

4.5.1 General

The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. the Owner may prescribe or control the sequence of delivery of materials, at his own discretion.

4.5.2 Marking

Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection.

4.5.3 Packing and Shipping

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

Shipping shall be strictly in accordance with the sequence stipulated in the agreed programme. Payment may be held up for items sent in advance of the sequence till they could be erected. The Contractor shall include and provide for in his rates, the freight and other charges for despatching the materials to the worksite and also for securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All packings shall allow for easy removal and checking at site. Special precautions shall be taken against rusting, corrosion, breakage or damage otherwise of the materials. All parts shall be adequately braced to prevent damage in transit.

Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following : -

- a) Name and address of the consignee



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- b) Name and address of the consignor
- c) Gross weight of the package in tonnes and its dimensions
- d) Identification marks and/or number of the package
- e) Custom registration number, if required

All markings shall be carried out with such materials as would ensure quick drying and indelibility.

Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers.

Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially :

- a) Name of the Contractor
- b) Number and date of the Contract
- c) Name of the office placing the contract
- d) Nomenclature of stores
- e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawings and the quantity of each.

The shipping dimensions of each package shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads.

After delivery of the materials at site, all packing materials shall automatically become the property of the Owner.

Notwithstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the Contractor. When facilities exist, all shipments shall be covered by approved Insurance Policy for transit at the cost of the Contractor.

The contractor shall ship the complete materials or part on board a vessel belonging to an agency approved by the Owner or on rail and/or road transport as directed. The Contractor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no case will the Owner be liable to pay any warehouse, wharfage, demurrage and other charges.

If, however, the Owner has to make payment of any of the above mentioned charges, the amount paid will be deducted from the progressive bills of the Contractor.



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

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 With Tender

The following information are required to be submitted with the Tender :

a) Progress Schedule

The Contractor shall quote in his Tender a detailed schedule of progress of work and total time of completion, itemizing the time required for each of the following aspects of work.

- 1) Preparation and approval of shop drawings
- 2) Procurement of materials
- 3) Fabrication and shipping of all anchor bolts
- 4) Fabrication and shipping of main steelwork
- 5) Fabrication and shipping of steelwork for bunkers. Tanks and/or silos as applicable.
- 6) Fabrication and shipping of all other remaining steel work including miscellaneous steelwork
- 7) Final date of completion of all shipments

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

b) Shop

Location of the Tenderer's fabrication workshop giving details of equipment, manpower, the total capacity and the capacity that will be available exclusively for this contract shall be submitted.

c) Matching Steel

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



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5.2.0

After Award

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

- a) Complete fabrication drawings, material lists, cutting lists, bolt lists, field welding schedules based on the design drawings in accordance with the approved schedule.
- b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Engineer on or before the 7th day of each month, giving the upto date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other relevant information.
- c) Results of any test as and when conducted and as required by the Engineer.
- d) Manufacturer's mill test report in respect of steel materials, bolts, nuts and electrodes as may be applicable.



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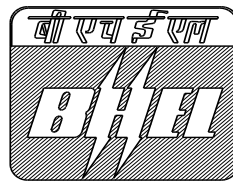
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CIVIL, STRUCTURAL & ARCHITECTURAL WORKS**

SPECIFICATION NO. PE-TS-417-620-C001

SECTION - D

GENERAL TECHNICAL SPECIFICATION

ERECTION OF STRUCTURAL STEELWORK



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



**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

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FOR ERECTION OF STRUCTURAL STEELWORK

1.0.0 SCOPE

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

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified in the Contract, shall include but not be limited to the following:-

- a) The Contractor shall provide all construction and transport equipment, tools, tackle, consumables, materials, labour and supervision required for the erection of the structural steelwork.
- b) Receiving, unloading, checking and moving to storage yard at Site including prompt attendance to all insurance matters as necessary for all fabricated steel materials arriving at Site. The Contractor shall pay all demurrage and/or wharfage charges etc. on account of default on his part.
- c) Transportation of all fabricated structural steel materials from Site storage yard, handling, rigging, assembling, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer. If necessary suitable temporary approach roads to be built for transportation of fabricated steel structures.
- d) Checking center lines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets. any defect observed in the foundation shall be brought to the notice of the Engineer. The Contractor shall fully satisfy himself regarding the correctness of the foundations before installing the fabricated steel structures on the foundation blocks.
- e) Aligning, plumbing, levelling, bolting, welding and securely fixing the fabricated steel structures in accordance with the Drawings or as directed by the Engineer.
- f) Painting of the erected steel structures if required by the Contract.
- g) All minor modifications of the fabricated steel structures as directed by the Engineer including but not limited to the following :



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- i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.
- ii) Cutting, chipping, filling, grinding etc. if required for preparation and finishing of site connections.
- iii) Reaming of holes for use of higher size bolt if required.
- iv) Welding of connections in place of bolting for which holes are either not drilled at all or wrongly drilled during fabrication. Welding in place of bolting will be permitted only at the discretion of the Engineer.
- v) Refabrication of parts damaged beyond repair during transport and handling or Refabrication of parts which are incorrectly fabricated.
- vi) Fabrication of parts omitted during fabrication by error, or subsequently found necessary.
- vii) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.
- viii) Carry out tests in accordance with this Specification if directed.

2.2.0 Work by others

No work under this Specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the Contract.

2.3.0 Codes and Standards

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

IS-800 : Code of Practice for general construction in steel

IS-456 : Code of Practice for plain or reinforced concrete

IS-7205 : Safety Code for erection of Structural Steel work

IS-12843 : Tolerance for erection of Steel Structures

2.4.0 Conformity with designs

The Contractor will erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification and the design criteria detailed in the approved erection drawings and/or other stated document. All work shall conform to the provisions of the relevant Indian Standard



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

2.5.0 Material

2.5.1 General

The Contractor will check the quantity, quality and the sizes of the fabricated materials and verify the adequacy of the same in accordance with the Drawings and Specifications. The Contractor shall make good any deficiency, if detected, either by repair or with fresh material as may be directed by the Engineer.

All consumables like oxygen and acetylene gas, paints, fuels, lubricants, oil, grease, cement, sand, aggregates and any other material that may be required for the execution of the works in accordance with the contract will be supplied by the contractor for erection work and will be deemed to have been included in this rates.

2.5.2 Materials to conform to Indian Standards

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

2.6.0 Storage of materials

2.6.1 General

All material shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site, failing which, the Engineer shall be at liberty to get the materials removed by agency.

2.6.2 Yard

The Contractor will have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other materials which will be delivered to him by the Owner according to the Contract. The yard shall have proper facilities like, drainage, lighting, suitable access for large cranes, trailers and other heavy equipments. The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved programme of work. The Tenderer should visit the site prior to submission of his Tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc. all of which shall be carried out by the Contractor as directed by the Engineer.

2.6.3 Covered Store



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All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building to be built.

2.7.0 Quality Control

The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the following items of work:-

- 1) Erection : Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.
- 2) Grouting : Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency and strength of grout.
- 3) Painting : Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

The Contractor shall salvage, collect and deliver all the packing materials to the Owner.

3.0.0 WORKMANSHIP

3.1.0 Erection

3.1.1 Plant and equipment

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

3.1.2 Method and sequence of erection

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

3.1.3 Temporary bracing

Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install 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.



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If additional temporary guys are required to resist wind or seismic forces acting upon components of the finished structure installed by others during the course of the erection of the steel framing, arrangement for their installation by the erector shall be made.

The responsibility of the Contractor in respect of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer.

3.1.4 Temporary floors for buildings

It shall be the responsibility of the Contractor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or by-laws of state, Municipal or other local authorities.

3.1.5 Setting out

Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Engineer. Concrete foundations, where required, shall be made by other agencies. Anchor bolts and other anchor steel shall be embedded by other agencies. The Contractor shall check the positions and levels of the anchor bolts, etc. before concreting and get them properly secured against disturbance during pouring operations. He shall remain responsible for correct positioning. For heavy columns, etc. the Contractor shall set proper screed bars if desired by the Engineer, to maintain proper level.

Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance allowable under this Specification.

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

3.1.6 Field bolting

All relevant portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following :

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other defects that would prevent solid seating of the parts. Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, or galvanizing.



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All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods.

a) Turn-of-nut method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the joint are brought into good contact with each other. "snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table-1 with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

TABLE - I

Bolts length not exceeding 8 x dia. or 200 mm	Bolt length exceeding 8xdia. or 200 mm	Remarks
1/2 turn	2/3 turn	Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation - 30 over or under.

Bolts may be installed without hardened washers when tightening is done by the turn-of-nut method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have the outer face of the nut match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque Wrench tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques specified in TABLE - II. Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.



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TABLE - II

Nominal Bolt Diameter (mm)	Torque to be applied (Kg.M) for bolt class 8.8 of IS : 1367
20	59.94
22	81.63
24	103.73

NOTE :

The above torque values are approximate for providing tensions of 14.7 MT for 20 mm dia., 18.2 MT for 22 mm dia; and 21.2 MT for 24 mm dia. bolts under moderately lubricated condition. The torque wrench shall be calibrated at least once daily to find out the actual torque required to produce the above required tension in the bolt by placing it in a tension indicating device. These torques shall be applied for tightening the bolts on that day with the particular torque wrench.

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

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

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

3.1.7

Field Welding

All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints.

3.1.8

Holes, cutting and fitting



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No cutting of sections, flanges, webs, cleats, bolts, welds etc. shall be done unless specifically approved and/or instructed by the Engineer.

The erector shall not cut, drill or otherwise alter the work of other trades, or his own work to accommodate other trades, unless such work is clearly specified in the Contract or directed by the Engineer. Wherever such work is specified the Contractor shall obtain complete information as to size, location and number of alterations prior to carrying out any work.

3.2.0

Drifting

Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes as necessary to make connections. Reaming, that weakens the member or makes it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited.

3.3.0

Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced)

Grouting shall be carried out with Ordinary Cement grout as described below :

The mix shall be one (1) part cement and one (1) part sand and just enough water to make it workable. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water and any accumulated water shall be removed. These shall be placed under expert supervision, taking care to avoid air-locks. Edges shall be finished properly. If the thickness of grout is 25 mm or more, two (2) parts of 6 mm down graded stone chips may be added to the above noted cement-sand grout mix, if required, by the Engineer or shown on the drawings.

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

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

No grouting shall be carried out until a sufficient number of bottom lengths of stanchions have been properly lined, levelled and plumbed and sufficient floor beams are tied in position.

Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned.



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3.4.0

Painting after erection

Field painting, if required to be done by the erection Contractor, shall only be done after the structure is erected, levelled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. However, touch up paintings, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the erection Contractor to the Owner. The materials and specification for such painting in the field shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable for the project.

Painting shall not be done in rainy or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust.

All field bolts, welds and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces which will be in contact after site assembling shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet.

Surface which will be inaccessible after field assembly shall receive the full specified protective treatment before assembly. Bolts and fabricated steel members which are galvanized or otherwise treated and steel members to be encased in concrete shall not be painted.

The specification for paint and workmanship shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable to the project.

The number of coats and the shades to be used shall be as specified or as directed by the Engineer.

3.5.0

Stainless Steel Plate Lining in Bunker Hopper

The hopper portion of the coal bunkers shall be lined with stainless steel plates of 3 mm thickness. The stainless steel shall be of AISI-316 quality. The work includes supply, fabrication, welding and fixing of stainless steel lining plate to bunker M.S. plate as per drawing.

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

3.6.0

Final cleaning up

Upon completion of erection and before final acceptance of the work by the Engineer, the Contractor shall remove all falsework, rubbish and all Temporary Works resulting in connection with the performance of his work.

3.7.0

Safety Measures during Erection



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

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 General

Loading tests shall be carried out on erected structures, if required by the Engineer, to check adequacy of fabrication and/or erection. Any structure or a part thereof found to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member. 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 by the Contractor responsible, to the satisfaction of the Engineer.

The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing and the tests shall be conducted as indicated in the following Sub-clauses 4.1.1, 4.1.2 and 4.1.3. The method of testing and application of loading shall be as approved by the Engineer.

4.1.1 Stiffness Test

In this test, the structure or member shall be subjected, in addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after this second test is not less than 90 percent of the maximum increase in strain or deflection recorded during the second test.

4.1.2 Strength Test

The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours.

In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both



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conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load.

4.1.3 Structure of same design

Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first application of the test load, particular note shall be taken of the strain or deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours. This information is required as a basis of comparison in any check test carried out on samples of the structure.

When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 time the specified live load, in a manner and to an extent prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the maximum strain or deflection recorded at similar load in the test on the prototype.

4.1.4 Repair for subsequent test and use after strength tests

An actual structure which has passed the "Strength Test" as specified in Sub-clause 4.1.2 hereinbefore and is subsequently to be erected for use, shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in Sub-clause 4.1.1. hereinbefore.

4.2.0 Tolerances

Some variation is to be expected in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications for fabrication of structural steelwork applicable to this Project and as specified below :

I. For Buildings Containing Cranes

Component	Description	Variation Allowed
Main columns	a) Shifting of column axis at foundation level with respect to building line	



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i) In longitudinal direction i) ± 3.0 mm

ii) In lateral direction ii) ± 3.0 mm

b) Deviation of both major column axis from vertical between foundation and other member connection levels :

i) For a column upto and including 10M height i) ± 3.5 mm from true vertical

ii) For a column greater than 10M but less than 40M height ii) ± 3.5 mm from true vertical for any 10M length measured between connection levels, but not more than ± 7.0 mm per 30 m length.

Component

Description

Variation Allowed

c) For adjacent pairs of columns across the width of the building prior to placing of truss. ± 9 mm on true span.

d) For any individual column deviation of any bearing or resting level from levels shown on drawings. ± 3.0 mm

e) For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating level supposed to be at the same level. 3 mm

Trusses

a) Deviation at centre of span of upper chord member from vertical plane running through centre of bottom chord. 1/1500 of the span or not greater than 10 mm whichever is the least.



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Crane Girders & Tracks

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.
a) Difference in levels of crane rail measured between adjacent columns.	2.0 mm
b) Deviation to crane rail gauge	± 3.0 mm
c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermit welding.	1.0 mm
d) Deviation of crane rail axis from centre line of web.	± 3.5 mm

Component

Description

Variation Allowed

Setting of
Expansion
gaps

At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30°C. The coefficient of expansion or contraction shall be taken as 0.000012 per °C per unit length.

II. For Building without Cranes

The maximum tolerances for line and level of the steel work shall be ± 3.0 mm on any part of the structure. The structure shall not be out of plumb more than 3.5 mm on each 10M section of height and not more than 7.0 mm per 30 M section.

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

4.3.0

Acceptance

Structures and members which have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.1.0, 4.1.1, 4.1.2, 4.1.3 and 4.1.4 and other applicable provisions of this Specification and are within the limits of tolerances specified in Sub-clause 4.2.0 and/or



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otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfilment of the provisions of this Contract.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 Before Tender

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

5.1.1 Tentative Programme

The Tenderer shall submit a tentative programme based on the information available in the Tender Document and visit to Site indicating the structure-wise erection schedule proposed to be maintained by the Contractor to complete the job in time in accordance with the Contract.

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

A detailed list of all Constructional Plant & Equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tenderer which he will be able to employ on the job to maintain the progress of work in accordance with the Contract shall be submitted along with the Tender. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.

5.1.3 Erection yard

A site plan showing the layout and location of the erection yard proposed to be established by the Tenderer shall be attached with the Tender indicating the storage space for fabricated steel materials, site-fabrication and repair shop, covered stores, offices, locations of erection equipments and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the Contractor shall comply with the same without any claim whatsoever.

5.2.0 After award of the Contract

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

5.2.1 Detailed Programme

The Contractor shall submit a detailed erection programme for completion of the work in time in accordance with the Contract. This will show the target programme, with details of erection proposed to be carried out in each fortnight, details of major equipment required and an assessment of



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required strength of various categories of workers in a proforma approved by the Engineer.

5.2.2

Fortnightly Progress Report

The Contractor shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and all details of actual achievements against the target programme specified in Sub-clause 5.2.1 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the Contractor shall also furnish details of fabricated materials in hand at site and the strength of his workers.



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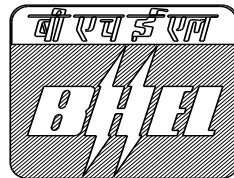
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GENERAL TECHNICAL SPECIFICATION

FINISH TO MASONRY & CONCRETE



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



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TECHNICAL SPECIFICATION FOR FINISH TO MASONRY & CONCRETE

1.0.0 SCOPE

This Specification covers furnishing, 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 minimise damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.0.0 INSTALLATION

2.1.0 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 brushed down with stiff wire brush to remove all loose dust from joints and thoroughly washed with water. All laitance shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as to the acceptability of the base.

2.2.0 Plastering

2.2.1 Mortar

Mortar for plastering shall be as specified in the drawings.

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.



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For lime gauged plaster, lime putty or hydrated lime and sand in the required proportion shall be mixed on a watertight platform with necessary addition of water and thoroughly ground in mortar mill. This mix shall then be transferred to a mechanical mixer to which the required quantity of cement is added and mixed for at least 3 minutes.

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.

2.2.2

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 make up any irregularity in the brickwork with plaster.

All vertical edges of brick pillars, doorjambs etc. shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.

2.2.3

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, colour and finish.

a) Standard Finish

Wherever punning is indicated, the interior plaster shall be finished rough. Otherwise the interior plaster shall generally be



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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 2.2.2 but using coloured cement in place of ordinary cement. When coloured plastering is specified in more than one coat, the top coat 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 edition. 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 2.2.2. While the mortar is still plastic small pebbles or crushed stone of size generally from 10 mm to 20 mm as approved by the Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float or the flat end of 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 mm 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 2.2.2 after being levelled and allowed to stiffen for a few hours, shall be scraped



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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.

2.2.4

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.

2.3.0

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 finished with suitable tools to shape as shown on the drawings. Any surplus mortar shall be scraped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.4.0

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 BG 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, 1/2 part lime and 4 parts sand by volume, or 1 part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.2.1. The application, finish etc. shall be as specified under relevant clause above. A 2 mm Plaster of Paris punning



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shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.

2.5.0 Lime Punning

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the lime punning. The 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.

2.6.0 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. area and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

2.7.0 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 drawing 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 noncorrodable anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanised (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.



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Where pointing is specified on drawings it shall be done by mortar as specified on drawings.

3.0.0

ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as shown on drawings.

4.0.0

I.S. CODES

Important relevant code for this Section :

- a) IS:1661 : Code of practice for cement and cement-lime plaster finish on walls & ceilings.
- b) IS:4101 : Code of practice for external facings and veneers.



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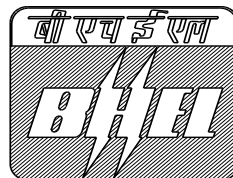
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GENERAL TECHNICAL SPECIFICATION

FLOOR FINISHES AND ALLIED WORKS



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



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TECHNICAL SPECIFICATION FOR FLOOR FINISHES AND ALLIED WORKS

1.0.0

SCOPE

This specification 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) Red Oxide of Iron finish
- iii) Terrazzo finish
- iv) Granolithic finish
- v) Patent Stone
- vi) Metallic Hardener like "Ironite" finish
- vii) Mastic Asphalt finish
- viii) 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

1.0.1

Base

The base to receive the finish is covered under other relevant specifications.

1.0.2

Sequence



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Commencement, scheduling and sequence of the finishing works shall be planned in detail and must be specifically approved by the Engineer in view the activities of other agencies working in that area. However, the Contractor for the finishing items shall remain fully responsible for all normal precautions and vigilance to prevent any damage whatsoever till handing over.

2.0.0 INSTALLATION

2.0.1 Special Materials

Basic materials are covered under Specification "Properties Storage and Handling of Common Building Materials". Special materials required for individual finishing items are specified under respective items. In general, all such materials shall be as per relevant I.S. Codes where available. In all cases these materials shall be of the best quality available indigenously, unless specified otherwise.

The materials for finishing items must be procured from well-reputed specialised manufacturers and on the basis of approval of samples by the Engineer. The materials shall be ordered, procured and stored well in advance to avoid compulsion to use substandard items to maintain in the construction schedule.

2.0.2 Workmanship

Only workers specially experienced in particular items of finishing work shall be engaged, where such workers are not readily available, with the Engineer's permission, experienced supervisors recommended by the manufacturer shall be engaged. In particular cases where the Engineer so desires the Contractor shall get the finishing items installed by the manufacturer.

2.0.3 Preparation of the Base Surface

The surface to be treated shall be thoroughly examined by the Contractor. Any rectification necessary shall be brought to the notice of the Engineer and his approval shall be taken regarding method and extent of such rectification work.

For all types of flooring, skirting, dado and similar locations, the base to receive the finish shall be adequately roughened by chipping, raking out joints and cleaning thoroughly all dirt, grease etc. with water and hard brush and detergent if required, unless otherwise directed by the manufacturer of any special finishing materials or specifically indicated in this specification under individual item.

To prevent of water from the finishing treatment the base shall be thoroughly soaked with water and all excess water mopped up.



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The surface shall be done 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.

2.1.0 In Situ Finishes

2.1.1 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' a 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 laying.

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.

2.1.2 Red Oxide of iron Finish

It shall consist of an underbed and a topping over 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 (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 finishes. Necessary cutting into the surface receiving the finish shall be done to accommodate the specified thickness.

All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.

b) Mix

i) Underbed

The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 part cement, 2 parts coarse sand and 4 parts 10 mm down graded stone chips by volume.



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For vertical and similar surfaces the mix shall consist of 1 part cement to 3 parts coarse sand by volume.

ii) **Topping**

For the topping cement, screened through a fine mesh and red oxide of iron pigment powder similarly screened shall be dry mixed thoroughly in right proportions to produce the desired colour when laid. The mix shall then be prepared with 1 part cement (mixed with pigment) and 3 parts coarse sand volume. The whole quantity required for each visible area shall be prepared in one batch to ensure uniform colour.

c) **Laying**

The underbed shall be laid in panels of mixing area 5 Sq.M. each and no side shall be more than 2.5 along. For outdoor locations the maximum area shall be 2.0 Sq.M. The forms for the panels shall have perfectly aligned edges to the full depth of the total thickness of finish. If specified aluminium or glass dividing strips shall be used.

The panels shall be laid in alternate bays or in chequered board pattern. No panel shall be cast in contact with another already laid until the contraction of the latter has taken place. The underbed shall be laid, compacted, levelled and brought to proper grade with a screed or float. The topping shall be placed after about 24 hours while the underbed is still somewhat 'green' but firm enough to receive the topping. The surface of the underbed shall be roughened for better bonding. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water to achieve a compact dense mass fully bonded with the underbed. The topping shall then be levelled up by trowelling and finished smooth with a slurry made with already prepared cement and pigment mixture. About 2.0 Kg. of the mixture shall be consumed/per Sq.M. for horizontal surface, and 1.0 Kg. for vertical surface. The surface shall be cured for seven days by keeping it moist.

d) **Polishing**

About 36 hours after laying when the surface has hardened sufficiently it shall be polished with polishing stone till a smooth shiny surface to the satisfaction of the Engineer, is achieved. The finish shall be washed and cleaned just before handing over.



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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 cut 6 mm from the adjacent plaster or other finish. Necessary cutting into the surface receiving the finish shall be done to accommodate the specified thickness.

All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.

b) **Mix**

i) **Underbed**

The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 part cement, 1.1/2 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 grey or a mixture of the two to which pigment shall be added to achieve the desired colour. To 3 parts of this mixture 1 part marble powder by volume shall be added and thoroughly mixed dry. To 1 part of this mix 1 to 1.1/2 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 may 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.



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c) Laying

The underbed shall be laid in panels. The panels shall not be more than 5 sq.m in area of which no side shall be more than 2.5 M long. For exposed locations the maximum area of a panel shall be 2.0 Sq.M. The panel shall be laid in alternate bays or chequered board pattern. No panel shall be cast in contact with another already laid until the latter has contracted to the full extent.

Dividing strips made of aluminium or glass shall be used for forming the panels. The strips shall exactly match the total depth of underbed plus topping.

After laying, the underbed shall be levelled compacted and brought to proper grade with a screed or float. The topping shall be laid after about 24 hours while the underbed is still somewhat "green" but firm enough to receive the topping. A slurry of the mixture of cement and pigment already made shall be spread evenly and brushed in just before laying the topping. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the underbed. The surface of the topping shall be trowelled over, pressed and brought to a smooth dense surface showing a minimum 75% area covered by marble chips in a even pattern of distribution.

d) Curing

The surface shall be left for curing for about 12 to 18 hours and then cured by allowing water to stand on the surface or by covering with wet sack for four days.

e) Grinding and Polishing

When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (no.60) 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. The grinding shall be done by a suitable machine. Where grinding machine can not be used hand grinding may be allowed when the first rubbing shall be with carborundum stone of coarse grade (no.60), second rubbing with medium grade (no.: 80) and final rubbing and polishing with fine grade (no.: 120). The surface shall be cleaned with water, dried and covered with soil free, clean sawdust if directed by the Engineer. The final



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polishing shall be positioned 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.

2.1.4

Granolithic Finish

Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete.

a) Thickness

The finish shall be average 20 mm and minimum 12 mm thick, unless specified otherwise.

b) Mix

The mix shall consist of 1 part cement : 1 part coarse sand : 2 parts coarse aggregate by volume. The coarse aggregate shall be very hard like granite and well graded between 6 mm and 12 mm. Minimum quantity of water to get workability shall be added.

c) Laying of Monolithic Topping

The concrete base shall be laid as per specification "Cement Concrete" and levelled upto the required grade. The form shall remain sufficiently protruding to take the finish.

Within about 3 hours of laying the base while it is still fully "green" the topping shall be laid evenly to proper thickness and grade. If considered necessary the surface of the base shall 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 to 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 2.0.3 and a slurry of neat cement applied just prior to laying the granolithic



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concrete mix (1:1:2). The method of compaction etc. shall be same as for monolithic topping.

e) **Curing**

Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface had hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or ponding of water on the surface. The floor shall not be exposed to heavy traffic during this period.

f) **Grinding**

If grinding is specified, it shall start only after the finish has fully set. Clause 2.1.3 (c) shall be followed. However, the ultimate polish required shall be decided upon by the Engineer.

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 specified. The concentration and method of application of the solutions shall be as specified in IS : 5491.

2.1.5

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 2.1.2 (a) except that the topping shall be 6 mm thick.

b) **Mix**

i) **Underbed**

The mix shall be as stipulated under clause 2.1.3(b).

ii) **Topping**

The mix for the topping shall consist of 1 part cement and 1 part fine sand 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.



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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 levelled to proper grade with a screed or float. The topping shall be applied evenly on the underbed while it is not fully set but firm enough and rolled and pressed to get full bond.

The topping shall 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.

2.1.6

Metallic Hardener Like "Ironite" 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 the required grade. The forms, if any shall remain sufficiently projecting to take the finish.

The surface shall be roughened by wire brush as soon as possible.



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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 \smoothened with steel trowel.

The finished floor shall be cured for 7 days by keeping it wet.

2.1.7

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 grades 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 lime stone 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 to IS: 1195 and shall be either brought to site in blocks weighing about 25Kg. or prepared at site. If brought in blocks, these shall be remelted in mechanically agitated mastic cookers and coarse aggregate, preferably preheated fed in successive portions until the complete change is thoroughly incorporated. At no stage during the remelting and mixing process, shall the temperature exceed 205°C.

d) **Laying**

The hot mastic shall be laid on dry base surface cleaned thoroughly by wire brushing and sweeping. The mastic shall be levelled and when cooled to some extent shall be finished with a wooden float with addition of small quantity of fine sand if required. No load shall be allowed till the finish has cooled to normal temperature.



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The mastic shall be laid in suitable panels of about 15 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.

2.1.8 Chemical Resistant in Situ Finish

Chemical resistant in situ finish shall be as epoxy resin with suitable filler material over a primer or called for in the Schedule of Items. 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 specialised manufacturer, get guarantee of performance from the organisation and pass it on to the Owner in addition to his own guarantee.

2.2.0 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.

2.2.1 Terrazzo Tile Finish

The finish will consist of manufacture terrazzo tile 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 trade mark of the manufacturer. All angles of the tiles shall be right angles all arises sharp and true, colour and texture of the wearing face uniform throughout. Maximum tolerance allowance length and breadth shall be ± 1 mm and the thickness ± 3 mm. Face of the tile shall be plane, free from pin holes 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.



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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 grey cement and 3 parts of stone chips by weight mixed with water.

The topping shall be as specified under clause 2.1.3 (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 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.



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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 2.1.3 (c) may be used for dividing the work into suitable panels.

e) **Grinding and Polishing**

Procedure shall be same as Clause 2.1.3 (c) 2. Grinding shall not commence earlier than 14 days after laying of tiles.

2.2.2 **Chequered Tile Finish**

The finish shall consist of manufactured grey 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 2.2.1 (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 2.2.1 (b) except that these may have the topping in terrazzo or plain grey cement or colour pigment added to cement as specified.

c) **Underbed**

As per clause 2.2.1 (c).

d) **Laying**

As per clause 2.2.1 (d).

e) **Grinding and Polishing**

As per clause 2.2.1 (e) except that the tiles shall be ground and polished by hand after laying taking special care in polishing the grooves properly and uniformly.

2.2.3 **Glazed Tiles Finish**

This finish shall be composed of glazed earthenware tiles with an underbed laid over a concrete or masonry base.



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a) Thickness

The total thickness shall be between 20 mm and 25 mm 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 10 mm thick unless otherwise specified. The tolerance shall be ± 1.5 mm for length and breadth and ± 0.5 mm for thickness specials like internal and external angles, beads, covers, cornices, corner pieces etc. shall match. The top surface of the tiles shall be glazed with a gloss or matt unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures, dense and homogeneous. The tiles shall be strong and free from flaws like cracks, craze, specks, crawlings, etc. and other imperfections. The edge and the underside of the tiles shall be completely free from glaze and the underside shall have ribs or indentations for better anchorage with the fixing mortar.

The coloured tiles, when supplied, shall preferably come from one batch to avoid difference in colour.

c) Mix : Underbed

The mix for the underbed shall consist of 1 part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified.

d) Laying

Same as clause 2.2.1 (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.

2.2.4

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.



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a) Thickness

The total thickness including the underbed shall be between 16 mm and 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 2.2.3 (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 2.2.3 (d) shall generally be followed. However, instead of grey cement the slurry shall be made with white cement to fix the panels. The paper mounted patterns in sections shall be carefully placed and pressed in position true to lines and levels. Earliest possible the paper shall be peeled off and surface examined and cleaned, joints flush pointed with white cement and cured for 7 days by keeping it wet.

2.2.5

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 as detailed in the Schedule of items shall be of the best indigenous manufacture unless otherwise specified and shall be resistant to the chemical described in the Schedule of Items. The tiles shall have straight edges, uniform thickness, plain surface, uniform non-fading colour and textures.



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Glazed tiles if permitted to act as chemical resistant finish shall be considered under clause 2.2.3.

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 the tiles shall be durable and strong. 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.

2.2.6

Rubber, Vinyl or Vinyl Asbestos Tiles Finish

This shall include various types of tiles manufactured from rubber, vinyl, etc. set with a 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 mentioned in the Schedule or in drawing.

b) Tiles

Unless otherwise desired the tiles shall be squares of approved dimensions. The tolerance in dimensions shall be $\pm 1.5\text{mm}$.

The face of the tiles shall be free from porosity, blisters, cracks, embedded foreign matters or either physical defects which affect appearance or serviceability. All edges shall be cut true and square. The colour shall be nonfading and uniform in appearance, insoluble in water and resistant to alkalies, cleaning agents and usual floor polishes.

Each tile shall be marked on the back legibly and indelibly with manufacturer's trade mark, 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.



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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 : 4 parts coarse sand mixed with just sufficient water to make it workable.

d) **Laying**

The tiles shall be kept in the room to be tiled for at least 24 hours to bring them to the same temperature as the room. For air conditioned space, the air-conditioning shall be completed before tiling is taken up.

The surface to receive this finish shall be firm even textured but not too smooth, without undulations and other deficiencies. If an underbed is laid the same shall be cured for at least 7 days by keeping it moist and then fully dried.

The surface shall be thoroughly cleaned. All loose dust particles shall be removed. Oil and grease if any shall be completely cleaned by use of detergent.

The adhesive shall be applied to fully dry surface in desired thickness uniformly. The adhesive shall also be applied to the backs and edges of the tiles and allowed to surface dry. The tiles shall be placed neatly on the surface exactly to the approved pattern and set with a suitable tool. If the edges tend to curl, weights are to be used to keep the edges down. Special care shall be taken to avoid formation of air pockets under the tiles. The joints shall be very fine. Any adhesive squeezed out through the joints shall be removed immediately.

e) **Finishing**

If any adhesive mark is there on the surface a soft cloth soaked in solvent shall be used to wipe it off. The surface shall be cleaned with soft soap, dried and polished with an approved type of polish just before handing over.

2.2.7

Stone Slab Finish : Marble, Stone and Similar Fine Grained Stone

a) **Thickness**

The underbed shall be minimum 12 mm and average 20 mm thick. The slabs may be 25 mm, 30 mm or 40 mm thick as specified.

b) **Stone Slab**



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The stone slabs shall be made from selected stock which are hard, sound, homogeneous and dense in texture and free from flaws. Angles and edges shall be true, square, 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 2.2.1 (c).

d) **Laying**

The sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand stone and washed clean before laying.

The underbed mortar shall be evenly spread and brought to proper level on the area under each slab. The slab shall be laid over the underbed, pressed and tapped down with wooden mallet to the proper level. The slab shall then be lifted and the underbed corrected as necessary and allowed to stiffen a little. Next, a thick cement slurry shall be spread over the surface. The edges of the slab shall be buttered with slurry of cement, grey/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 2.2.1 (e). However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for.

2.2.8

**Stone Slab Finish : Sand Stone and
Similar Coarse Grained Stone Finish**



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Generally clause 2.2.7 shall be followed except that the workmanship and finish shall not be fine as which are explained hereunder.

The slabs shall be rough chiseled or fine chiseled as specified. Tolerance may be allowed upto ± 6 mm for rough finish, but no sharp unevenness and shall be allowed. For fine chiseling 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.

3.0.0

ACCEPTANCE CRITERIA

The finish shall be checked specially for :

- a) Level, Slope, Plumb as the case may be
- b) Pattern and Symmetry
- c) Alignment of joints, dividing strip etc.
- d) Colour, texture
- e) Surface finish
- f) Thickness of joints
- g) Details at edges, junctions etc.
- h) Performance
- i) Precautions specified for durability

4.0.0

I.S. CODES

Important relevant codes for this section :

- 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



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- 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.



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MISCELLANEOUS METAL**

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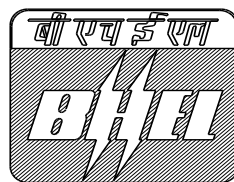
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GENERAL TECHNICAL SPECIFICATION

MISCELLANEOUS METAL



Bharat Heavy Electricals Limited

Project Engineering Management

PPEI Building, Power Sector,

Plot No. 25, Sector 16A,

Noida (U.P.)-201301



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TECHNICAL SPECIFICATION FOR MISCELLANEOUS METAL

1.0.0 SCOPE

This specification shall generally be read in conjunction with item nos. 6.01 & 6.03.

This shall include supply, fabrication and erection of miscellaneous metal items of light nature in gates, grills, balcony and stair handrails particulars, structural mullions and transoms, ladders hangers masonry anchors, shelf angles, anchor bolts, fasteners, etc. as shown on drawing or as instructed by the Engineer. The above items shall be of fabricated or cast M.S./Aluminium/Brass, cast iron, M.S. and galvanised M.S. Sheets, aluminium sheets, expanded metal, wire mesh etc. as shown on drawings and/or described.

2.0.0 INSTALLATION

2.1.0 Fabrication/Casting

2.1.1 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.

2.1.2 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 the IS : 816. Use of metal arc welding for general construction in Mild Steel.
- c) Welding of aluminium shall be done in 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.

2.1.3 Shop Coat



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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. Steel work shall be galvanised or galvanized and painted with a coat of zinc chromate primer. Aluminium surfaces which shall come in contact with masonry shall be given one coat of zinc chromate primer.

2.2.0 Erection

2.2.1 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.

2.2.2 Temporary Bolting-Up

As erection proceeds the Contractor shall plumb up and level all members and shall securely bolt up to take care of all dead load, wind load and erection stresses. Wherever piles of materials, erection equipment or other loads are carried during erection, proper provision shall be made to take care of the stresses resulting from the same.

2.2.3 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.

2.2.4 Welding

Where specified on drawings, welding shall be done in accordance with IS : 816 for steel and IS: 2812 for Aluminium and Alloys.

2.2.5 Cutting and Fitting

No cutting of sections, flanges, webs of angles shall be done without the approval of the Engineer. Where indicated on the drawings, holes, cuttings, etc. shall be provided as required for installation, to the work by the other Contractors. No additional holes or cuttings, than those shown on drawings, shall be made without the approval of the Engineer.



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2.2.6

Drifting

Correction of minor misfits and a reasonable amount of reaming 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 weakens the members or make it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins or a moderate amount 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.

2.2.7

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 1:1.5:3 or 1:1- 1/2:3 concrete with 6 mm down stone chips.

2.2.8

Anchor Bolting

When shown on drawings, the miscellaneous metal items shall be fixed to concrete by case hardened and drawn carbonizing steel expander nut and bolt. The Contractor shall submit the manufacturer's literature showing the average pull out and average shear values for bolts of various sizes. The bolts shall be fixed strictly as per the manufacturer's instructions.

2.2.9

Pipe Joints

M.S. Pipes shall be joined by threaded sockets or by welding. Cast iron pipes shall be socket and spigot jointed and caulked with hemp and molten lead.

2.2.10

Spot Painting

All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials as used for the shop paint.

2.2.11

Making Good

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.



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3.0.0

ACCEPTANCE CRITERIA

- a) All items shall be of correct shape, size, weight etc. shown on drawings.
- b) For installed items, the tolerances shall be 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 blow holes, cracks and other blemishes.

4.0.0

I.S. CODES

- IS : 226 - Structural Steel (Standard Quality)
- IS:800 - Code of practice for use of structural steel in general building construction.
- IS : 816 - Use of metal arc welding for general construction in mild steel.
- IS : 2812 - Arc welding of Aluminium and Alloys
- IS : 3150 - Hexagonal Wire Netting
- IS : 4948 - Welded steel wire fabric for general use.



**TECHNICAL SPECIFICATION FOR
PAINTING, WHITE WASHING AND
POLISHING ETC.**

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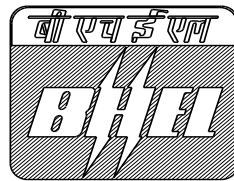
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GENERAL TECHNICAL SPECIFICATION

PAINTING, WHITE WASHING AND POLISHING ETC.



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



**TECHNICAL SPECIFICATION FOR
PAINTING, WHITE WASHING AND
POLISHING ETC.**

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TECHNICAL SPECIFICATION FOR PAINTING, WHITE WASHING AND POLISHING ETC.

1.0.0 SCOPE

This specification covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster or paris, Punning false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items as shown on drawings, or as directed by the Engineer.

Copper, bronze, chromium plate, nickel, stainless steel, aluminium and monel metal shall generally not be painted or finished except if otherwise specified.

The painting Contractor shall inspect the work of others prior to the application of paint. If surface to be finished cannot be put in suitable condition for painting by customary preparatory methods, the painting contractor shall notify the Engineer in writing or assume responsibility for and rectify unsatisfactory finishing that results.

Before commencing painting, the painting Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage, disfiguration or staining by other trades. He shall also undertake normal precautions to prevent damage, disfiguration or staining to work of other trades or other installations.

2.0.0 INSTALLATION

2.0.1 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 & paint or one shade is obtained the same manufacturing batch. All paint shall be subject to analysis from random samples taken at site from painters bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finishing coats to be applied.

All unspecified materials such as shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All



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such materials shall be made by reputable recognised manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.

a) **White Washing**

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 edition. 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 of water 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 quantity of indigo or synthetic ultramarine blue shall be added to the lime.

b) **Dry distemper**

Shall be made from suitable pigments, extenders, lime proof tinters, water soluble binders etc. and shall conform to IS:427.

c) **Oil Bound Washable Distemper**

Shall be of oil emulsion type, containing suitable preservatives and shall conform to IS:428.

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 retile titanium dioxide and other selected pigments and fungicide. 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 and water without any deterioration in colour, or without showing flaking, blistering or peeling.



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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 interior surfaces. White and pastel shades shall resist 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) **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 wood is pretreated with a liquid wood filler conforming to IS:345 is applied and rubbed out.

2.0.2

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.

2.1.0

Preparation of surface

Before starting the work the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.

2.1.1

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 shellac 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.



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2.1.2

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 re- surfacing 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 :

a) Mildew

All mildewed surfaces shall be treated with an approved fungicide such as ammonia cal wash consisting of 7g of copper carbonate dissolved in 80 ml. liquor ammonia and diluted to 1 litre with water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

2.1.3

Metal

All metal surfaces shall be absolutely clean, dry and free from wax, grease or dried soap films. In addition, all steel and iron surfaces shall be free from rust, surfaces shall be cleaned by mechanical power tools to remove mill scales unless otherwise approved by the Engineer for exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanised iron surfaces shall be pretreated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat.

2.2.0

Application

2.2.1

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 if used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor holes.

Painting shall be done by skilled labours in a workmanlike manner. All materials shall be evenly applied so as to be 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.



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All priming undercoats 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 for 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 properly 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 1 & 2). The total dry thickness of the film should not be less than 120 micron.

2.2.2

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 application of the lime solution.

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. No brush marks shall show on the finished surface.

2.2.3

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 a solution of 100 gms. of zinc sulphate to 1 litre of water and then allowed to dry.

Dry distemping shall be done as per manufacturer's instruction. In applying the distempers the brush should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long as otherwise brush marks may result.



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2.2.4 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.

2.2.5 Waterproof Cement Paint

Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours) the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

2.2.6 Acrylic Emulsion Paint

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 strictly as per manufacturer's specification.

2.2.7 Synthetic Enamel Paint

Shall be applied on properly prime red surface. Subsequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats.

2.2.8 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.

2.2.9 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.



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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 while 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 began to set, shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh.

The varnish shall be minimum of two coats, with the first coat being a flatting varnish. This shall be allowed to dry hard and be flatted down, before applying the next coat. Sufficient time must be allowed between coats to get a hard dry surface before next coat is applied. All work shall be as per relevant IS Code.

2.2.10

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 wood shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt sienna or umber.

After application of the filler paste, the french polish shall be applied with a pad of woolen 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 ease 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 dampened with methylated spirit and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss.

2.2.11

Chemical Resistant Paint

For chemical resistant paints, epoxy, chlorinated rubber or vinyl butyl paint system shall be used manufacturer's recommendation regarding the paint system exposed to moderately severe corrosive condition and subject to acid/alkali spillage and fumes, shall be followed.

2.2.12

Epoxy coating/painting

On the clean surface of concrete after properly drying of the following system is to be adopted as per manufacturers specification :

One coat of primer of following proportion to be applied over clean and dried concrete surface by brush application.

ARALDITE GY 250 - 100 Parts by weight

HARDENER HY 840 - 50 Parts by weight



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Over the primer, the uneven surface of concrete should be filled with leveling putty as mentioned above. The cost of putty is included in the item rate without fixing prior limit to consumption of putty. Two top coats of the protective treatment to be applied over the prepared smooth surface in the following proportion.

ARALDITE GY 250 - 100 Parts by weight

HARDENER HY 830 - 45 Parts by weight

HARDENER BY 850 - 15 Parts by weight

SILICA FLOUR - 20 Parts by weight

**FLOW CONTROL
AGENT - 2 Parts by weight**

Pigment may be added if desired by Engineer. The first top coat is applied over the primer and is left to reach a tack free state. At this stage, the final top coat is applied.

2.3.0 Protection

Furniture and other movable objects, equipments, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipments shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

2.4.0 Cleaning up

In addition to provisions in general conditions the Contractor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been spilled, splashed or splattered, including all equipments, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.

3.0.0 ACCEPTANCE CRITERIA

- All painted surfaces shall be uniform and pleasing in appearance.
- All varnished surfaces shall be of uniform texture and high glossy finish.
- The colour, texture etc. shall match exactly with those of approved samples.
- All stains, splashes and splatters of paints and varnishes shall be removed from surrounding surfaces.

4.0.0 I.S. CODE



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Important relevant IS Codes for this Sections are listed below :

- IS:348 : Specification for French Polish
- IS:427 : Specification for Distemper, dry colour as required.
- IS:428 : Specification for Distemper oil emulsion, colour as required.
- IS:1477 : Code of Practice for painting of ferrous (I&II)metal in buildings.
- IS:2338 : Code of Practice for finishing of wood (I&II)and wood based materials.
- IS:2339 : Specification for Aluminium Paints for general purposes in dual containers.
- IS:2395 : Code of Practice for painting concrete, masonry and plaster surface.
- IS:2932 : Specification for enamel, synthetic, exterior, type-I.
- IS:5410 : Specification for cement paint, colour as required.



TITLE:

BOROSILICATE GLASS BLOCK
LINING SYSTEM
(5X800 MW YADADRI TPS CHIMNEY)

SPECIFICATION NO. PE-TS-417-620-C002

VOLUME – 7D

SECTION - D

SUB SECTION- D26

REV. 1

DATE 24/01/2020

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BOROSILICATE GLASS BLOCK LINING SYSTEM

SPECIFICATION NO. PE-TS-417-620-C002 (REV 03)



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



TITLE:

BOROSILICATE GLASS BLOCK
LINING SYSTEM
(5X800 MW YADADRI TPS CHIMNEY)

SPECIFICATION NO. PE-TS-417-620-C002

VOLUME – 7D

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TITLE:

**BOROSILICATE GLASS BLOCK
LINING SYSTEM
(5X800 MW YADADRI TPS CHIMNEY)**

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1 PROJECT DESCRIPTION

1.1. Description

The subject project includes 2 No.s twin flue R.C.C chimneys and 1 No. single flue RCC chimney of 275m high with mild steel flue and borosilicate glass block lining system on inside surface of flue.

1.2. Flue gas characteristics (Refer Annexure I)

The chimney shall be working with FGD in line mode as well as bypass mode with the operating conditions for the flue gases shall be as per Annexure-I.

1.3. General configuration

The Chimney general arrangement configuration shall be as provided elsewhere in the specification. However, during detailed engineering, minor modification may be done. with owner's consent, without any extra cost implication.

2 SCOPE OF WORK

2.1 The scope of work includes Engineering, materials, equipment's and Services for the:

- 2.1.1 Design, preparation of drawing, material supply, fabrication, erection, application, Handling, transportation, storage, preserve, pack and furnish with adequate moisture proof packing, test and on site, application of borosilicate glass block lining system, over mild steel liner in the chimney, including:
- Supply of suitable primer, supply of two components adhesive membrane and supply of closed cell borosilicate glass blocks.
 - Required Surface finish (minimum (SA 2 $1/2$)) of internal surface of mild steel flue can, on ground or in erected position, over which borosilicate lining system can be applied, using grit blasting, and application of suitable primer, under expert supervision by borosilicate glass block lining manufacturer/supplier.
 - Installing closed cell borosilicate glass block lining system, over all heights, on ground or in erected position, on internal surface of mild steel flue can & SS mini shell, using two component suitable adhesive membrane material under controlled temperature and humidity conditions, including cost of skilled labor, material, tools & tackles, equipment required to create controlled temperature & humidity conditions on ground or in erected flue can during installation, hot blow cleaning (after priming) of internal surface before application, mixing of two components adhesive membrane by automated mixing machines etc. all complete.
 - Complete onsite QA and supervision, by borosilicate glass block lining manufacturer/supplier, during surface finish, application of primer, application of two components adhesive membrane, installation of borosilicate glass block on internal surface of flue can.



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- e) Ten (10) year full replacement guarantee, including cost of supply, erection, enabling works, all labor, material, adhesive, primer, surface preparation, arrangement for application etc. all complete, and fulltime onsite QA supervision during erection & commissioning.

During the guarantee period if the lining system fails to protect the chimney flue from deterioration, the borosilicate glass block lining manufacturer/supplier shall replace the partially affected portion or complete borosilicate lining system without any additional cost, including all labor, material, surface finish (SA 2 ¹/₂), supply and application of primer, supply and application of two component adhesive membrane, supply and application of closed cell borosilicate glass blocks, arrangement for application on erected flue cans etc all complete with onsite QA supervision of borosilicate glass block supplier.

Mild steel flue can fabrication and erection is not in this scope of work and shall be done by chimney EPC contractor.

- 2.1.2 All necessary parts, and works necessary for transport, storage and application purposes. Coordination with chimney designer & chimney contractor- providing required inputs.
- 2.1.3 Submission of the drawings and getting the same approved from BHEL and the project owner for borosilicate glass block lining system, erection, transportation and storage.
- 2.1.4 The Bidder shall furnish all design, labor, materials, tools and equipment necessary for the installation of borosilicate lining system, as indicated and specified herein.
- 2.1.5 The Work shall include everything requisite and necessary to finish the job properly, to the satisfaction of engineer in charge, notwithstanding that every item of labor or materials or accessories required to make the installation complete may not be specifically mentioned.
- 2.1.6 The Equipment / material for the Unit shall be supplied complete with provisions for appurtenances and accessories, to form a complete system which will achieve and assure safe and reliable operation with best overall performance.
- 2.1.7 Bidder shall provide, in the required format and form and in a timely manner, all drawings and documentation required by this Specification and/or required by applicable Standards and codes. A consistent nomenclature shall be used project-wide in naming all component parts within the Scope of Work. This shall apply to all drawings, Bill of Materials, special instructions, etc. The cost of correcting inconsistent nomenclature shall be borne by the Bidder.
- 2.1.8 Changes in design and drawings already approved by the owner are normally unacceptable. However, should such changes become necessary on an exceptional basis, the Bidder shall obtain the owners approval prior to introducing any such change.

2.2 Bidder Services

Field personnel provided by the Bidder shall be capable and qualified to perform the required duties to the satisfaction of BHEL and the owner.

Erection services:

The Bidder shall furnish competent supervision for erecting the equipment provided under this Specification. The erection services shall be coordinated with other agencies in the scope of the subject chimney contract.



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3 SPECIAL EQUIPMENT, TOOLS AND INSTRUMENTS

Bidder shall provide all special equipment, tools and instruments, skilled manpower required for handling and storage, and for test and maintenance of borosilicate lining system provided under this Contract.

4 STANDARDS AND CODES

- 4.1 The borosilicate lining system to be provided under this Specification, including all appurtenances and accessories, shall be designed, fabricated, inspected, tested, stamped and preserved to the extent indicated in said referenced Standards and Codes. Where this Specification does not include such reference, the system, or any of its components, shall be designed, fabricated, inspected, tested and preserved, as applicable, to comply with currently recognized International and/or manufacturer's specification, whichever is stringent and more restrictive.
- 4.2 In all cases Bidder shall adhere to and comply with the requirements of Indian standards, which are found to be more restrictive than those specified herein.

5 QUALITY ASSURANCE AND QUALITY CONTROL

- 5.1 The Bidder shall submit upon request a copy of Its Quality Assurance Manual including Quality Procedures.
- 5.2 The Bidder shall conduct an inspection and testing program which shall record and verify the essential properties of the constituent materials and the finished liner.
- 5.3 The Bidder shall conduct test to verify the mechanical properties of borosilicate bricks and adhesive/mortar and the tests shall be documented during the course of design and fabrication, and shall be made available to owner.
- 5.4 Unless otherwise specified the bidder's standard tests shall be performed on all batches of materials furnished. The owner may or may not elect to witness tests, but the bidder shall notify the Owner's Quality Assurance Department no later than 10 days in advance of all scheduled tests.

6 SAFETY, NOISE AND ENVIRONMENT REQUIREMENTS

6.1 SAFETY

The equipment supplied under this Specification shall meet the U.S. "OCCUPATION, SAFETY, AND HAZARD ADMINISTRATION" (OSHA) requirements or equivalent.

6.1.1 Jobsite Safety and Scrap Disposal

- o Safety programs and procedures shall be within the scope of this Specification, it should be noted that the all materials that are



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(5X800 MW YADADRI TPS CHIMNEY)**

SPECIFICATION NO. PE-TS-417-620-C002

VOLUME – 7D

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potentially flammable materials and must be handled in keeping with good industry practice and in compliance with the manufacturer's recommendations.

- o Owner shall supply the Bidder with the applicable rules and regulations for disposal of scrap and waste materials, which are to be followed by the bidder.

6.1.2 Safety and protection of work and property:

The Bidder shall provide for the safety and protection of the work and of materials and equipment to be incorporated therein, whether in storage on or off the site. Provide protection at all times against rain, wind, storms, condensation, or heat so as to maintain all work and equipment and materials free from injury of damage. At the end of each day, all new work likely to be damaged shall be appropriately protected.

6.2 Environmental Data

6.2.1 Should the lining system to be furnished by the Bidder have discharge points to the environment and/or generate waste materials that must be discharged to the environment, the Bidder shall provide, upon Purchaser's request, a plan for the treatment of the discharge/waste to meet current regulations of the Indian government/ regulatory authorities.

6.2.2 The Bidder shall submit, within thirty (30) days of demand, additional information on noise and/or other environmental data. All information shall be prepared in a manner acceptable Indian government/ regulatory authorities.

7 TECHNICAL REQUIREMENTS OF BOROSILICATE GLASS BLOCK LINING SYSTEM

7.1 Design parameters

7.1.1 Liner considerations

The borosilicate glass block liner will have thickness of 51 mm for all its entire length. Proper provisioning should be made for borosilicate lining system for lining around gas sampling ports, expansion joints, man holes and other appurtenances.



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**BOROSILICATE GLASS BLOCK
LINING SYSTEM
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7.2 Operating conditions of flue gas are as follows:

- o Flue gas Operating conditions shall be as per Annexure-I
- o A margin of 15 deg centigrade above the operating conditions mentioned in Annexure-I shall be taken while selecting the appropriate material and thickness for design of the lining system.
- o Short Term failure of Air Preheater - minimum 15 minutes duration with around 200 deg C

The borosilicate lining system shall be designed for worst of all the conditions as mentioned above.

7.3 Performance Requirements

7.3.1 Borosilicate brick lining system will be designed in such a way that it will not require unscheduled outages for repair except for planned and scheduled routine maintenance and inspections.

7.3.2 Borosilicate brick lining system and all of the required components will be designed for a safe, useful life of thirty (30) years (minimum).

7.3.3 Ten (10) year full replacement guarantee, including cost of supply, erection, enabling works, all labor, material, adhesive, primer, surface preparation, arrangement for application etc. all complete, and fulltime onsite QA supervision during erection & commissioning. During the guarantee period if the lining system fails to protect the chimney flue from deterioration, the borosilicate glass block lining manufacturer/supplier shall replace the partially affected portion or complete borosilicate lining system without any additional cost, including all labor, material, surface finish (SA 2 1/2), supply and application of primer, supply and application of two component adhesive membrane, supply and application of closed cell borosilicate glass blocks, arrangement for application on ground or erected flue cans etc all complete with onsite QA supervision of borosilicate glass block supplier.

7.3.4 The lining system (borosilicate glass block and adhesive) shall be offered by a supplier with demonstrated capabilities in the area of onsite technical support and QA/QC supervision, who employs QA/QC supervisors with a demonstrated experience in technical support and QA/QC supervision of the subject lining system.

7.3.5 The supplied lining system (borosilicate glass block and adhesive) shall be capable of withstanding fire risk for a minimum period of 2 hours as per ASTM E-119. Proper certification from an independent institute of



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sufficient knowledge and experience shall be submitted by supplier subject to acceptance by the project owner, showing the capability of the lining system (borosilicate glass block and adhesive) to protect the steel chimney flues from structural damage by fire of said rating.

7.3.6 Supplier shall produce certificates from an independent institute of sufficient knowledge and experience, subject to acceptance by the project owner, showing that the workers can do the work on supplied lining system safely, without any adverse health effects and without requiring excessive protective measures.

7.4 Design Requirements

7.4.1 General

- o Design of the borosilicate lining system must be performed by a professional engineer of manufacturer of borosilicate lining system. Manufacturer should hold guarantee for satisfactory performance under all operating conditions as per specification. Manufacturer should satisfactorily demonstrate proveness.
- o Specified requirements of this specification are to be regarded as minimum requirements. If the Fabricator's design and/or experience dictate these minimum requirements should be exceeded, the design, supply and application shall be performed accordingly, without any extra cost implication to BHEL.

7.5 Materials Requirements

The steel chimney flues, made of minimum 10 mm thick mild steel, shall be internally protected with a lining system consisting of 51mm thickness, applied with a flexible, chemically resistant adhesive, using a lining system that meets all of the following requirements:

- 7.5.1 The lining system shall use closed cell borosilicate glass blocks with the following minimum physical properties:
- a. Minimum Density $0.144 \times 10^3 \text{ kg/m}^3$
 - b. coefficient of linear thermal expansion not greater than $5.5 \times 10^{-6} / ^\circ\text{C}$,
 - c. compressive strength greater than 1.00 MPa as per ASTM C-165,
 - d. flexural strength greater than 0.62 MPa as per ASTM C-203/C-240.
 - e. The blocks shall be resistant to thermal cyclic loading under FGD bypass/ hot gas service conditions, and sudden temperature changes, including high temperature spikes.
- 7.5.2 The borosilicate glass block system shall use a flexible, chemically resistant adhesive, with all required surface preparation, primer,



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labor, equipment etc., all complete. The adhesive membrane shall be a 2-component having excellent elastomeric properties and be acid & heat resistant. The adhesive membrane shall be applied in between and behind the blocks in a 3 mm thick layer ensuring a proper bond and adhesion. The adhesive membrane shall have the following properties.

- a. Minimum tensile strength at 23 °C greater than or equal to 1.0 N/mm² as per ASTM D-412
- b. Resistant to corrosive flue gas environments.
- c. Remain elastomeric and flexible under hot gas conditions and sudden temperature changes.
- d. The adhesive shall be suitable for trowel application.

- 7.5.3 The steel surface shall be grit blasted to a cleanliness of SA 2 1/2 and approved by the supplier of the lining system. The substrate shall thereafter be primed using a high performance epoxy primer within a short time window approved by the supplier. The lining system manufacturer shall demonstrate a proven Quality Control system that monitors and documents the key physical properties, as described above.

8 HANDLING, STORAGE AND PROTECTION

8.1 Facilities

- 8.1.1 Bidder shall construct adequate facilities for the storage of material. Upon completion of fabrication, the Bidder shall remove the fabrication facility from the site and return the area to the pre-construction condition.
- 8.1.2 The installation of borosilicate lining system must be done in a suitable environment (temperature, humidity etc. control as per manufacturer recommendation to stand by the required guarantee). Maintenance of the required suitable condition and any tools/tackles, machinery required to maintain the controlled environment during installation of borosilicate glass block shall be in the scope of bidder.

8.2 Storage

- 8.2.1 Materials shall be stored in a dry area and within the temperature and humidity limits recommended by the material Bidders. Do not allow shelf-life limits, as determined by the Bidder, to be exceeded.
- 8.2.2 Materials surfaces shall be protected from dust, fog, rain and other contaminants.
- 8.2.3 Affected plies shall be removed if any of the above requirements are not met during final surface preparation. The surface exposed due



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to the removal of the plies shall be abraded and prepared, per this Specification, before applying new plies.

9 JOB SITE INSPECTION AND PREPARATION

- 9.1 In coordination with the chimney contractor the borosilicate installation agency should submit a plan detailing the application sequence and methods to be employed, including moving, handling, storage, erection, fit up and the methods to be used for environmental protection.



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ANNEXURE-I



TITLE:
CHIMNEY SIZING CALCULATION
5 X 800 MW YADADRI TPS, NALGONDA

DOCUMENT NO.: PE-DC-417-100-N318
REVISION NO.: 02
DATE: 17.11.18
SHEET: 4 OF 6

6.0 SIZING CALCULATION:

Chimney exit internal diameter calculations for following conditions are made on the basis of formula and procedure as given above.

i) Chimney Flue Diameter Calculation with FGD in Operation:

02

CHIMNEY FLUE DIAMETER CALCULATION

01

Parameter		Units	BMCRC DC	BMCRC- IMPORTED COAL	BMCRC- Indian Coal	TMCR- DC	Worst Operating Condition
Flue gas quantity per boiler		T/Hr	3793.23	3662.81	3845.21	3417.45	3965.432
Temp. of flue gas at stack inlet	T_{gi}	°C	90	87.5	90.9	87	90.9
Flue gas density at stack inlet	ρ_{gi}	Kg/m ³	0.98	0.99	0.97	0.987	0.96959
Volumetric flow per boiler	Q	M ³ /s	1075.18	1027.72	1101.15	961.80	1136.06
Stack Height	H	M	275	275	275	275	275
Breeching level	H_b	M	17.8	17.8	17.8	17.8	17.8
Ambient air temp.	T_a	°C	27	27	27	27	27
Site Elevation from MSL	EL	M	85	85	85	85	85
Relative Humidity	RH		60	60	60	60	60
Air density at ambient temp.	ρ_a	Kg/m ³	1.155	1.155	1.155	1.155	1.155
Temp. drop in flue gas	ΔT	°C	10	10	10	10	10
Temp. of flue gas at stack exit	T_{ge}	°C	80	77.5	80.9	77	80.9
Flue gas density at stack exit (corrected for barometric pressure)		Kg/m ³	0.9484	0.9581	0.9387	0.9552	0.9383
Flue gas density at stack exit (corrected for barometric pressure & exit temperature)	ρ_{ge}	Kg/m ³	0.9753	0.9854	0.9653	0.9825	0.9648
Average Flue gas density	ρ_g	Kg/m ³	0.9776	0.9877	0.9676	0.9847	0.9672
Effective Stack Height	H_e	M	257.2	257.2	257.2	257.2	257.2
Draught created	H_{dr}	mmWC	45.60	43.01	48.18	43.78	48.28
Internal flue dia	D	M	6.998	6.998	6.998	6.998	6.998
Flue gas velocity at stack exit	V_{ge}	m/sec	27.97	26.73	28.64	25.02	29.55
Exit velocity loss	H_{el}	mmWC	38.88	35.90	40.36	31.34	42.95
friction factor	f		0.0085	0.0085	0.0085	0.0085	0.0085
Frictional loss (for cylindrical flue)	H_{fl}	mmWC	12.15	11.21	12.61	9.79	13.42
Unaccounted loss		mmWC	5.10	4.71	5.30	4.11	5.64
Total Loss		mmWC	56.13	51.82	58.27	45.25	62.00
Net draught available		mmWC	-10.53	-8.81	-10.10	-1.47	-13.72



TITLE:
CHIMNEY SIZING CALCULATION
5 X 800 MW YADADRI TPS, NALGONDA

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DATE: 17.11.18
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ii) Chimney Flue Diameter Calculation Without FGD in Operation:

02

CHIMNEY FLUE DIAMETER CALCULATION

Parameter		Units	BMCR-DC	BMCR-Imported Coal	BMCR-Indian Coal	TMCR-DC	WORST OPERATING CONDITION
Flue gas quantity per boiler		T/Hr	3546	3424	3593	3198	3790
Temp. of flue gas at stack inlet	T_{gi}	°C	135	130	135	129	150
Flue gas density at stack inlet	ρ_{gi}	Kg/m ³	0.869	0.877	0.87	0.882	0.84
Volumetric flow per boiler	Q	M ³ /s	1133.49	1084.51	1147.19	1007.20	1253.31
Stack Height	H	M	275	275	275	275	275
Breeching level	H_b	M	17.8	17.8	17.8	17.8	17.8
Ambient air temp.	T_a	°C	27	27	27	27	27
Site Elevation from MSL	EL	M	85	85	85	85	85
Relative Humidity	RH		60	60	60	60	60
Air density at ambient temp.	ρ_a	Kg/m ³	1.155	1.155	1.155	1.155	1.155
Temp. drop in flue gas	ΔT	°C	10	10	10	10	10
Temp. of flue gas at stack exit	T_{ge}	°C	125	120	125	119	140
Flue gas density at stack exit (corrected for barometric pressure)		Kg/m ³	0.8410	0.8487	0.8420	0.8536	0.8129
Flue gas density at stack exit (corrected for barometric pressure & exit temperature)	ρ_{ge}	Kg/m ³	0.8621	0.8703	0.8631	0.8753	0.8326
Average Flue gas density	ρ_g	Kg/m ³	0.8656	0.8737	0.8666	0.8787	0.8363
Effective Stack Height	H_e	M	257.2	257.2	257.2	257.2	257.2
Draught created	H_{dr}	mmWC	74.43	72.34	74.17	71.06	81.95
Internal flue dia	D	M	6.998	6.998	6.998	6.998	6.998
Flue gas velocity at stack exit	V_{ge}	m/sec	29.48	28.21	29.84	26.20	32.60
Exit velocity loss	H_{el}	mmWC	38.20	35.30	39.17	30.62	45.10
friction factor	f		0.0085	0.0085	0.0085	0.0085	0.0085
Frictional loss (for cylindrical flue)	H_{fi}	mmWC	11.93	11.03	12.24	9.57	14.09
Unaccounted loss		mmWC	5.01	4.63	5.14	4.02	5.92
Total Loss		mmWC	55.15	50.96	56.55	44.21	65.11
Net draught available		mmWC	19.28	21.38	17.62	26.84	16.84



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ANNEXURE-B

DATA FOR CHIMNEY DESIGN

(For FGD bypass operation)

GENERAL DATA						
Boiler Application	Utility	No. of Chimneys		By PEM		
Boiler Capacity	2585 t/h	Type of Chimney		By PEM		
No. of Boilers	Five(5)	Chimney Arrangement		By PEM		
Fuels Fired	Coal	Height of Chimney		By PEM		
OPERATING CONDITIONS (Per Boiler)						
DESCRIPTION / LOAD		BMCR-DC	BMCR-Imported Coal	BMCR-Indian Coal	TMCR-DC	Worst Operating Condition
Flue Gas Flow	t / h	3546	3424	3593	3196	3790
Flue Gas Volume	m ³ / s	1133.5	1084.5	1147.2	1007.2	1253.3
Flue Gas Temperature	°C	135	130	135	129	150
Flue Gas Density	kg / m ³	0.869	0.877	0.870	0.882	0.840
FLUE GAS COMPOSITION % BY WEIGHT - WET BASIS						
CO ₂		20.290	20.224	20.372	20.290	19.315
N ₂		69.309	69.458	69.031	69.309	69.382
O ₂		5.047	5.052	5.036	5.047	5.963
SO ₂		0.167	0.106	0.278	0.167	0.263
H ₂ O		5.187	5.160	5.282	5.187	5.077
*DUST SIZE DISTRIBUTION AT CHIMNEY INLET - % MICRONS						
Below 3		97.16	Between 10 - 20		0.17	
Between 3 - 5		1.18	Between 20 - 30		0.03	
Between 5 - 10		0.78	Between 30 - 40		0.68	
OTHER DATA						
Elevation of Breaching Line of the Duct	m	Refer GA Drawing				
Duct Opening Dimensions	mm x mm	Refer GA Drawing				
Flue Gas Pressure at Chimney Entry Level	mmwc	10				
REMARKS: *APPLICABLE ONLY FOR COAL FIRING						
a) Suitable margins may be added over and above the given operating conditions for chimney design.						
b) The temperature can vary within the range of 110°C to 150°C (corresponding density will be in the range of 0.923 kg/m ³ to 0.840 kg/m ³).						
c) FGD/BAP to furnish Chimney sizing data with FGD in operation for the above conditions.						
Sheet 1 of 1						
Customer / Plant : TSGENCO/Yadadri TPS, 5x800 MW						
Cont. No.: 1823-1827	Rev. 0	Rev. 1	Rev. 2	Rev. 3		
	Sign	Date	Sign	Date	Sign	Date
Engineer : SV		28.10.17				
Reviewer : KSC		28.10.17				
Approver : BMM		28.10.17				

ANNEXURE-B,CHIMNEY SIZING DATA WITH FGD

[illegible]



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ANNEXURE-B, CHIMNEY SIZING DATA WITH FGD

DATA FOR CHIMNEY DESIGN

GENERAL DATA								
Boiler Application	Utility	No. of Chimneys		By PEM				
Boiler Capacity	800 MW	Type of Chimney		By PEM				
No. of Boilers	Five(05)	Chimney Arrangement		By PEM				
Fuels Fired	Coal	Height of Chimney		By PEM				
OPERATING CONDITIONS (Per Boiler)								
DESCRIPTION / LOAD	Worst Operating condition of Boiler							
	Worst Coal							
Flue Gas Flow	t / h	3965.432						
Flue Gas Volume	m ³ / s (wet)	1136.09						
Flue Gas Temperature	°C	90.9						
Flue Gas Density	kg / m ³	0.96959						
FLUE GAS COMPOSITION % BY WEIGHT-WET BASIS								
CO ₂	18.85							
N ₂	67.44							
O ₂	5.81							
SO ₂	0.017							
H ₂ O	7.865							
*DUST SIZE DISTRIBUTION AT CHIMNEY INLET - % MICRONS								
Below 3	Same as ESP Outlet		Between 10 - 20		Same as ESP Outlet			
Between 3 - 5	Same as ESP Outlet		Between 20 - 30		Same as ESP Outlet			
Between 5 - 10	Same as ESP Outlet		Between 30 - 40		Same as ESP Outlet			
OTHER DATA								
Elevation of Breeching Line of the Duct				PEM Chimney designer to decide				
Duct Opening Dimensions				PEM Chimney designer to decide				
Flue Gas Pressure at Chimney Entry Level				PEM Chimney designer to decide				
REMARKS:				*APPLICABLE ONLY FOR COAL FIRING				
Sheet 1 of 1								
Customer / Plant: TSGENCO-YADADRI (5X800MW)								
Prop. No.:	Rev. 0		Rev. 1		Rev. 2		Rev. 3	
	Sign	Date	Sign	Date	Sign	Date	Sign	Date
Engineer : Yuvaraj.R	YR	15-05-18	YR	25-05-18				
Reviewer : Raju.P	RP	15-05-18	RP	25-05-18				
Approver : Lakshmanan R	RL	15-05-18	RL	25-05-18				



TITLE

LIGHTNING PROTECTION & EARTHING
OF CHIMNEY
(SUPPLY & INSTALLATION)

SPECIFICATION NO. PES-509-02A

VOLUME II B

SECTION D

REV NO. 0 DATE 08.02.2002

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GENERAL TECHNICAL REQUIREMENTS
OF
LIGHTNING PROTECTION OF CHIMNEY

SPECIFICATION NO. PES-509-02A



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**LIGHTNING PROTECTION & EARTHING
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1.0 GENERAL

- 1.1 This section includes the design, fabrication, supply, installation and testing of Lightning Protection system for the Chimney(s). The requirements of this specification shall be complied with in relation to the requirements set out in Data Sheet-A & Section-C.
- 1.2 The contractor's scope, besides material supply shall include complete installation of Lightning Protection System, protective coating application, and testing of the system. All materials, consumables, erection equipment etc. as required for the completion of installation and testing facilities shall be supplied.

2.0 CODES & STANDARDS

- 2.1 The latest revisions of the following codes & standards shall be applicable:

IS:2309 Code of practice for protection of buildings & allied structures against lightning.

IS:3043 Code of Practice for earthing

IS:4759 Hot-dipped galvanised coating on structural steel

IS:2629 Recommended practice for Hot-dipped galvanising for Iron & Steel.

IS:2633 Methods of Testing Uniformity of Coating on zinc-coated Articles.

IS:1731 Dimensions for Steel flats for structural & General Engineering Purposes.

IS:1752 Electroplated Coatings of Cadmium on Iron & Steel

Indian Electricity Rules, 1956,

Indian Electricity Act, 1960.

IS:4990(Part-I) Criteria for Design of Reinforced concrete Chimney.

3.0 DESIGN REQUIREMENTS

- 3.1 Lightning Protection system for the chimney shall consist of air-termination network comprising requisite number of vertical copper rods, 20mm in dia, projecting at least 1000mm above the top of the chimney and the flues, spaced uniformly along the top periphery of the outer shell of the Chimney and that of the flues. A ring of 75x6mm GI strip shall be laid along the top periphery of the flues and the Chimney, forming the



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annular horizontal air terminations. The vertical air terminations shall be electrically connected (Brazed) to the horizontal air terminations, the vertical termination of the flues and those of the Chimney to the horizontal termination of the Chimney. The vertical terminations shall be spaced not more than 3m apart from each other.

- 3.2 The air terminations shall be secured to the top of Chimney top by an arrangement of substantially strong construction to withstand high wind pressure prevalent in the area commensurate with the height involved. All materials for the securing arrangement shall be of the same grade as the conductors and must be galvanised. The vertical air terminals at the top of the shell shall also be secured to the guard ring at the top of the shell.
- 3.3 A minimum of two numbers of equally spaced conductors, each consisting of 50x6mm GI strip, shall be brought down from their connecting points on the annular rings at the top of the Chimney/flues. The down-conductors originating at the top of the flues shall be brought down along the walls of the flues and electrically connected (welded) to the annular ring at the top of the outer shell of the Chimney. The down conductors (minimum two numbers) from the chimney top shall be brought down to the bottom of the Chimney all along the exterior Chimney wall.
- 3.4 A test link of copper black/phosphor bronze gunmetal bolted to the conductor for the purpose of isolation & testing shall be provided on each down conductor 1000mm above ground level.
- 3.5 Down conductors shall be cleated to the wall at an interval of 1500mm all along the length of the Chimney.
- 3.6 Down conductors near ground level shall be protected against mechanical injuries by means of wood-moulding or non-metallic cover. A removable cover of the same material shall be provided over the test-link for easy access.
- 3.7 The connection between the downconductor from the test link onwards upto an annular ring of galvanised steel running around the entire periphery of the chimney bottom shall be provided through risers which shall be of 40mm dia MS rods.
- 3.8 The risers shall be terminated on the annular ring of 40mm dia MS rod running around the periphery of the chimney buried 1 metre deep in the ground and clearing all foundation by at least 2 metres.
- 3.9 From the termination points of the downconductors on to this underground ring, mild steel rods shall terminate at test pits complete with test-links and electrodes.
- 3.10 The test pits at para 3.9 shall in turn be connected to the main earthmat of the power house through 40mm dia MS rod.
- 3.11 All joints, except for testing purposes, shall be welded type lap joints with an overlap of 100mm. The welding shall be complete around the joint and not tack welded. Electric arc welding shall be used for all joints.
- 3.12 After welding, two coats of anti-corrosive (red-oxide) paint followed by a coat of bituminous paint shall be applied to each joint.
- 3.13 The 40mm dia MS rods shall be protected against corrosion by applying a coat of barium chromate paint and two coats of bitumen below the test link.



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**LIGHTNING PROTECTION & EARTHING
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- 3.14 The complete lightning protection system arrangement including air-terminations, conductors, connections, fittings etc. and materials located on the exterior within 10m from the top of the chimney shall have lead coating of 2.0mm thickness.
- 3.15 All exposed metal structures such as hand rails, platforms, ladders/stairs shall be connected to the downconductors through earthing band rings, of 50x6mm GI strip located 2000mm above each platform. Ladders and platforms shall be bonded together for electrical continuity. A strip of 25x3mm GI shall be used for connection between equipment and earthing band rings. Similarly, all lighting fixtures shall be earthed.
- 3.16 Temporary lightning protection system shall have to be provided and maintained during the construction of chimney or till final lightning protection system is installed by the contractor free of cost and in line with IS:4998(Part-I).
- 3.17 For general reference and guidance, Below Ground Earthing Typical Details drg.no. PE-DG-XXX-509-0004 & drg.no. PE-DG-XXX-509-003 may be used.

4.0 GALVANISING

- 4.1 All steel strips and materials requiring galvanisation shall be hot-dip galvanised according to the IS:2629 & IS:4759. Galvanising shall be done at a place where galvanising and testing facilities conforming to the relevant Indian Standards exist. The galvanising shall be smooth, clean, uniform, continuous & free from acid spots. The thickness of zinc deposit at any spot shall not be less than 75 microns. The purchaser reserves the right to measure the thickness of zinc deposit and reject any component which shows thickness of zinc at any location less than 75 microns. Should the galvanising of the sample be found defective, the entire batch of the steel will have to be re-galvanised at the seller's cost.
- 4.2 All nuts, bolts and washers, wherever used, shall be cadmium coated or zinc passivated, the thickness of plating conforming to the relevant Indian Standards.

5.0 INSPECTION & TESTING

- 5.1 The following stages of manufacture/installation shall be stage inspected by purchaser or his duly authorised representative:
- 5.1.1 Inspection of all material such as vertical air terminals, steel strips, electrodes, test links including hardware items such as bolts, nuts etc.
- 5.1.2 Inspection of manufacturing processes such as shearing, punching, bending, welding, galvanising, painting etc.
- 5.1.3 Inspection of installation procedures
- The actual inspection will be carried out as per the agreed Quality Plan.

5.2 TESTING

- 5.2.1 The supplier shall perform all tests necessary to ensure that the material and workmanship conform to relevant standards and that such tests are adequate to



TITLE

**LIGHTNING PROTECTION & EARTHING
OF CHIMNEY
(SUPPLY & INSTALLATION)**

SPECIFICATION NO. PES-509-02A

VOLUME II B

SECTION D

REV NO. 0 DATE 08.02.2002

SHEET 3 OF 4

demonstrate that the equipment shall comply with the requirements of this specification.

5.2.2 The tolerance in dimensions shall be in accordance with appropriate Indian Standards.

5.2.3 Forged steel below 10mm thick is subject to Magnetic Particle Testing.

6.0 DRAWINGS, DATA & DOCUMENTS

6.1 Data sheet-A of this specification gives the details of materials to be used for the Lightning Protection system for Chimney.

6.2 The tenderer shall submit his design(s) and drawings for Direct stroke Lightning Protection System of Chimneys for purchaser's evaluation/scrutiny and approval.

6.3 The contractor shall furnish his design(s) and installation drawings for approval.

6.4 The contractor shall furnish the requisite number of prints & RTF's of all drawings as specified elsewhere in this specification.

6.5 The site modifications/deviations shall be marked on the latest revision of the drawings & submitted as 'As Built' drawings to the purchaser after completion of installation.

6.6 Tenderer shall submit all filled up schedules as per Volume-III.

6.7 The tenderer shall submit reports on Type tests & Special tests conducted on lightning protection materials & accessories.

7.0 COMPLETENESS

7.1 The offer for supply and erection shall be complete in all respects & shall include all materials, tools and appliances, whether specified or not, required for the completion of the job.

7.2 Supply/arrangements of all accessories and material etc. shall be the responsibility of the contractor.



TITLE

**LIGHTNING PROTECTION & EARTHING
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SPECIFIC TECHNICAL REQUIREMENTS

MATERIALS & SIZES

The following are the minimum sizes of material to be used for lightning protection system:

S.No.	Material	Minimum Size
1.	COPPER RODS (Lead Coated)(for vertical air Terminations projecting 1000mm above the Chimney/ flues)	20mm dia
2.	GI STRIP (for annular horizontal band ring at the top of the Chimney/flues)	75x6mm
3.	GI STRIP (for downconductor)	50x6mm
4.	GI STRIP (for earthing band ring each platform)	50x6mm
5.	MS ROD (for risers)	40mm dia
6.	TEST LINK	compatible with size at Sl.No.3 & 5 above
7.	MS ROD (for annular ring buried 1 metre in the ground around the chimney)	40mm dia
8.	MS ROD (for electrodes) with Test Pits	40mm dia
9.	MS ROD (for connection between test pit and customer's earthmat)	40mm dia
10.	GI STRIP/WIRE (for connection between equipment and earthing band rings)	25x3mm/As required

1.0 GUARANTEED TECHNICAL PARTICULARS:



TITLE

**LIGHTNING PROTECTION & EARTHING
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The tenderer shall fill up and submit the following technical particulars:

1.01 Name of Manufacturer :

1.02 Place and country of Manufacture :

1.03 Standards applicable :

i/ For materials & sizes :

ii/ For galvanisation/Electroplated coating :

iii/ For testing uniformity of Galvanization :

iv/ For code of practice :

v/ For hexagonal bolts, nuts washers :

vi/ For welding :

1.04 Thickness of galvanizing on steel :

1.05 Thickness of Electroplated coatings :

1.06 Thickness of Lend coating on copper :

1.07 Materials and sizes offered :

i/ Below ground conductor :

ii/ Electrodes :

iii/ Risers :

iv/ Down Conductors :

v/ Air terminations (Vertical) :

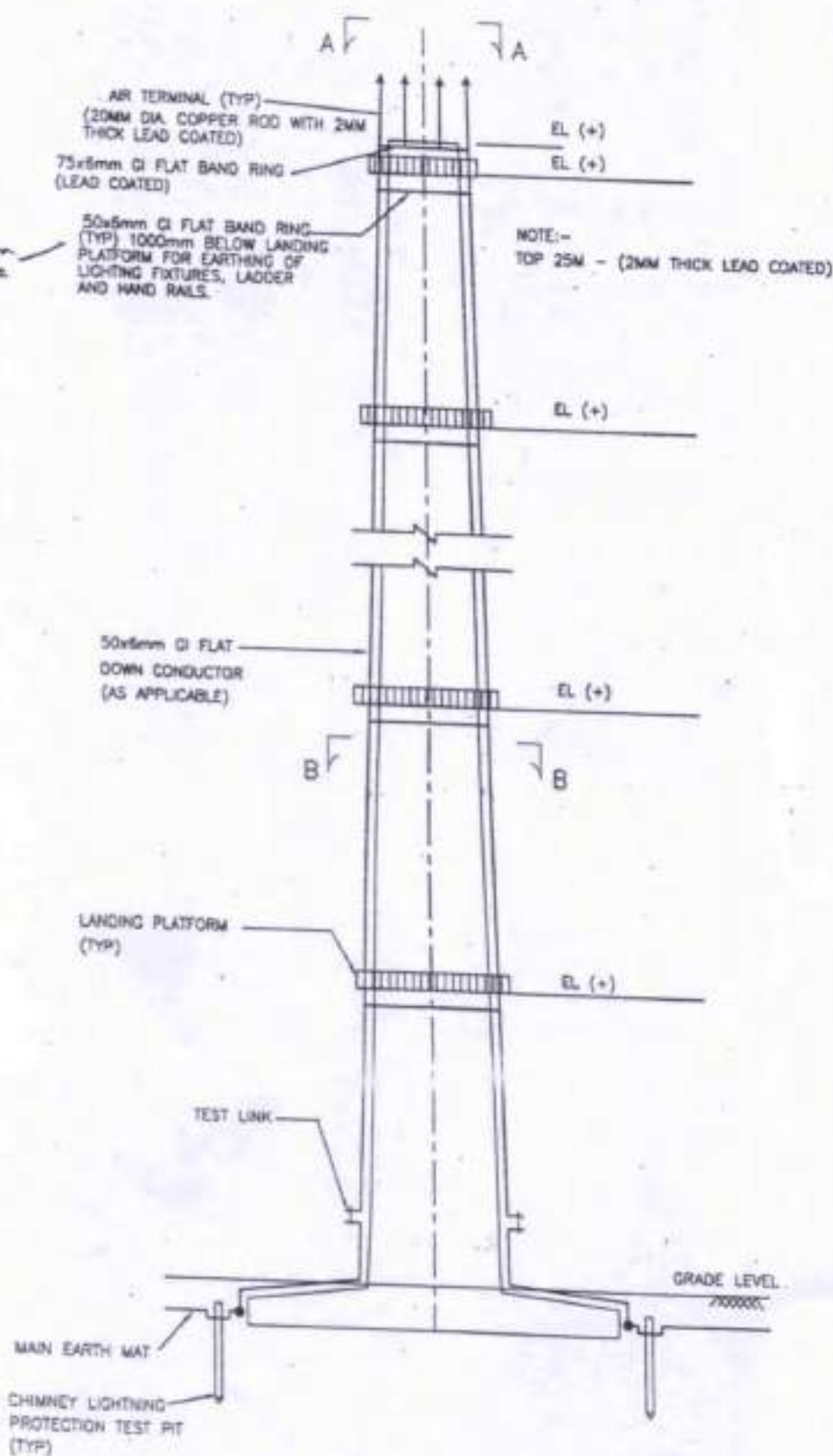
vi/ Air termination (Horizontal) :

vii/ Test Pits :

viii/ Test Links :

1.08 Whether all type test certificates furnished

1.09 Whether all schedules of Vol.III filled up and submitted.



CHIMNEY (ELEVATION)



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
NEW DELHI

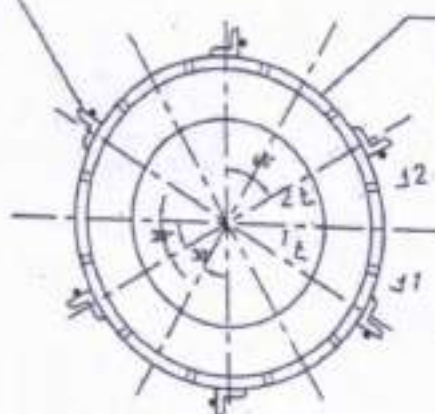
LIGHTNING PROTN. OF CHIMNEY

DRG. No.
PE-DG-XXX-509-0003

SHEET 1 OF 4

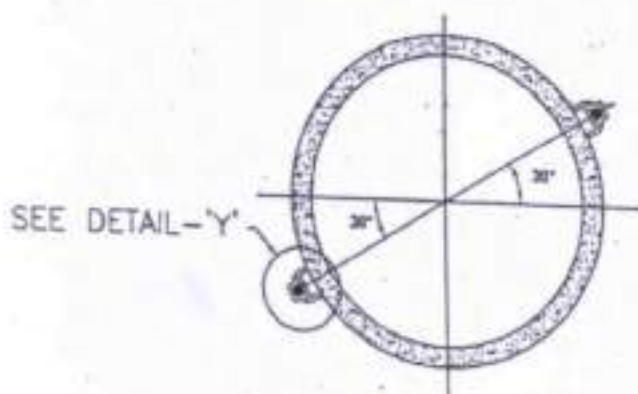
REV. 00

AIR TERMINAL (TYP)
(20MM DIA. COPPER
ROD WITH 2MM THICK
LEAD COATING)



75X6 G.I. FLAT BAND
RING-LEAD COATED
(HORIZONTAL AIR
TERMINATION)

SECTION A-A



SECTION B-B

NOTE:-
TOP 25M OF CHIMNEY SHALL
HAVE A LEAD COATING OF
2MM THICKNESS.



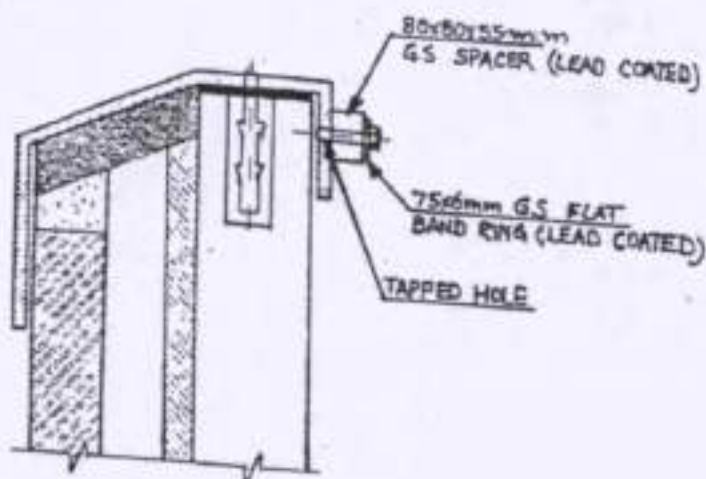
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PROJECT ENGINEERING MANAGEMENT
NEW DELHI

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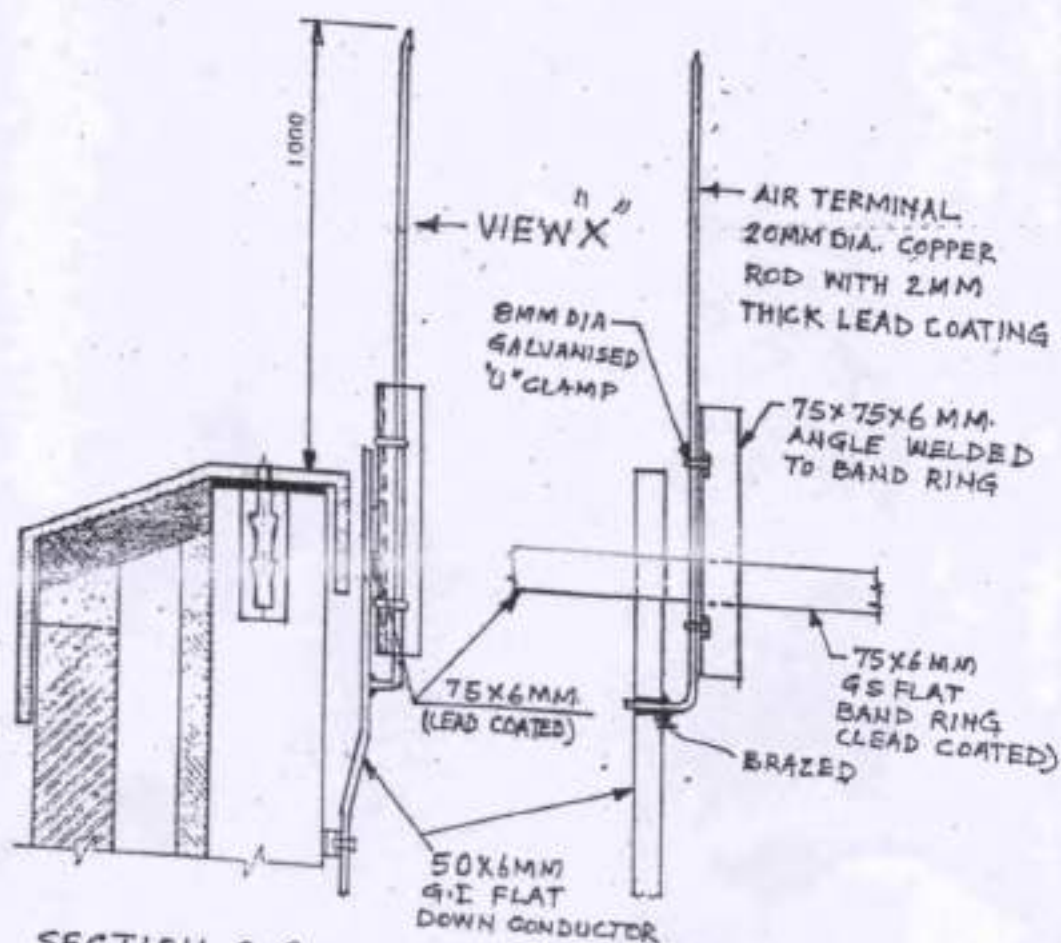
PE-DG-XXX-509-0003

SHEET 2 OF 4

REV. 00



SECTION 1-1



SECTION 2-2

VIEW-X



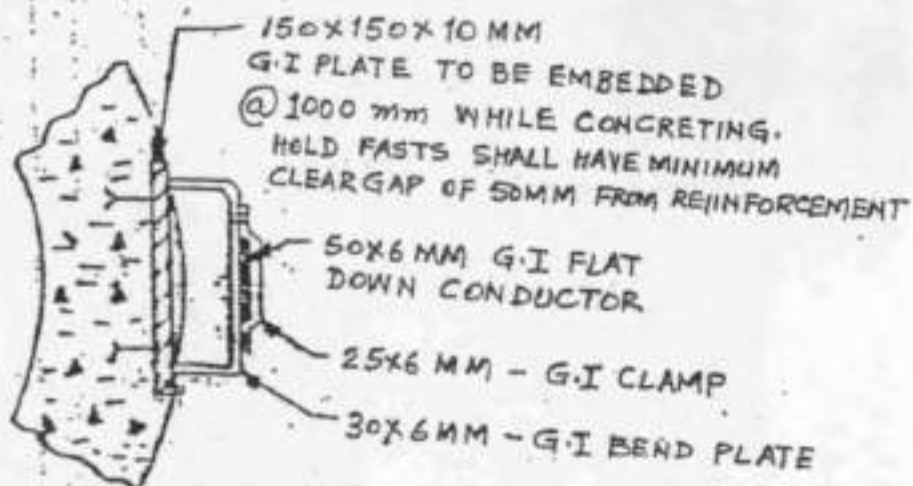
BHARAT HEAVY ELECTRICALS LIMITED
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NEW DELHI

DRG. No.

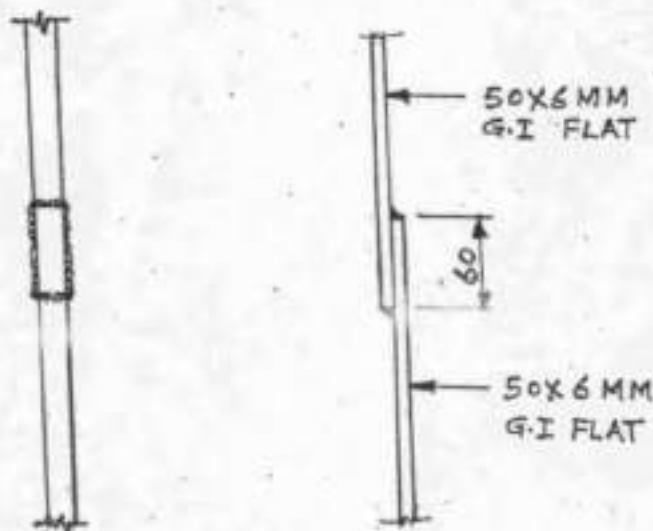
PE-DG-XXX-509-0003

SHEET 3 OF 4

REV. 00



DETAIL-"Y"



TYPICAL WELDED JOINT



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NEW DELHI

DRG. No.

PE-DG-~~XXX~~-509-0003

SHEET 4 OF 4

REV. 00

BELOW GROUND EARTHING
TYPICAL DETAILS

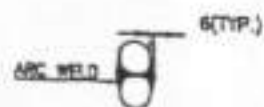
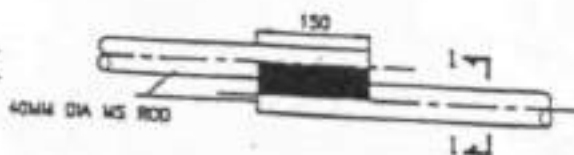
DRG. NO. PE-DG-~~XXX~~509-0004



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NEW DELHI

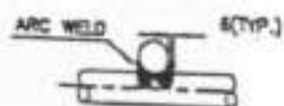
SHEET 1 OF 8

LAP JOINT



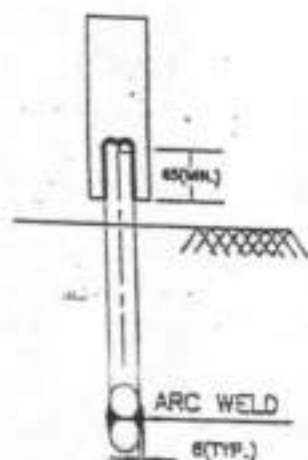
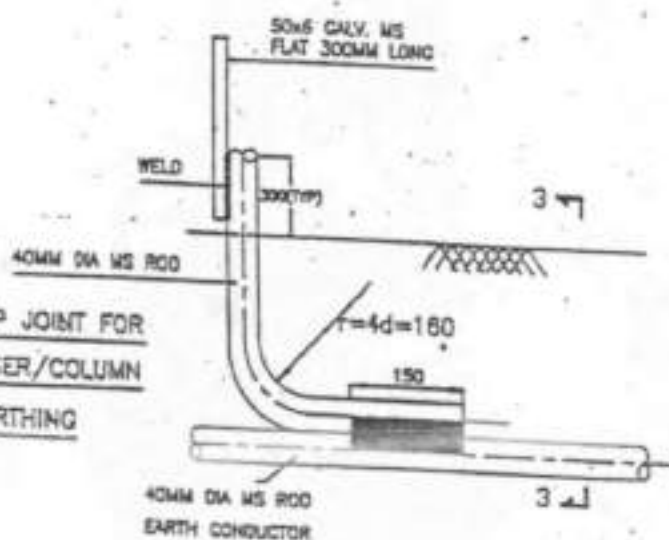
SECTION 1-1

CROSS JOINT



SECTION 2-2

LAP JOINT FOR
RISER/COLUMN
EARTHING



SECTION 3-3

WELDED JOINTS

NOTES :-

ALL DIMENSIONS ARE IN MM.

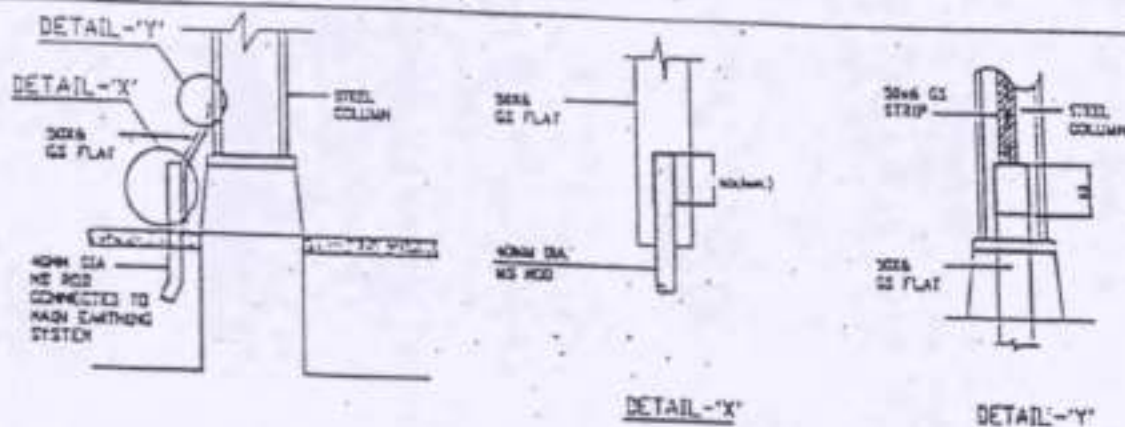
SHEL DRAWING No.

PE-DG-XXX-509-0004

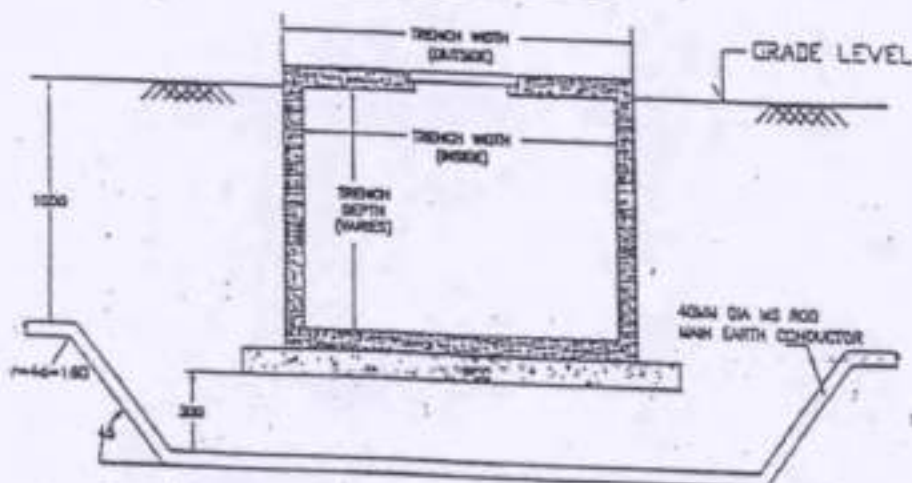
SHEET 2 OF 6



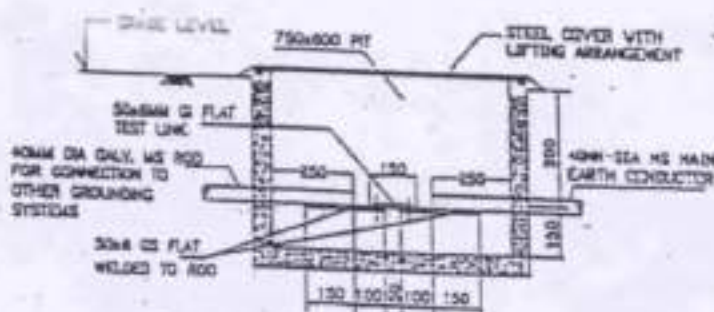
BELOW GROUND EARTHING
TYPICAL DETAILS



COLUMN EARTHING



TRENCH CROSSING



Convert cover

TEST-LINK

(PROVIDED FOR CONNECTION BETWEEN VARIOUS GROUNDING SYSTEMS)

NOTES :-

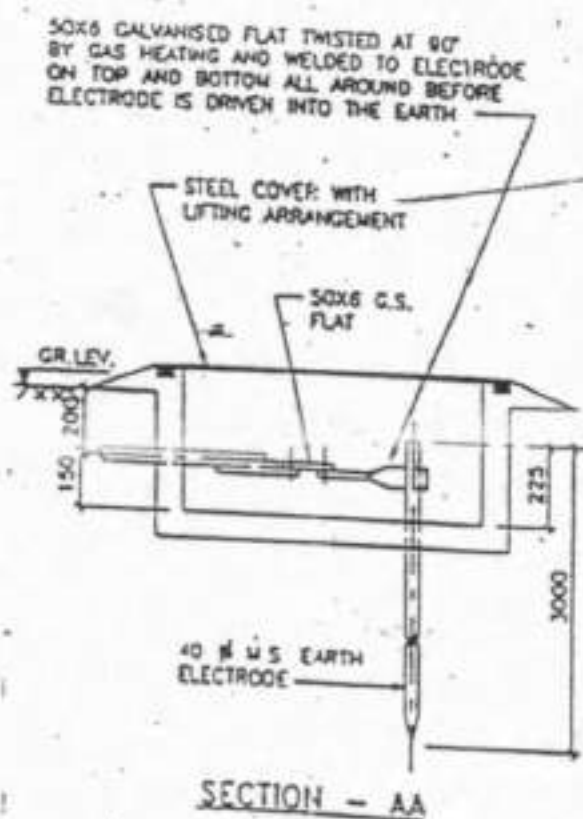
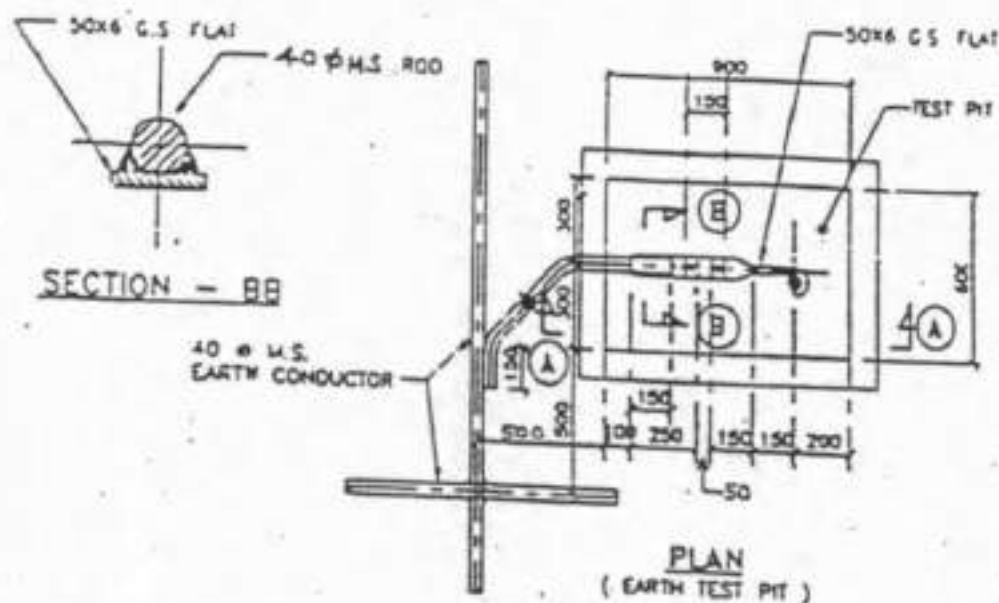
ALL DIMENSIONS ARE IN MM.

SHEL DRAWING No.

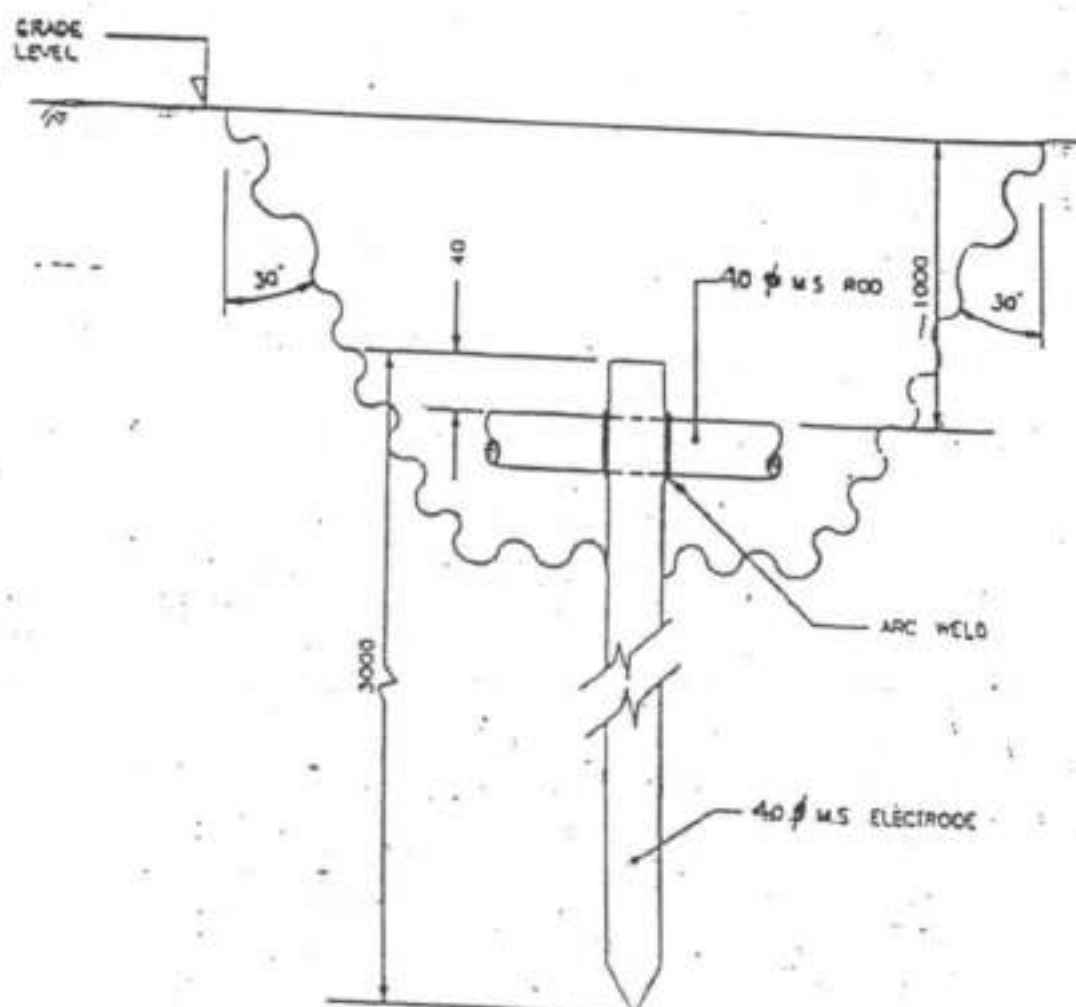


BELOW GROUND EARTHING
TYPICAL DETAILS

PE-DG-XXX-503-0004



NOTE: ALL DIMENSIONS ARE IN MM.



GROUND ELECTRODE

NOTE:-

1. ALL DIMENSIONS ARE IN MM.

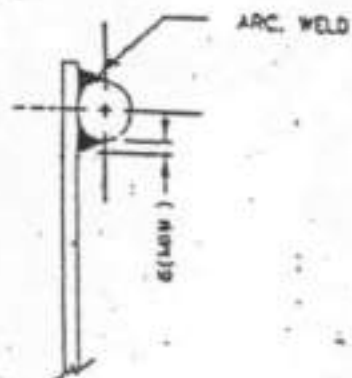
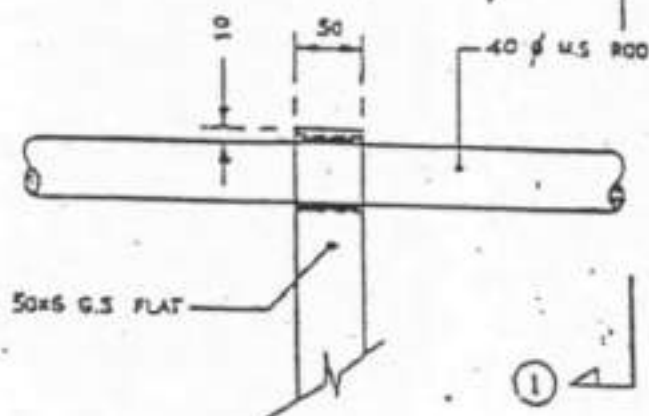


BELOW GROUND EARTHING
TYPICAL DETAILS

BHEL DRAWING No.

PE-DG-XXX509-0004

Sheet 5 of 8



SECTION - ①

CROSS JOINT
BETWEEN M.S. ROD & G.S. FLAT

NOTE:-

1. ALL DIMENSIONS ARE IN MM.

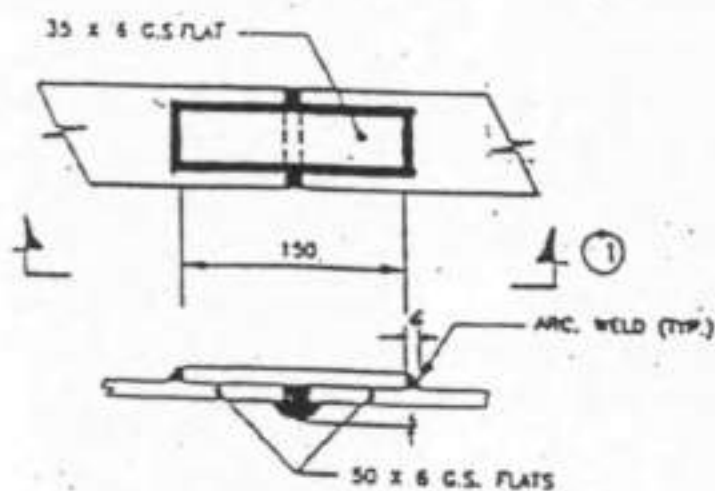


BELOW GROUND EARTHING
TYPICAL DETAILS

DRAWING No.

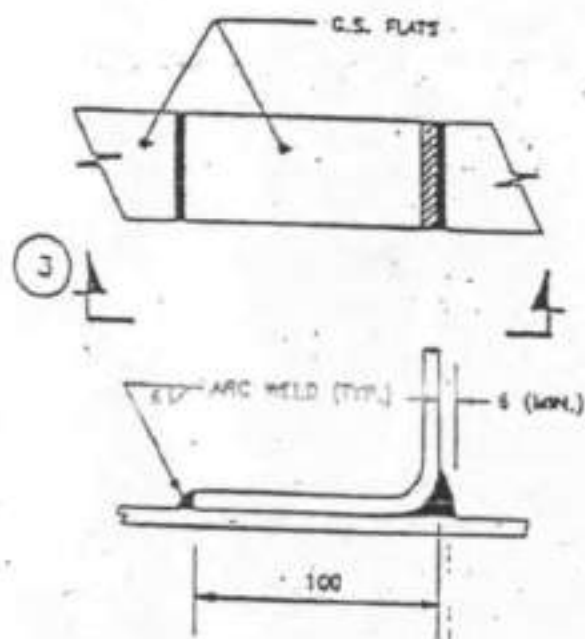
PE-DG-XXX/509-0004

SHEET 6 OF 8



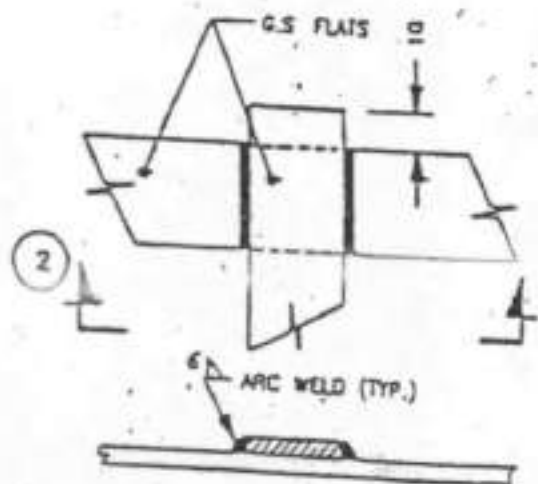
SECTION - ①

LAP JOINT
BETWEEN G. S. FLATS



SECTION - ③

ANGULAR JOINT
BETWEEN G. S. FLATS



SECTION - ②

CROSS JOINT
BETWEEN G. S. FLATS



BELOW GROUND EARTHING
TYPICAL DETAILS

SHEET DRAWING No.

PE-DG-XXX-509-0004

SHEET 7 OF 8

NOTES:-

1. WELDING OF GALVANISED FLAT/MS RODS SHALL BE CARRIED OUT AS FOLLOWS:
 - a) CLEANING OF WELD AREA WITH WIRE BRUSH.
 - b) REMOVAL OF GALVANISATION COATING IN THE WELD AREA.
 - c) WELDING OF CONDUCTORS AS PER DETAILS SHOWN IN THIS DRAWING BY ELECTRIC ARC WELDING PROCESS USING LOW HYDROGEN CONTENT WELDING ELECTRODES.
 - d) NATURAL COOLING OF WELDED JOINT.
2. EARTH CONDUCTOR SHALL BE ROUTED BELOW ROADS/ TRENCHES WITH MINIMUM CLEARANCE OF 300MM.
3. CIVIL DETAILS OF EARTH PITS/ TEST PITS ARE INDICATIVE. ACTUAL DETAILS SHALL BE SHOWN IN CIVIL DRAWINGS.
4. MINIMUM DEPTH OF BURIAL OF EARTH CONDUCTOR SHALL BE 1000 MM.

NOTES :-

ALL DIMENSIONS ARE IN MM.



BELOW GROUND EARTHING
TYPICAL DETAILS

SHEL DRAWING No.

PE-DG-XXX-509-0004

SHEET 8 OF 8



TITLE CHIMNEY LIGHTING

SPECIFICATION NO. PES-558-03

VOLUME II B

SECTION D

REV. NO. 1 DATE 7-2-95

SHEET 1 OF 7

GENERAL TECHNICAL REQUIREMENTS

OF

CHIMNEY LIGHTING

SPECIFICATION NO. PES-558-03 REV-01



TITLE CHIMNEY LIGHTING

SPECIFICATION NO. PES-558-03

VOLUME II B

SECTION D

REV. NO. | DATE 7.2.75

SHEET 2 OF 7

1.0 GENERAL

1.1 This specification covers the following :

- Engineering of lighting system including the associated power distribution system for chimney.
- Design, manufacture, supply, storage at site, testing of all necessary equipment such as lighting luminaries, lamps, wires, conduits, wiring accessories and any other equipment and material as would be found necessary for the satisfactory execution/ completion of the job.
- Erection, testing and commissioning of the lighting system for chimney.
- Temporary warning lights shall be provided during the course of work for heights above 45m free of cost.

2.0 CODES & STANDARDS

2.1 Unless otherwise specified, the following codes & standards are applicable. In all cases latest revision of codes shall be referred to.

Indian StandardsTitle

IS 418	Tungsten filament general service electric lamps.
IS 732	Code of practice for electric wiring installation (system voltage not exceeding 650 V)
IS 5133 (Part-I)	Boxes for enclosure of electrical accessories steel & cast iron boxes.
IS 9537	Hot dip galvanised conduit.
IS 1913	General Safety requirements for electric lighting fitting.
IS 1947	Specification for flood lights.
IS 9900	High pressure mercury vapour Lamp.
IS 3043	Code of practice for earthing.
IS 9974	High pressure sodium vapour Lamps.



TITLE CHIMNEY LIGHTING

SPECIFICATION NO. PES-558-03

VOLUME II B

SECTION D

REV. NO. 1 DATE 7.2.95

SHEET 3 OF 7

IS 3528 Water proof electric lighting fitting.

IS 694 PVC insulated cables for working voltages up to & including 1100 V.

Indian Electricity Rules -1956.
International Civil Aviation Code.

3.0 DESIGN REQUIREMENTS

3.1 Lighting luminaries

3.1.1 Twin obstruction luminaire for aviation lighting shall be used having aluminium alloy casting body with separate galleries to take two specially designed red prismatic glass domes to give a symmetrical light distribution with maximum intensity 10 degrees above horizontal. Two porcelain Bayonet cap lamp holders for 100 watt incandescent lamps shall be provided. Approved weather proof paint shall be provided.

3.1.2 Alternatively Neon lamp type Luminaire shall also be quoted.

3.1.3 The obstruction lights shall be fixed lights, red in colour, having an intensity sufficient to ensure conspicuity considering the intensity of adjacent lights and general level of illumination against which they would normally be viewed. In no case, the intensity shall be less than 10 candles of red lights.

3.1.4 Flood light shall be outdoor type consisting of light weight die cast aluminium alloy housing, heat resistant and toughened glass cover with synthetic rubber gasket, reflector and mounting bracket. The luminaries shall be suitable for 1x250 W High pressure Mercury Vapour lamp (HPMV) with suitable lamp holder, ballast, power factor improvement capacitor, mounting box for accessories and connector block & fuses duly pre-wired.

3.1.5 Alternatively flood lights with 150 W High Pressure sodium vapour lamp (HPSV) HPSV lamp shall be provided with external igniters and rapid restart facility.

3.2 Arrangement of lights

3.2.1 The number and arrangement of lights at each platform to be provided shall be such that the obstruction is indicated from every angle in azimuth. Number of obstruction luminaire at each platform shall not be less than four.



TITLE CHIMNEY LIGHTING

SPECIFICATION NO. PE-558-13

VOLUME II B

SECTION D

REV. NO. 1 DATE 7.2.95

SHEET 4 OF 7

- 3.2.2 The lights shall be placed between 1.5 metres and 3 metres below the top of chimney.
- 3.2.3 When the top of the chimney is more than 45metres above the level of the surrounding ground, intermate lights shall be provided for each additional 45metres or fraction thereof.
- 3.2.4 Four (4) Nos. flood lights shall be provided at the lowest platform of chimney for illuminating the surrounding of chimney.
- 3.3 Power Distribution Scheme
- 3.3.1 Lighting system load shall be supplied from A.C. Emergency lighting board. From the outgoing of A.C. ELDB, PVC armoured cable of suitable size shall emanate for feeding supply to lighting panel for chimney.
- 3.3.2 The contractor shall install lighting panel to be supplied by the purchaser.
- 3.3.4 A.C. ELDB shall be supplied & erected by the purchaser. Inter-connecting power cable between A.C. ELDB and lighting panel shall be supplied and installed by the purchaser. However, necessary provision shall be made by the chimney vendor in his civil works near the chimney for installation of above cable.
- 3.4 Method of wiring
- 3.4.1 From A.C. ELDB to lighting panel for chimney 650/1100 V grade, PVC insulated, PVC sheathed, armoured cable of aluminium conductor shall be installed. From lighting panel further distribution to lighting luminaries shall be done with 650 V/1100V grade, Single core, stranded copper conductor, PVC insulated, unsheathed wires of minimum 4mm sq in conduits fixed on the chimney wall.
- 3.4.2 Each circuit from lighting panel shall be taken in a separate conduit.
- 3.4.3 The minimum acceptable copper conductor size for connecting lighting fixtures shall be 4 sq.mm. or more depending upon the voltage drop consideration.
- 3.4.4 Minimum conductor size shall be such that the voltage drop to the farthest lighting point shall not exceed 2.5% of 240 V.
- 3.4.5 The aviation obstruction lights/flood lights shall be balanced on all the three phases to the extent possible.



TITLE CHIMNEY LIGHTING

SPECIFICATION NO. PES- 558-03

VOLUME II B

SECTION D

REV. NO. 1

DATE 7.2.95

SHEET 5 OF 7

3.5. Conduits

3.5.1 Conduits (Heavy gauge) & junction boxes, shall be hot dip galvanised type as per relevant IS. No conduit less than 20mm diameter shall be used. Junction boxes/pull boxes shall be made from 1.6mm thick galvanised sheet steel and shall incorporate terminal block for termination of incoming and outgoing cables. Junction boxes to be used outdoor shall be weather proof type with gasket conforming to degree of protection IP 55.

3.5.2 Conduit accessories/ fittings shall be as per relevant IS.

3.6 Earthing

A separate G.I. wire of 14 SWG shall be used for earthing the lighting fittings, lighting panels as per IE Rules & IS 3403. The contractor shall connect this earthing system to main earthing mat provided by the purchaser. Main earthing mat shall be located near the chimney.

3.7 For other general reqts. of Lighting design, refer to (w) enclosed "Lighting Notes & Details" (Dy No. PE-DG-XXX-558-0004).

4.0 TESTING & INSPECTION

4.1 Standard quality plan (QP) for lighting system is enclosed in VOL III. Bidder to confirm compliance to this quality plan by signing every page of it.

4.2 All equipment shall comply with the type and routine tests as prescribed in the relevant standards. Certificates of type tests shall be furnished with the tender. The vendor shall furnish certified test reports for all routine tests before the equipment is dispatched.

4.3 Test at Site: The vendor, in the presence of the customer shall subject the installation to the following tests.

- Insulation resistance test.
- Testing of earth continuity path connections.
- Complete operational tests on the whole of the installation.

4.4 Field quality plan (FQP) for quality checks to be observed at site during erection, testing & commissioning shall also be furnished by vendor alongwith offer as per standard BHEL format.



TITLE CHIMNEY LIGHTING

SPECIFICATION NO. PES-552-03

VOLUME IB

SECTION D

REV. NO. 1 DATE 7.2.95

SHEET 6 OF 7

5.0 SPARE PARTS

Recommended list of spares for commissioning and for operation and maintenance of the lighting system for a period specified in data sheet -A shall be furnished. The vendor shall furnish separate price and list of the same. Unit rates shall also be furnished in addition to total price.

6.0 GUARANTEED PERFORMANCE REQUIREMENTS

The vendor shall guarantee satisfactory performance of equipment supplied under all conditions & requirement as laid down by this specification.

7.0 DRAWINGS & DATA

7.1 Drawings & data to be furnished with the offer

- a) Filled in Data Sheet B.
- b) Technical leaflets of luminaires offered.

7.2 Drawings & data to be furnished after award of contract

- a) Design calculation for luminaries.
- b) Design calculation for selection of lighting wires.
- c) Lighting Layout plan showing lighting fixtures, conduit routing, conduit Size, cable size etc.
- d) Fixing and mounting details of luminaires, conduits, junction boxes etc.
- e) Test certificates for all equipment .
- f) General arrangement drawing of equipment supplied.
- g) Manufacturer catalogues/literature.
- h) Field quality plan
- i) As built drawings



TITLE CHIMNEY LIGHTING

SPECIFICATION NO. TES-558-03

VOLUME II B

SECTION D

REV. NO. 1 DATE 7.2.95

SHEET 7 OF 7

8.0 OPERATION AND MAINTENANCE MANUAL

Operation and maintenance manual shall contain the followings :

- a) Technical Data Sheet.
- b) Instruction for maintenance for various lighting equipment.



TITLE

DATA SHEET A CHIMNEY LIGHTING

SPECIFICATION NO. PE

VOLUME II BSECTION AREV. NO. 0

DATE

SHEET 1OF 1

1.0 Details of Supply System

- a) Rated voltage : $415\text{ V} \pm 10\%$
- b) Rated frequency : $50\text{ Hz} \pm 5\%$
- c) Combined voltage and frequency variation : 10% (Absolute)
- d) System fault level at rated voltage : $50\text{ kA for } 0.25\text{ sec.}$
- e) LV System grounding : Solidly
- f) Design ambient temp. : 50°C

2.0 Type of conduit mounting :

Surface Mounting

3.0 Type of obstruction light :

- i) GEC ZA 750 (L) NEON
- ii) High intensity flashing white light having intensity > 2000 candles & flashing freq. $40-60/\text{min.}$

4.0 Type of Flood light :

→ 250W HPSV lamps

5.0 Source for power :

Normal AC & Emergency AC

6.0 Junction boxes :

Weather-proof, Galvanised steel

7.0 Main earthing mat details :

MS Rod 40 mm dia

8.0 No. of years for which O&M spares required :

3 years

INSTRUCTIONS FOR BHEL
1. In the DE b. issue for an enquiry. The standard specification number shall be entered by the bidder. The specification number for the project shall be entered by the bidder. The standard specification number shall not be entered.

	TITLE	DATA SHEET - B	SPECIFICATION NO.
		CHIMNEY LIGHTING	VOLUME III
			SHEET 1 OF 2

1.0 CONDUIT

- a) Make :
- b) Size :
- c) Material :
- d) Applicable Standard :

2.0 Applicable Standard for Conduit accessories and fittings :

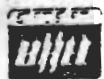
3.0 JUNCTION BOX
(for each type & size)

- a) Make :
- b) Type :
- c) Material :
- d) Degree of protection of enclosure :
- e) Applicable Standard :

4.0 LIGHTING WIRES

- a) Make :
- b) Type :
- c) Conductor material :
- d) Size :
- e) Voltage grade :
- f) Applicable Standard :

Name of Bidder / Vendor				Project	
Revision Number	0	1	2	3	
Signature of Bidder / Vendor / Authorised Representative					
Date					



TITLE

DATA SHEET - B

SPECIFICATION NO.

CHIMNEY LIGHTING

VOLUME III

SHEET 2 OF 2

5.0 LUMINARIES

- a) Make :
- b) Type :
- c) Type of lamp holder :
- d) Applicable Standard :

6.0 LAMPS

- a) Make :
- b) Type :
- c) Wattage :
- d) Nominal lamp voltage :
- e) Light output :
- f) Applicable Standard :

Name of Bidder / Vendor

Project

Revision Number

0

1

2

3

Signature of Bidder / Vendor /
Authorised Representative

Date

BIDDER'S SEAL

Specification No. The specification number for the standard specification number shall be entered by the bidder. The standard specification number shall be entered by the bidder.



TITLE

DATA SHEET - C

SPECIFICATION NO.

CHIMNEY LIGHTING

VOLUME II B PART D

SHEET 1 OF 3

1.0 CONDUIT
(for each type & size)

- a) Make :
- b) Type :
- c) Size :
- d) Applicable Standard :

2.0 JUNCTION BOX
(for each type & size)

- a) Make :
- b) Material :
- c) Size :
- d) Degree of protection of enclosure :
- e) Applicable Standard :

3.0 LIGHTING WIRES

- a) Make :
- b) Type :
- c) Voltage grade :
- d) Applicable Standard :
- e) Continuous current rating at design ambient :
- f) Conductor
 - i. Material :

Name of Bidder / Vendor

Project

Revision Number

0

1

2

3

Signature of Bidder / Vendor /
Authorised Representative

Date

BIDDER'S SEAL



TITLE

DATA SHEET - C

SPECIFICATION NO.

CHIMNEY LIGHTING

VOLUME II B PART D

SHEET 2 OF 3

ii. Nominal cross :
sectional areaiii. No. & Diameter:
of wires

g) Insulation

i. Composition of :
insulationii. Thickness of :
insulationiii. Tolerance on :
thickness of
insulationh) Colour scheme for :
identification of
wires4.0 LUMINARIES
(for each type)

a) Make :

b) Type :

c) Type of lamp holder :

d) Capacitor rating :

e) Weight of luminaires :

f) Applicable Standards :

5.0 LAMPS :

a) Make :

b) Type :

c) Wattage :

Name of Bidder / Vendor

Project

Revision Number

0

1

2

3

Signature of Bidder / Vendor /
Authorised Representative

Date

BIDDER'S SEAL



TITLE

DATA SHEET - C

SPECIFICATION NO.

CHIMNEY LIGHTING

VOLUME II B PART D

SHEET 3 OF 3

- d) Nominal lamp voltage :
- e) Light output (lumen) :
- f) Life of lamp :
- g) Applicable Standard :

Name of Bidder / Vendor

Project

Revision Number

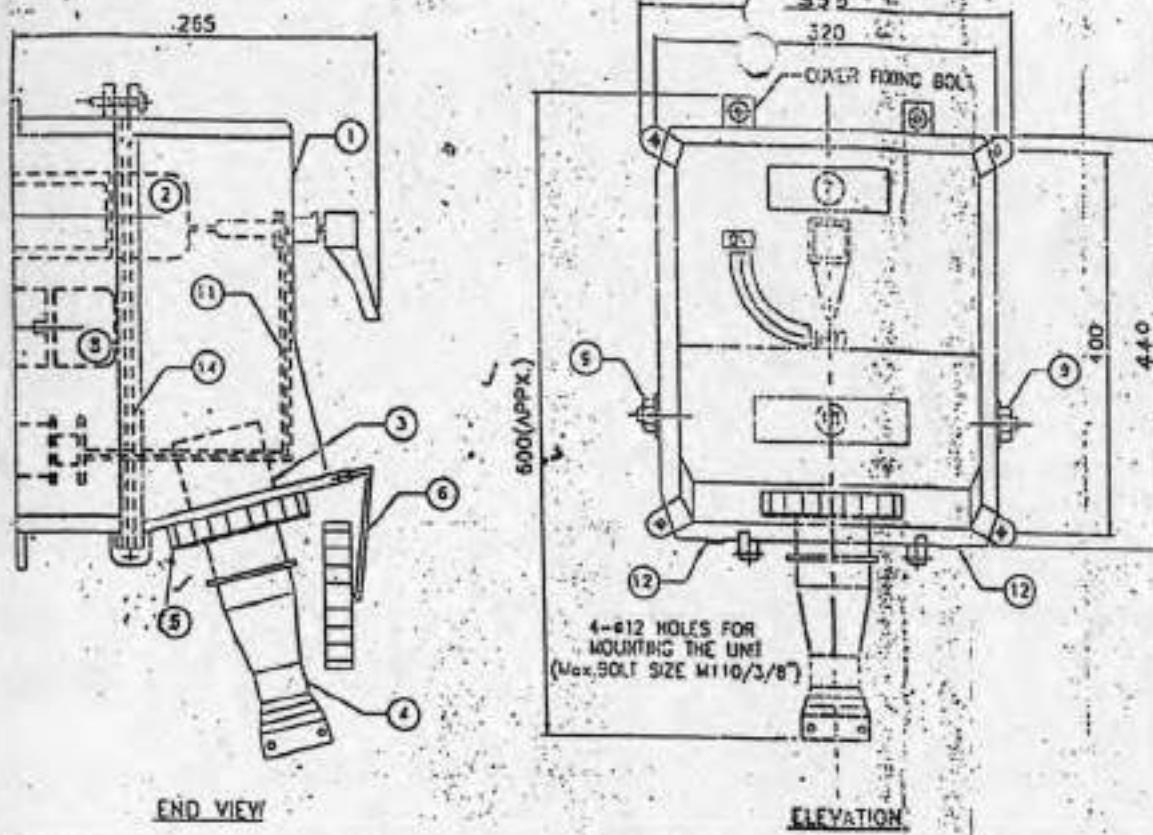
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1

2

3

Signature of Bidder / Vendor /
Authorised Representative

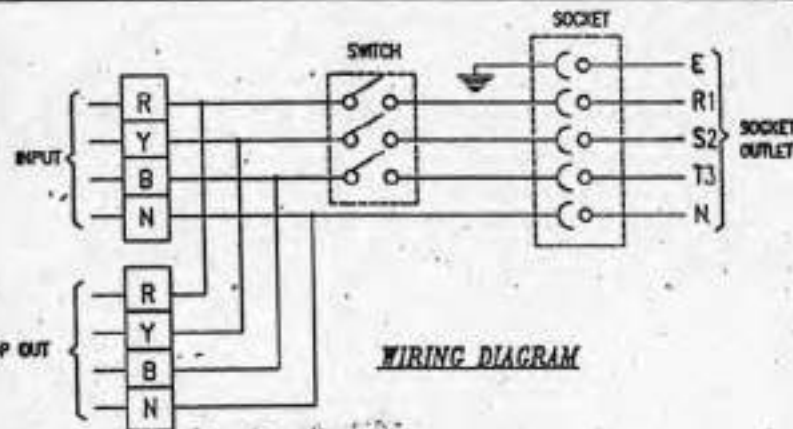


SPECIFICATION

- 1] ALUMINIUM ALLOY HOUSING (MIN THICKNESS 3mm)
- 2] GE POWER CONTROL TP ON/OFF SWITCH DOUBLE BREAK TYPE SP02, AC23 CATEGORY CONFORMING TO IS-13947-3
- 3] BEST & CROMPTON MAKE-63A, 415V, 5 PIN TRIPLE POLE, NEUTRAL & EARTH SOCKET
- 4] BEST & CROMPTON MAKE-63A, 415V, 5 PIN TRIPLE POLE, NEUTRAL & EARTH PLUG
- 5] PLUG RING
- 6] SPRING LOADED COVER FOR SOCKET OUTLET
- 7] NAME PLATE
- 8] 4 WAY STUD TYPE TERMINAL BLOCK 2 Nos. FOR LOOP IN LOOP OUT, ARRANGEMENT TO TERMINATE 3.5C²⁵ sq.mm STUD TYPE BEST & CROMPTON MAKE
- 9] ELECTROPLATED EARTHING TERMINAL 2 Nos. COMPLETE WITH 6mm BOLT, NUT & WASHER SUITABLE FOR 14 SWG. GL. EARTHING CONDUCTOR
- 10] CAUTION STICKER
- 11] MECHANICAL INTERLOCKING ARRANGEMENT
- 12] DETACHABLE GLAND PLATE 0 TAKE 2 Nos. GLAND SUITABLE FOR 3.5x70 sq.mm. CABLES.

NOTES

- 1] ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED SUBJECT TO TOLERANCE $\pm 5\text{mm}$
- 2] EACH UNIT PROVIDED WITH INTERNAL WIRING SIZE 3.5²⁵ sq.mm. CABLE
- 3] THE ENCLOSURE IS PAINTED WITH SHADE GREY RAL 9002 - POWER COATING
- 4] THE UNIT ARE SUITABLE FOR OUTDOOR USE, IP-55 AS PER IS-13947
- 5] SWITCH CAN NOT BE MADE 'ON' UNLESS PLUG IS INSERTED
PLUG CAN NOT BE WITHDRAWN UNLESS SWITCH IS IN OFF POSITION
- 6] UNIT IS MANUFACTURE BY "BEST & CROMPTON"
- 7] SUITABLE CABLE GRIP SHALL BE PROVIDED



WIRING DIAGRAM

SHOWING TERMINAL POSITION

COLOR CODED SLEEVE WILL BE PROVIDED ON BOTH ENDS ON COPPER FLEIBLE
 R PHASE - RED COLOUR
 Y PHASE - YELLOW COLOUR
 B PHASE - BLUE COLOUR
 NEUTRAL - BLACK COLOUR

CHIMNEY LIGHTING SPECIFICATION

REV	DATE	DESCRIPTION
01		
02		

NATIONAL THERMAL POWER CORPORATION LTD.
 RIHAND 2X500MW THERMAL POWER PROJECT STAGE-II



BHARAT HEAVY ELECTRICALS LIMITED
 POWER SECTOR, PROJECT ENGINEERING MANAGEMENT
 NEW DELHI



bajaj electricals limited

MUMBAI

Engineering & Projects Division

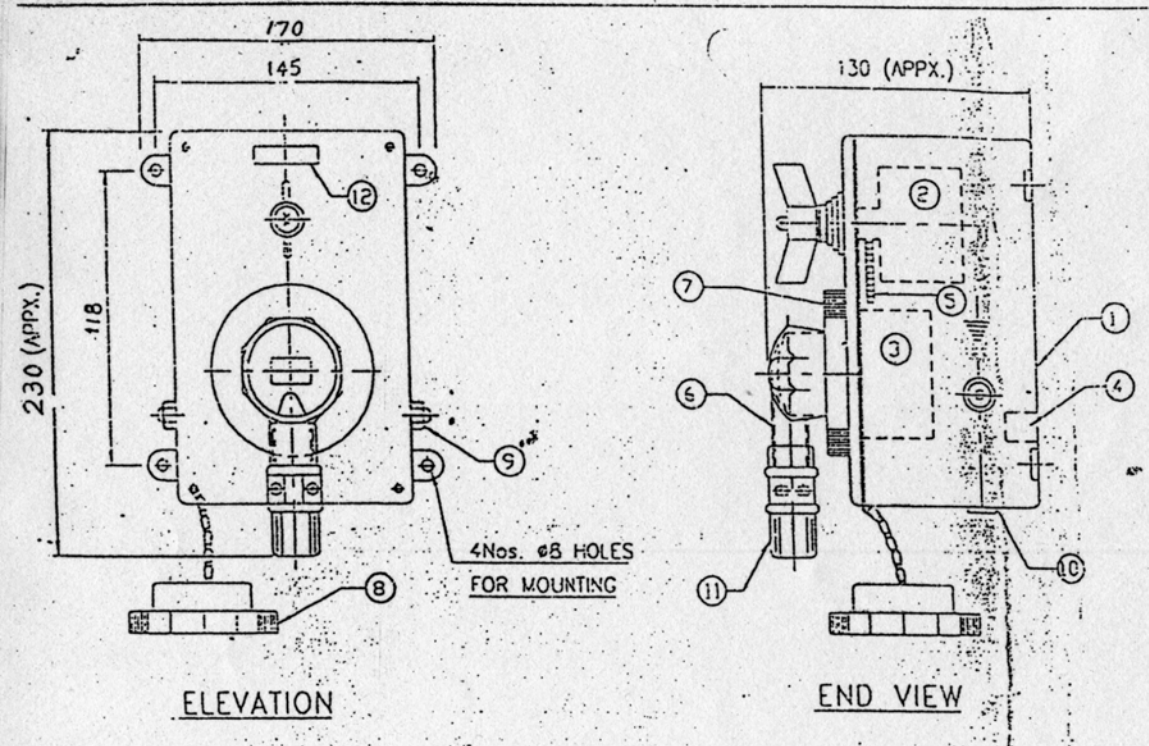
DRN	CHKD	APPD	DATE	BHEL DWG. No
KBM	JS	AP	30.06.03	PE-V0-200-558-E073

TITLE GENERAL ARRANGEMENT DWG FOR 63 A
 FULLY INTERLOCKED SWITCHED PLUG
 63 AMPS 415 VOLTS [TYPE RC]

DWG. NO. **EPBU-03-PS005-04-073**

REV
0

SHT. 1 OF 1

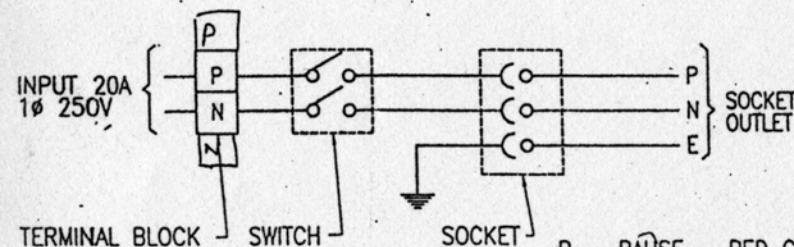


SPECIFICATION

- 1] ALUMINIUM ALLOY ENCLOSURE 3mm THICK
- 2] 25A, 250V, DOUBLE POLE/ OFF ROTARY SWITCH AC 23 CATEGORY IS-4064 - RECOM MAKE
- 3] ALUMINIUM ALLOY METAL CLAD SOCKET UNIT "BEST & CROMPTON" MAKE
- 4] BAKELITE STUD TYPE 4 WAY TERMINAL BLOCK TO TERMINATE 2Cx4 sq.mm CABLE
- 5] MECHANICAL INTERLOCKING SYSTEM
- 6] DIE CAST ALUMINIUM ALLOY METAL CLAD PLUG AND SOCKET OF 20A, 240V, 3 PIN (P+N+E), 3rd PIN GROUNDED
- 7] THREADED PLUG LOCKING RING
- 8] SOCKET COVER WITH CHAIN FOR SOCKET OUTLET
- 9] EARTHING TERMINAL 2 Nos. - M6 SIZE
- 10] CABLE ENTRY 25mm DIA - 2Nos.
- 11] PVC CABLE GRIP
- 12] NAME PLATE

NOTES

- 1] ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED SUBJECT TO TOLERANCE OF $\pm 5\text{mm}$
- 2] EACH UNIT PROVIDED WITH INTERNAL WIRING SIZE 4 sq.mm. COPPER CABLE
- 3] THE ENCLOSURE IS PAINTED WITH SHADE GREY RAL 9002 - POWER COATING
- 4] THE UNIT ARE SUITABLE FOR OUTDOOR USE, IP-55 AS PER IS-13947
- 5] SWITCH CAN ~~NOT~~ BE MADE 'ON' ONLY WHEN PLUG IS FULLY ENGAGED WITH SOCKET. PLUG CAN NOT BE WITH DRAWN WHEN SWITCH IS ON
- 6] 2 Nos. CABLE ENTRY AT BOTTOM



WIRING DIAGRAM
(FOR SINGLE PHASE UNIT)

P - PHASE - RED COLOUR
N - NEUTRAL - BLACK COLOUR
E - GREEN COLOUR.

VIEW ON SOCKET
PLUG REMOVED

1230-061-29PE-PVG-B-070

CHIMNEY LIGHTING SPECIFICATION.

REV	DATE	DESCRIPTION
01		
02		

TITLE GENERAL ARRANGEMENT DWG FOR FULLY INTERLOCKED SWITCHED PLUG 20 AMPS, 250 VOLTS [TYPE RA]

DWG. NO. EPBU-03-PS005-04-070

REV 0

SHT. 1 OF 1

NATIONAL THERMAL POWER CORPORATION LTD.
RIHAND 2X500MW THERMAL POWER PROJECT STAGE-II

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT

bajaj	bajaj electricals limited	MUMBAI
Engineering & Projects Division		
DRN	CHKD	APPD
DATE	BHEL DWG. No	
12.05.03	PE-V0-200-558-E070	



TITLE:

LIGHTING NOTES AND DETAILS

SPECIFICATION NO. PES-558-0004

VOLUME - II

SECTION - C Sub Sec -II

REV.NO. 0 DATE

SHEET 1 OF

LIGHTING NOTES AND DETAILS
SPECIFICATION NO. PES-558-0004



TITLE:

LIGHTING NOTES AND DETAILS

SPECIFICATION NO. PES-558-0004

VOLUME - II

SECTION - C Sub Sec -II

REV.NO. 0 DATE

SHEET 1 OF

LIGHTING NOTES

- 1.0 These lighting notes and details shall be read and construed in conjunction with the lighting specifications and drawings
- 2.0 Contractor shall develop final conduit/cable routings based on fixture location and other site conditions.
- 3.0 Unless otherwise shown, the mounting heights of lighting fixtures and accessories shall generally be as follows.
 - 3.a. Lighting fixture in general areas of powerhouse, miscl. Pump house etc.
 - 3.a.i. Low bay type : 3000 mm to bottom.
 - 3.a.ii. Medium bay type : bet 3500 mm to 8000 mm to bottom.
 - 3.a.iii. High bay type : above 8000mm to bottom.
 - 3.b. Bracket lights over door opening : 300 mm bot of fixture above opening.
 - 3.c. Receptacles
 - 3.c.i. In control room office : 450 mm floor to center.
 - 3.c.ii. Elsewhere : 900 mm floor to center.
 - 3.d. Local switches : 1500 mm floor to center
 - 3.e. Lighting panels : 1800 mm floor to top
- 4.0 All outdoor illumination fixtures unless it fed from photocell/tank-switch controlled lighting panel shall be provided with outdoor type local switches.
- 5.0 Separate neutral wire shall be provided for each circuit. Wiring throughout the installation shall be such that there is no break in the neutral wire in the form of switch or fuse.

SEPARATE NEUTRAL WIRE SHALL BE PROVIDED FOR EACH CIRCUIT. WIRING THROUGHOUT THE INSTALLATION SHALL BE SUCH THAT THERE IS NO BREAK IN THE NEUTRAL WIRE IN THE FORM OF SWITCH OR FUSE.

ALL EXPOSED CONDUIT RUNS IN BATTERY ROOM, CENTRAL FEED STATION AREA, WATER TREATMENT BUILDING ETC. SHALL BE SUITABLY PAINTED WITH ACID/ALKALI PROOF PAINTS.

THE ENTIRE METALLIC CONDUIT SYSTEM SHALL BE ELECTRICALLY CONTINUOUS AND THOROUGHLY GROUNDED.

LIGHTING FITTINGS SHALL NOT BE SUSPENDED DIRECTLY FROM JUNCTION BOX IN THE MAIN CONDUIT RUN.

AC AND DC CIRCUITS SHALL NOT BE RUN IN THE SAME CONDUIT.

RECEPTACLE SUB-CIRCUITS SHALL BE KEPT SEPARATE AND DISTINCT FROM LIGHTING AND FAN SUB-CIRCUITS.

WIRES/CABLES SHALL BE WELDED ONLY AT JUNCTION BOXES WITH RING-TONGUE LUGS OR APPROVED EQUAL.

FOR CABLE/WIRE NUMBERING, PVC SLEAVE WITH CABLE/WIRE TAP NUMBER OF DIFFERENT COLOUR CODE SHALL BE USED.

IN OUTDOOR AREAS, MAIN RUNS FROM LIGHTING PANELS SHALL BE BY MEANS OF ATTY CABLES, LAID IN TRENCHES OR DIRECTLY BURIED IN GROUND WITH PROPER PROTECTION AS PER DETAILS SHOWN.

WHEN BURIED CABLES CROSS ROAD/RAILWAY TRACK, ADDITIONAL PROTECTION TO BE PROVIDED IN FORM OF RING/C.I. PIPE.

FLAME PROOF INSTALLATIONS SHALL BE CARRIED OUT WITH FLAME-PROOF C.I. CONDUITS AND FLAME-PROOF ACCESSORIES AND OTHERS AS SHOWN.

UNLESS OTHERWISE NOTED, THE SIZE OF CABLES, WIRES, CONDUITS, JUNCTION BOXES SHALL BE AS BELOW :-



LIGHTING NOTES & DETAILS

DRG. No.
PE-DG-~~XXX~~-558-0004

REV. No.

0

SHEET 2

OF 15

37

A) CABLES

FROM STATION AUXILIARY SYSTEM TO MAIN
LIGHTING DISTRIBUTION BOARDS

AL PVC FRLS *

1) FROM MAIN LIGHTING DISTRIBUTION
BOARDS TO 415 V NORMAL A.C. LIGH-
TING PANELS

AL PVC FRLS *

11) FROM EMERGENCY MAIN LIGHTING DIST.
BOARDS (EMLDB) TO 415 V EMERGENCY
A.C. LIGHTING PANELS

AL PVC FRLS *

111) FROM MAIN LIGHTING DIST. BOARDS
(MLDB) TO 415 V AC/220 V DC
EMERGENCY LIGHTING DISTRIBUTION
BOARDS (DEMLDB)

AL PVC FRLS *

1v) FROM 220 V MAIN DC DISTRIBUTION
BOARDS TO 415 V AC/220 V DC
EMERGENCY LIGHTING DISTRIBUTION
BOARD (DC EMLDB)

AL PVC FRLS *

v) FROM MCC/PWCC/DB TO RC, RD
RECEPTABLES

AL HRPVC FRLS *

vi) FROM 415 V NORMAL AC STREET AREA
LIGHTING PANEL TO STREET LIGHTING
POLE JUNCTION BOX

ALVY *

* SIZE OF CABLES TO BE DECIDED BY THE ENGINEER.

LIGHTING NOTES & DETAILS

DRG. No.
PE-DG-XXX-558-0004

REV. No.

0

SHEET 3

OF 15

B) W I R E S

- 1) FROM LIGHTING PANELS TO JUNCTION BOXES : 1C, 24 mm^2 Cu
- 11) FROM JUNCTION BOXES TO LIGHTING FIXTURES : 1C, 2.5 mm^2 Cu.
- 111) FROM JUNCTION BOXES TO FLOOD LIGHT FIXTURES : $2 \times 2.5 \text{ mm}^2$, 1C, Cu
- 1v) FROM LIGHTING PANELS TO 240 V AC 5/15A, 1 PHASE RECEPTACLES & 24 V AC SUPPLY MODULES TYPE M4 : 1C, 24 mm^2 Cu
- v) FROM 24 V AC SUPPLY MODULES TO 24 V AC, 5A RECEPTACLES : 1C, 24 mm^2 Cu

C) C O N D U I T S

CABLE SIZE

CONDUIT SIZE

	20 MM	25 MM	32 MM	40 MM	50 MM	MAXIMUM NO. OF CONDUCTORS ADMISSIBLE FOR CONDUIT
1) 10 mm^2 AL	2	5	7	8		
11) 2.5 mm^2 CU	5	5	9	-	-	

D) JUNCTION BOXES

CONDUIT SIZE (MM)

JUNCTION BOX SIZE (MM)

	4-WAY	3-WAY	STRAIGHT THROUGH	90°
1) 20 / 25	150x150x100	150x100x100	88 ϕ	88 ϕ
11) 32 / 40	254x200x127	254x200x127	150x150x100	-
111) 50	254x200x127	254x200x127	254x200x127	-



LIGHTING NOTES & DETAILS

DRG. No.
PE-DG-XXX-558-0004

REV. No.

0

SHEET 4 OF 15

17. ALL LIGHTING PANELS/DISTRIBUTION BOARDS, JUNCTION BOXES, RECEPTACLES, FIXTURES, CONDUITS, ETC. SHALL BE GROUNDED IN COMPLIANCE WITH THE PROVISION OF I.E. RULE AND AS DETAILED BELOW :-

1) LIGHTING PANELS	: 35 x 6 MM G.S. PLATE
II) DISTRIBUTION BOARDS	: 50 x 6 MM G.S. PLATE
III) FIXTURES, RECEPTACLES, SWITCHES, CONDUITS, JUNCTION BOXES ETC.	: 16 SWG G.I. WIRE
IV) STREET LIGHT POLES & TOWERS FOR FLOOD LIGHTING	: 50 x 6 MM C.S. PLATE

18. A CONTINUOUS GROUND CONDUCTOR OF 12 SWG G.I. WIRE SHALL RUN ALONG EACH CONDUIT RUN AND BONDED TO IT EVERY 600 MM.

19. THE ELECTRICAL INSTALLATION WORK SHALL MEET THE REQUIREMENTS OF INDIAN ELECTRICITY RULES, RELEVANT IS CODES OF PRACTICE & SAFETY CODES, ALL AS AMENDED UPTO DATE. IN ADDITION, OTHER RULES OR REGULATIONS, AS APPLICABLE TO THE WORK SHALL BE FOLLOWED. IN CASE OF ANY DISCREPANCY, THE MORE RESTRICTIVE RULE SHALL BE BINDING.

20. TYPICAL DETAILS OF LIGHTING FIXTURES, OTHER LIGHTING SYSTEM COMPONENTS AND THEIR MOUNTING ARRANGEMENT AS SHOWN IN DRAWING NO.

SHEET 6 TO 7 ARE FOR GENERAL GUIDANCE ONLY. THE CONTRACTOR HAS TO DESIGN THE SAME FULFILLING THE REQUIREMENT OF THE SPECIFICATION.

LIGHTING NOTES & DETAILS

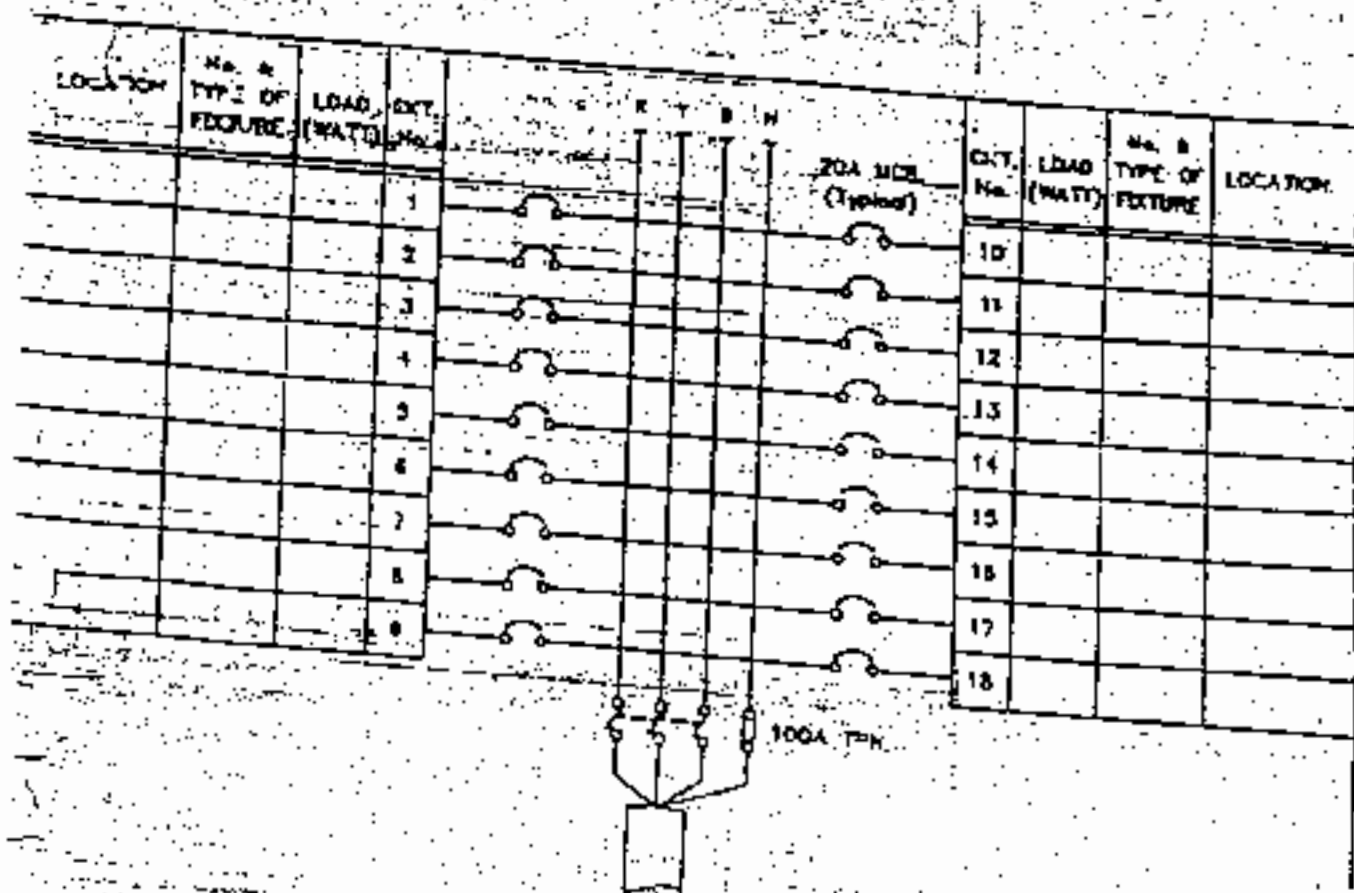
DRG. No.
PE-DG-XXX-558-0004

REV. No.

0

SHEET 5 OF 15



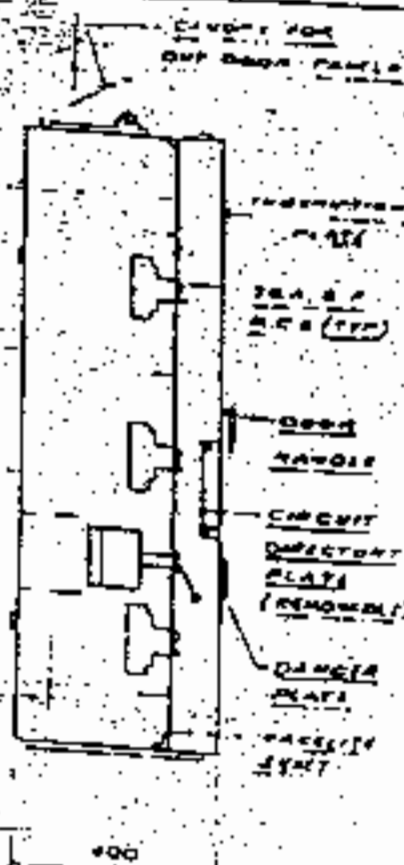
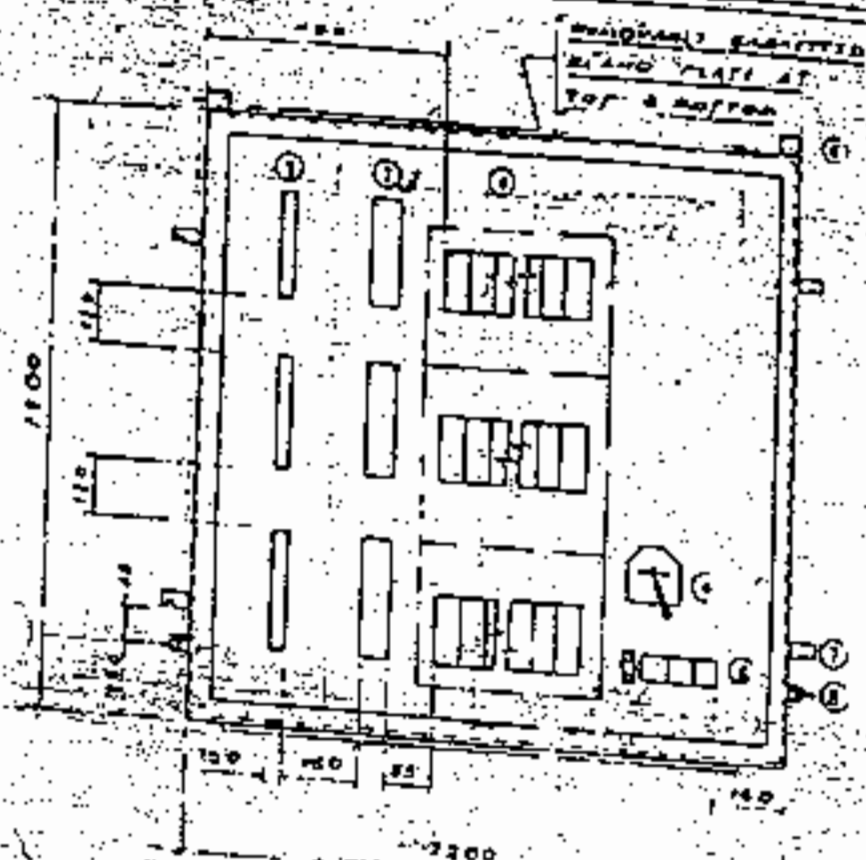


LIGHTING NOTES & DETAILS
 SLD OF 415V LTG. PANEL

DRG. No.
 PE-DG-~~558~~-558-0004

REV. No. 0

SHEET 7 OF 15



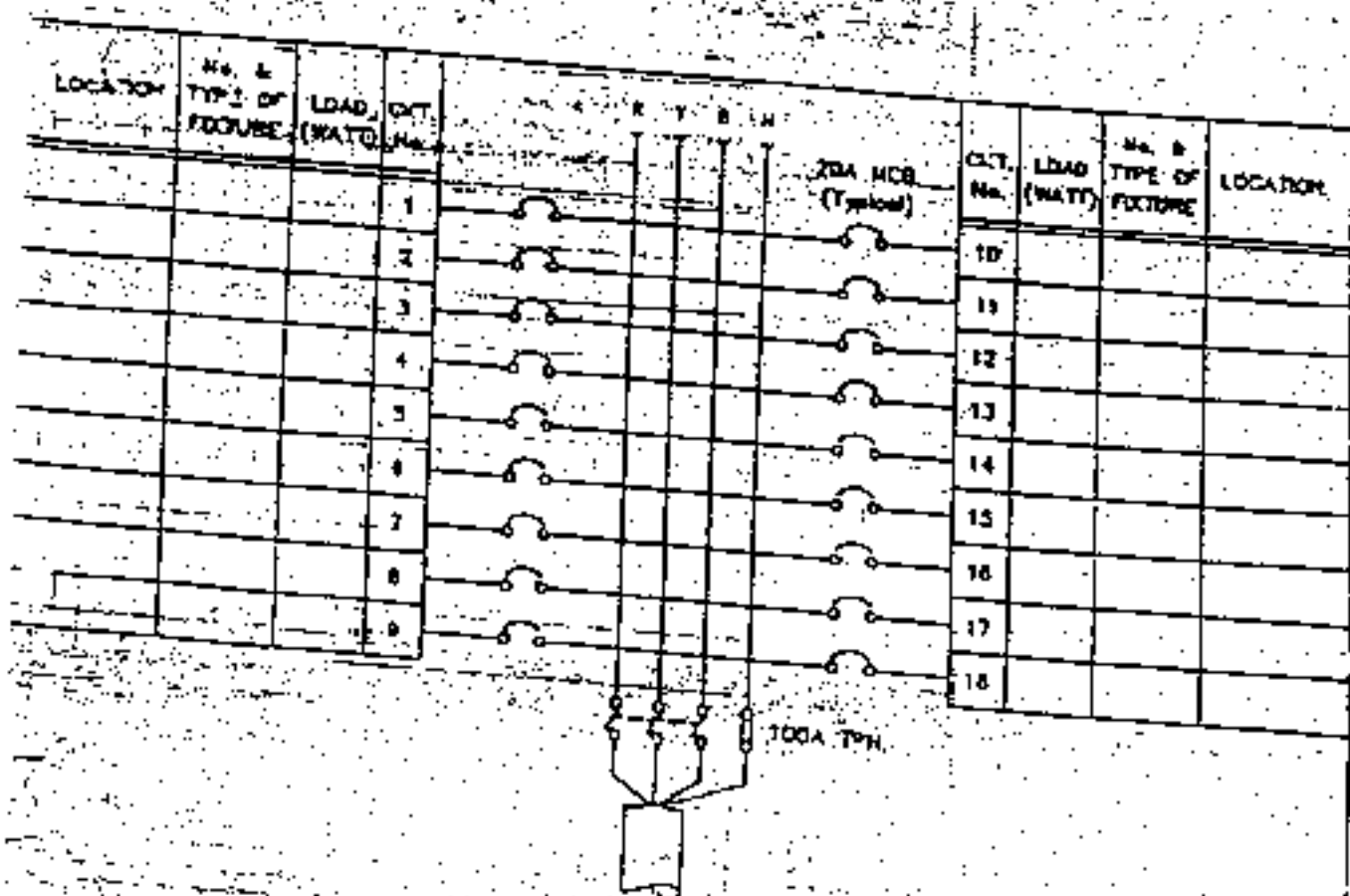
LEGEND

- MINIMUM SET AND
- ① BRASS TERMINAL STUD
- ② NEUTRAL BUS WITH
- ③ NUT, BOLT & WASHER
- ④ ISOLATOR
- ⑤ TERMINAL BLOCK
- ⑥ LIFTING LOG
- ⑦ FIRING LOG
- ⑧ EARTHING STUD WITH NUTS



LIGHTING NOTES & DETAILS
G.A. OF LIGHTING PANEL

DRG. No. PE-DG-~~XXX~~-558-0004
REV. No. 0
SHEET 6 OF 15

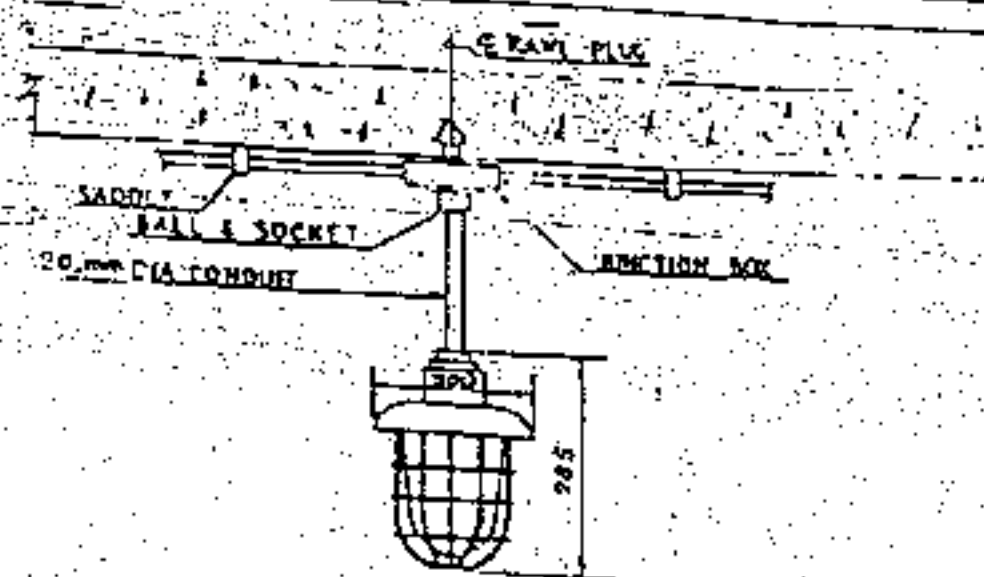


LIGHTING NOTES & DETAILS
SLD OF 45V LTG. PANEL

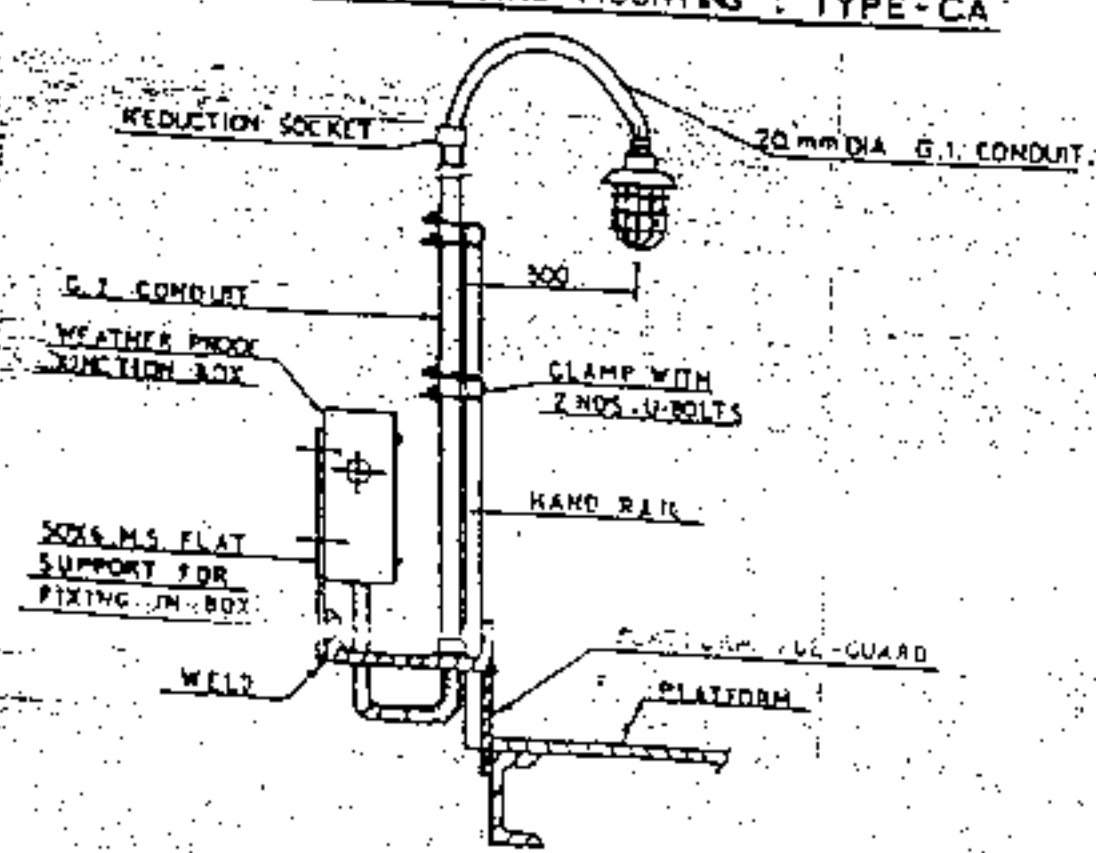
DRG. No.
PE-DG-~~558~~-558-0004

REV. No.
0

SHEET 7 OF 15



PENDANT/CEILING MOUNTING : TYPE-CA



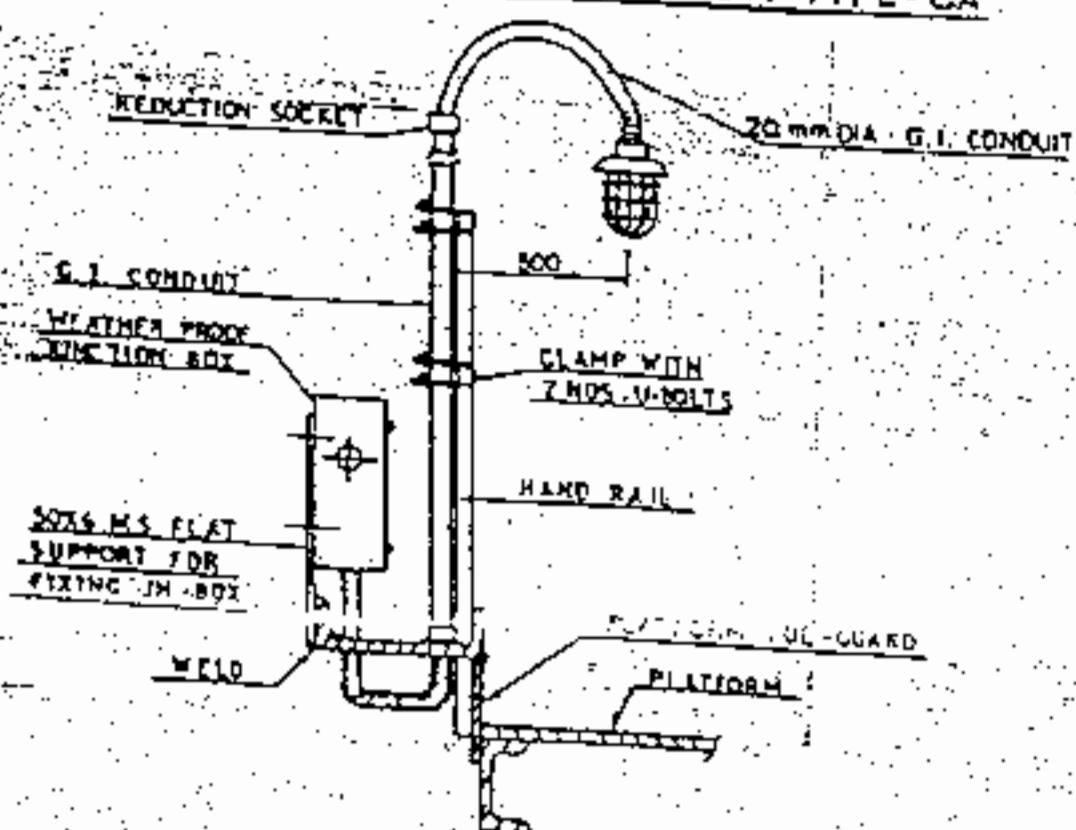
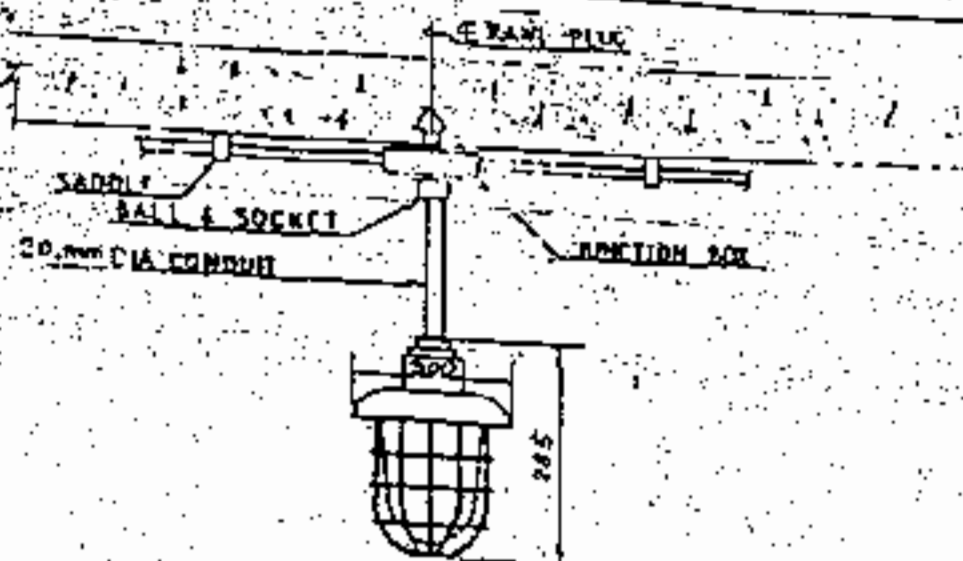
PLATFORM MOUNTING : TYPE-CB

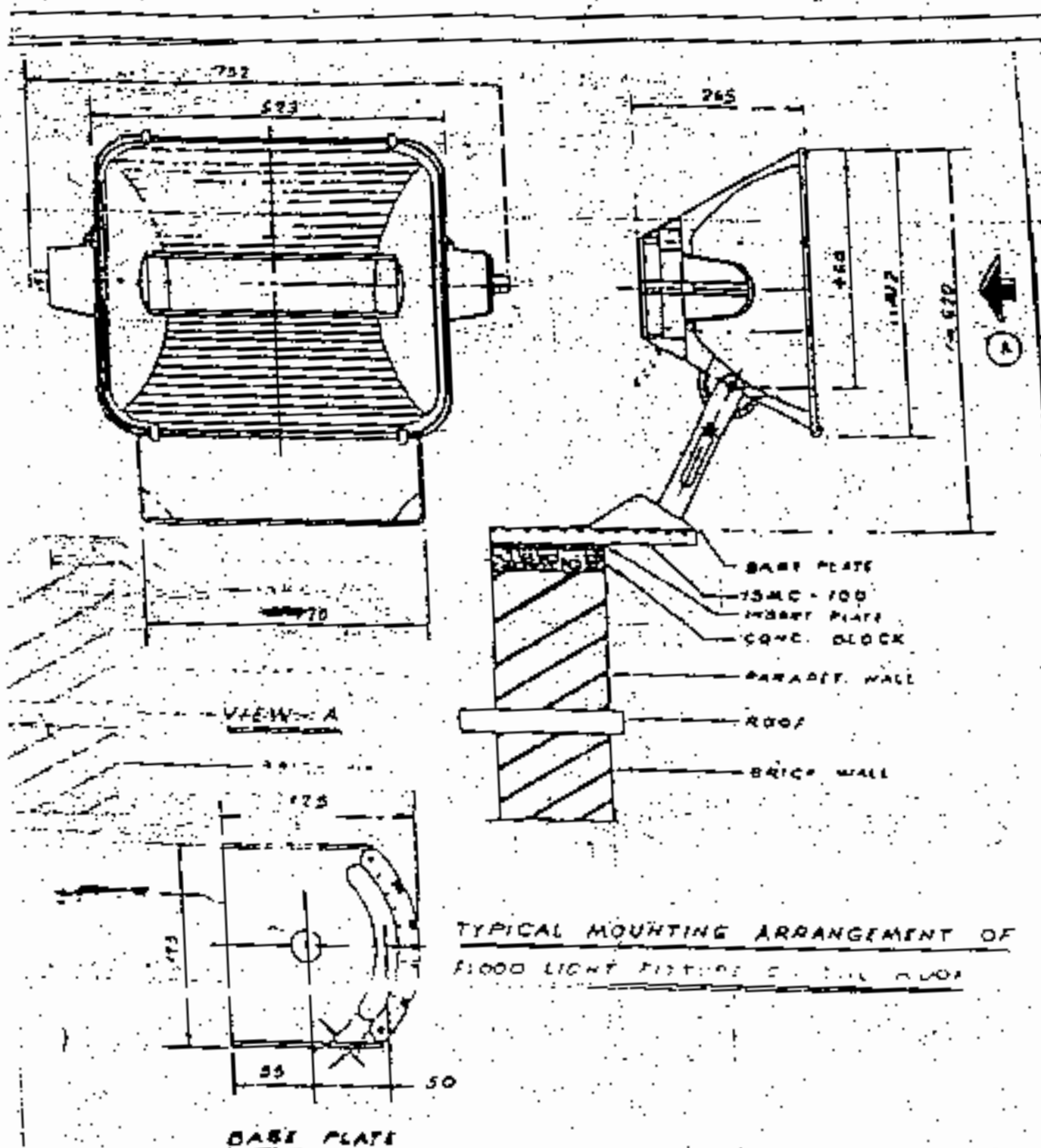


LIGHTING NOTES & DETAILS
FIXTURE MOUNTING ON DECK/
STAIRS

DRG. No.	PE-DC- ~~558~~ 558-0004
REV. No.	0
SHEET	OF 15

66





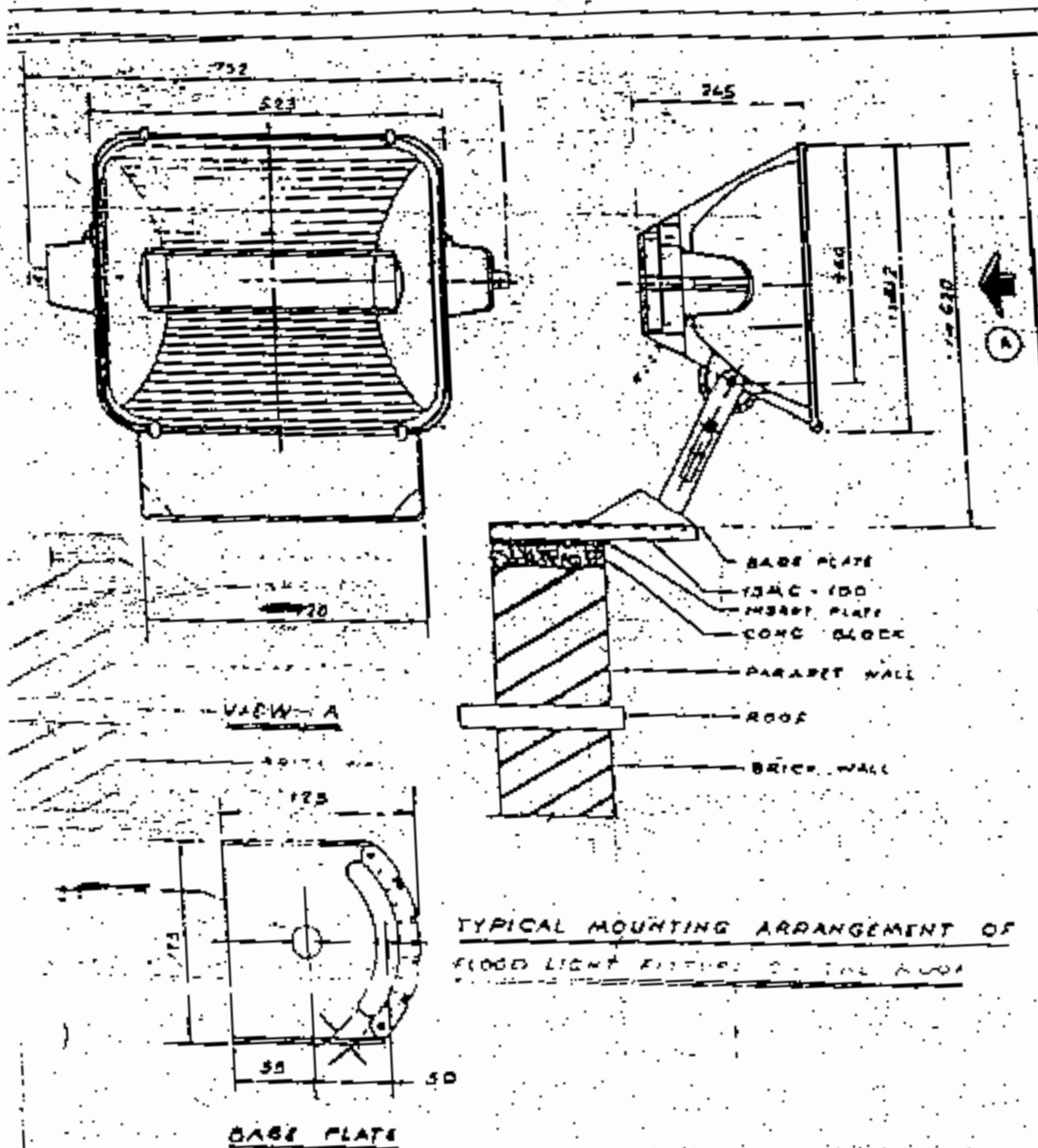
LIGHTING NOTES & DETAILS

MOUNTING OF FLOOD LIGHT
FIXTURE

DRG. No.
PE-DG-XXX-558-0004

REV. No. 0

SHEET 9 OF 15



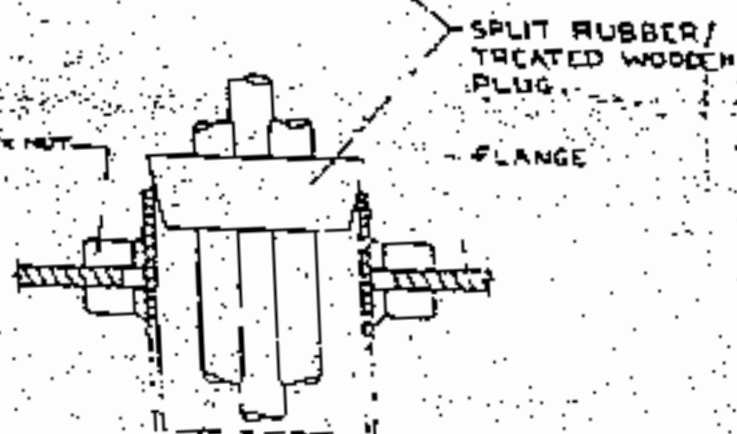
LIGHTING NOTES & DETAILS

MOUNTING OF FLOOD LIGHT
FIXTURE

DRG. No.
PE-DG-XXX-558-0004

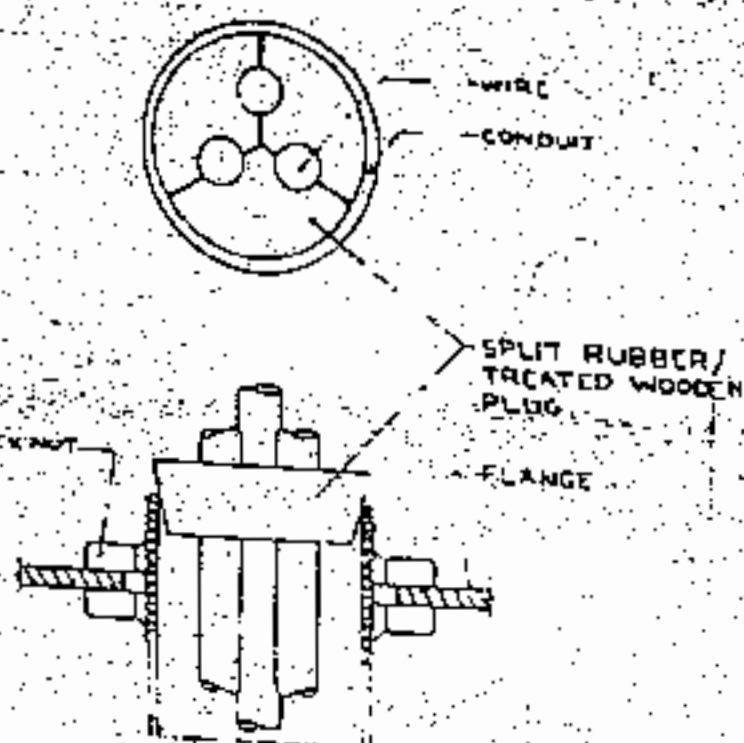
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SHEET 9 OF 15



CLAMPING OF WIRES
IN CONDUIT VERTICAL RUN





CLAMPING OF WIRES
IN CONDUIT VERTICAL RUN

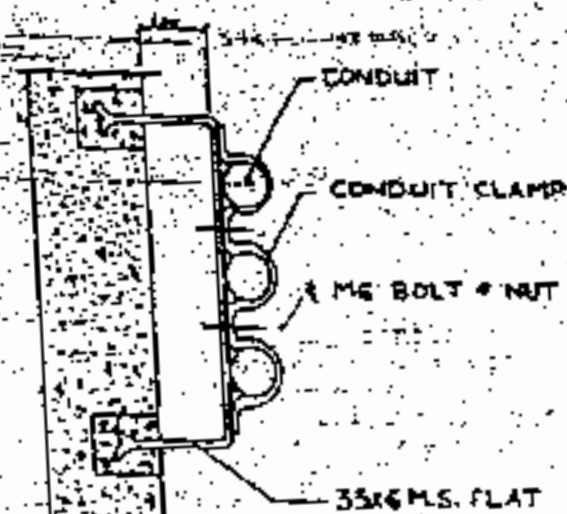


LIGHTING NOTES & DETAILS

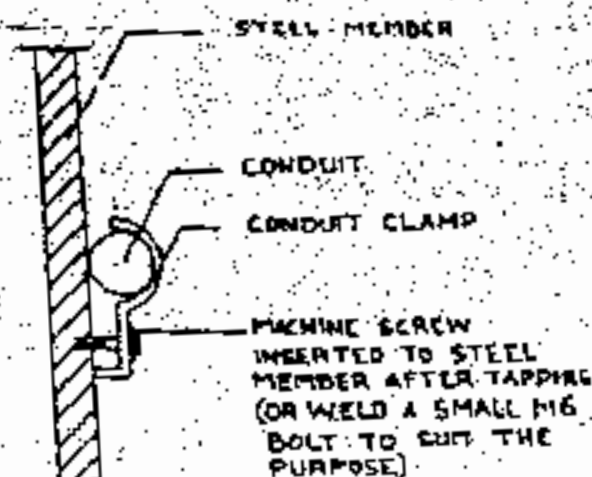
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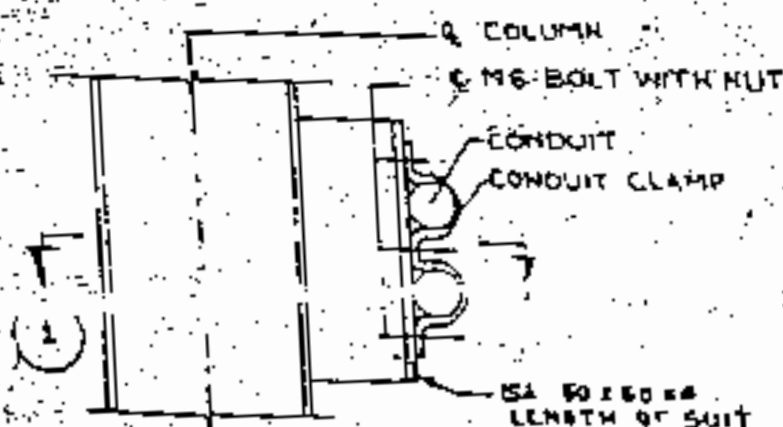
SHEET 10 OF 15



GROUP OF CONDUITS RUN ON CONCRETE SURFACE

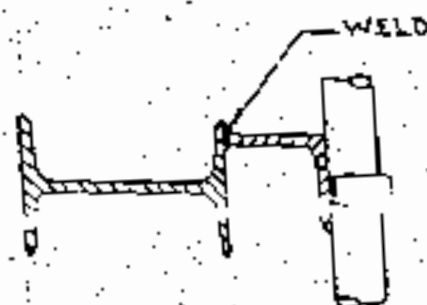


SINGLE CONDUIT RUN ON STEEL MEMBER



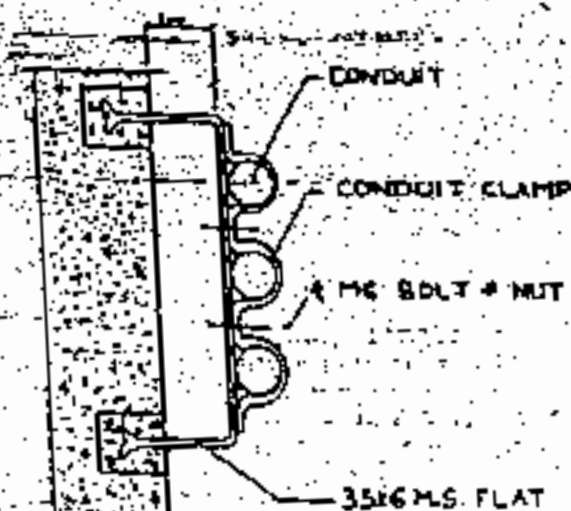
ELEVATION

GROUP OF CONDUIT RUN ON STEEL MEMBER ARRANGEMENT-A

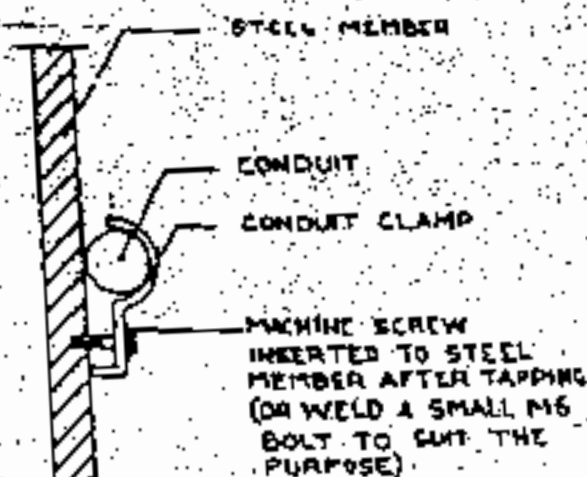


SECTION — 1

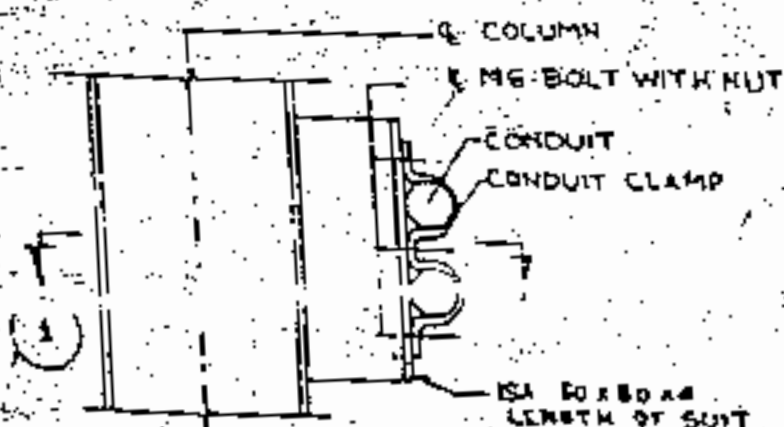




GROUP OF CONDUITS RUN ON CONCRETE SURFACE

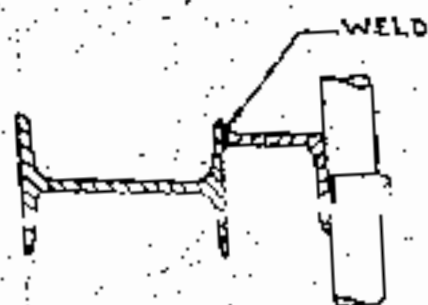


SINGLE CONDUIT RUN ON STEEL MEMBER



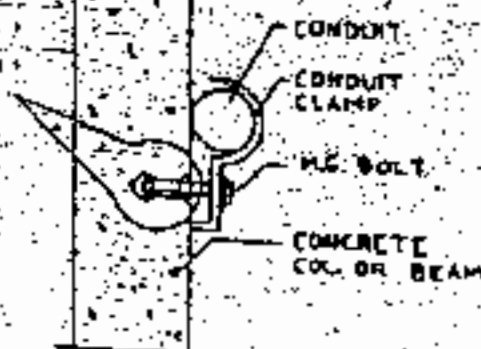
ELEVATION

GROUP OF CONDUIT RUN ON STEEL MEMBER ARRANGEMENT-A

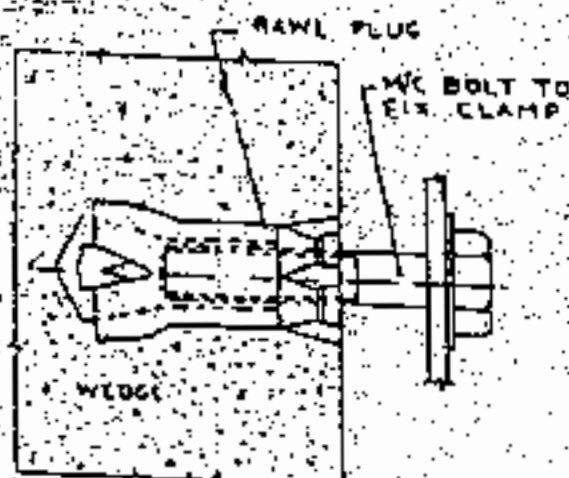


SECTION — ①

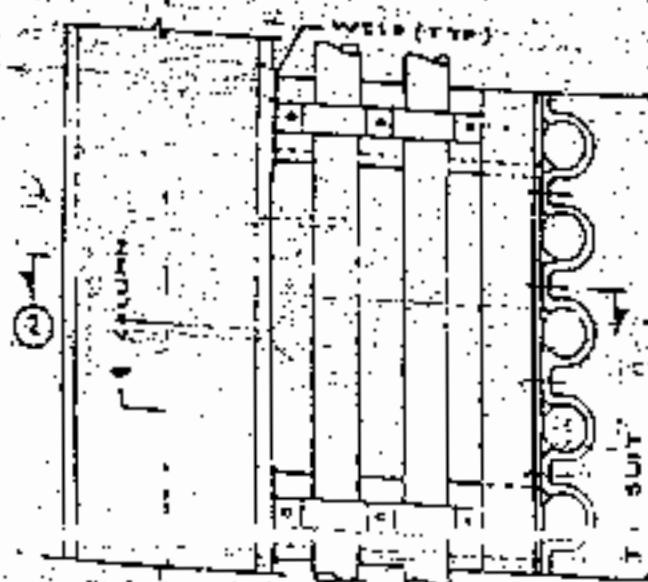
SEE
DETAIL-A



SINGLE CONDUIT RUN
ON CONCRETE SURFACE

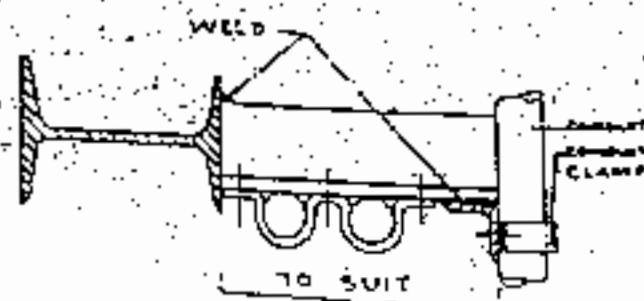


DETAIL-A



ELEVATION

GROUP OF CONDUIT RUN ON
STEEL MEMBER ARRANGEMENT-B



SECTION-2

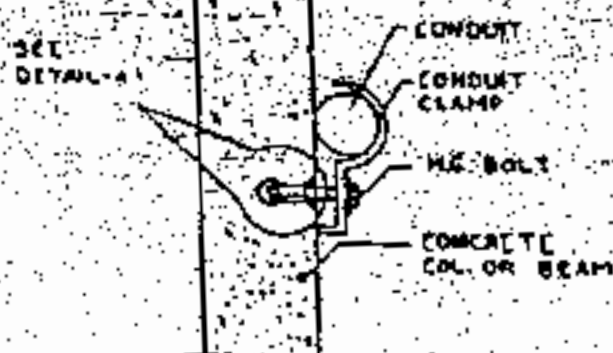


LIGHTING NOTES & DETAILS

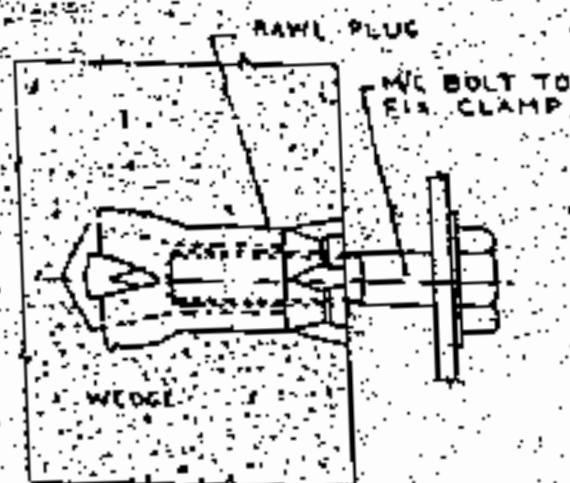
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PE-DG-XXX-558-0004

REV. No.
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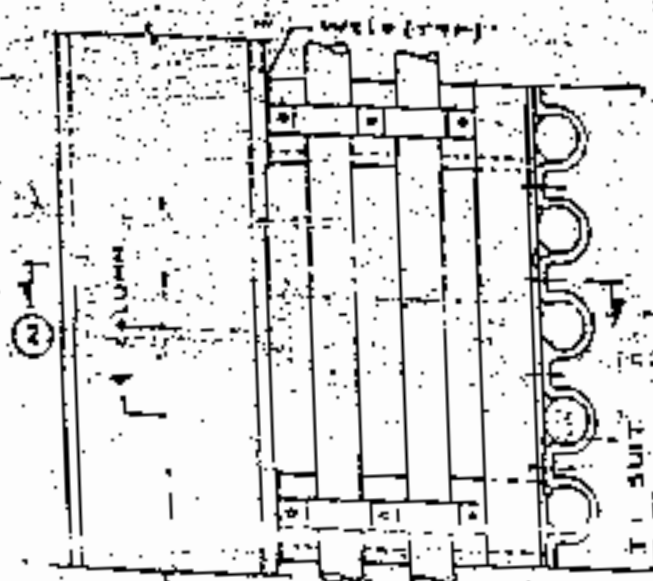
SHEET 12 OF 15



SINGLE CONDUIT RUN
ON CONCRETE SURFACE

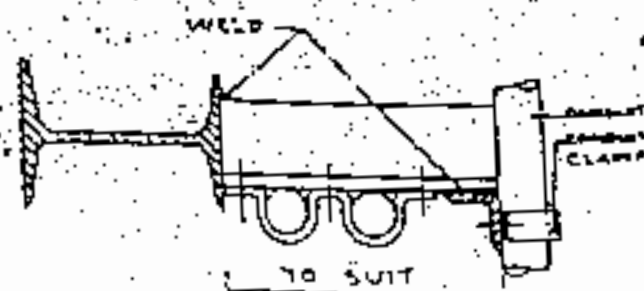


DETAIL-A



ELEVATION

GROUP OF CONDUIT RUN ON
STEEL MEMBER ARRANGEMENT-B



SECTION-2

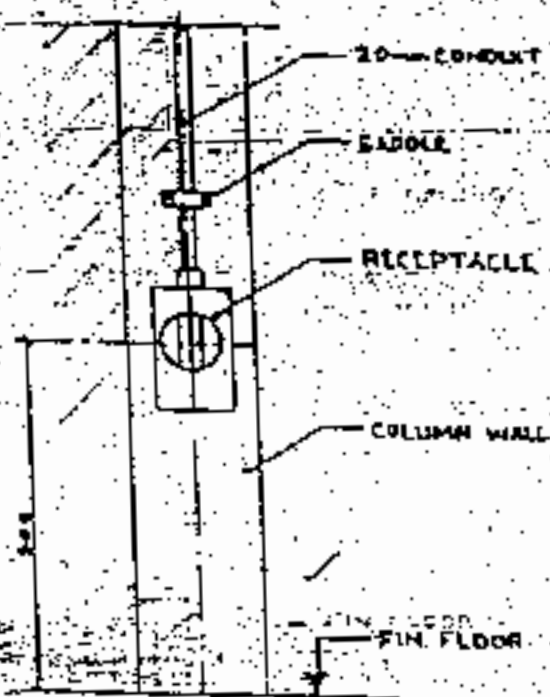


LIGHTING NOTES & DETAILS

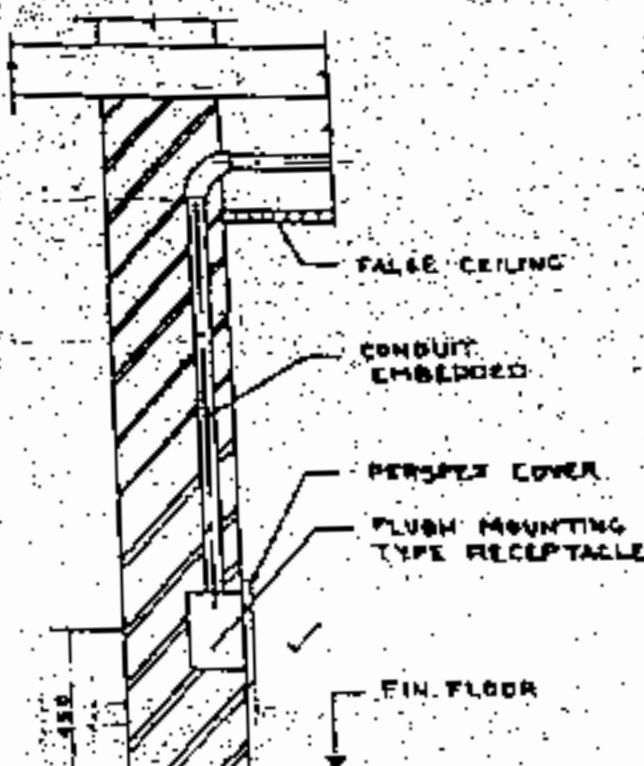
DRG. No.
PE-DG-~~XXX~~558-0004

REV. No. 0

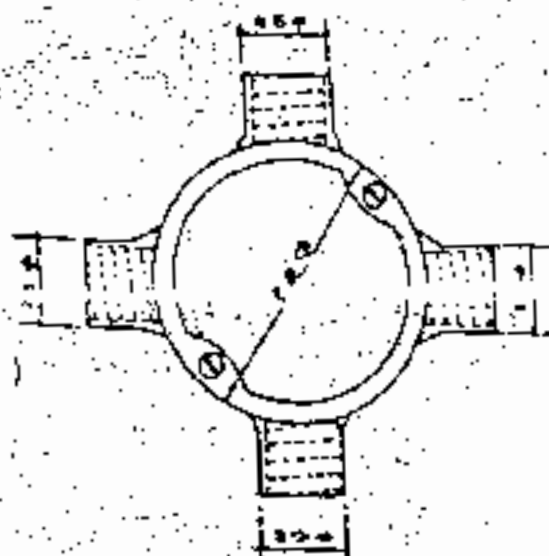
SHEET 12 OF 15



RECEPTACLE - TYPE RA
(STRUCTURE MOUNTING)



RECEPTACLE - TYPE RA
(WALL MOUNTING)



JUNCTION BOX ROUND (TYP.)

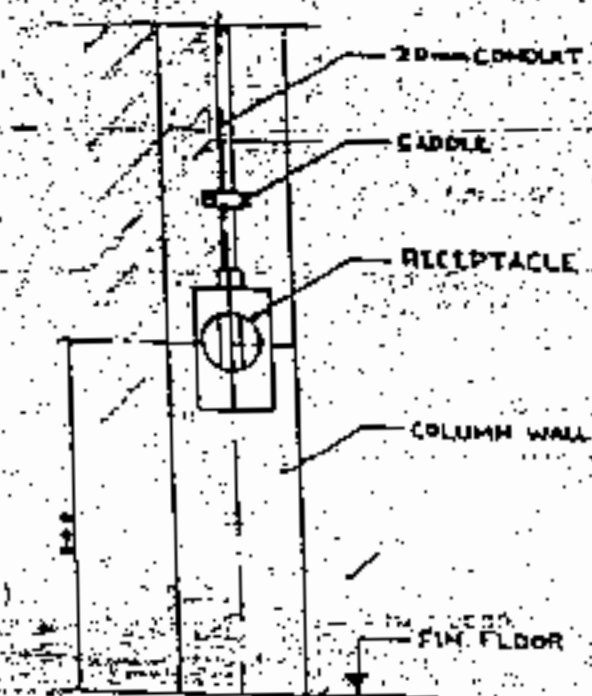


LIGHTING NOTES & DETAILS

DRG. No.
PE-DC-~~XXX~~358-0004

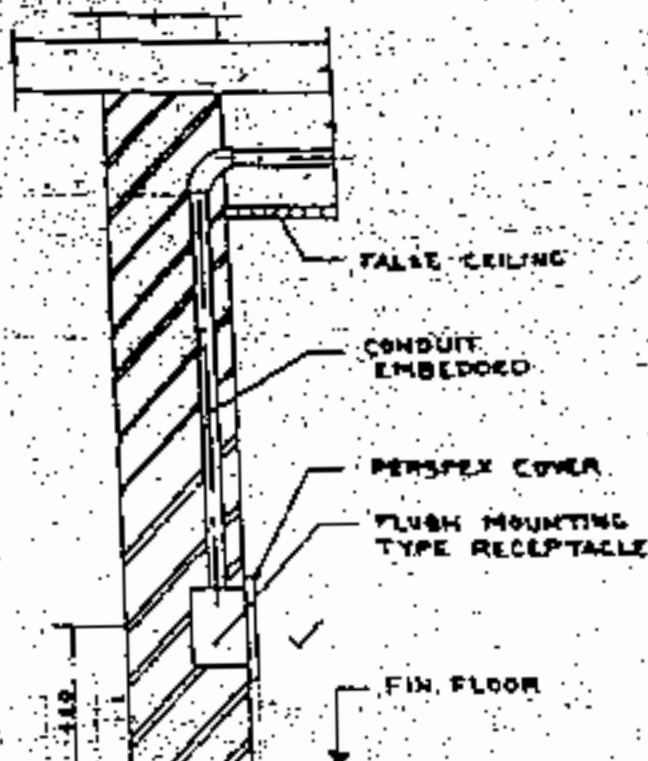
REV. No.
0

SHEET 13 OF 15



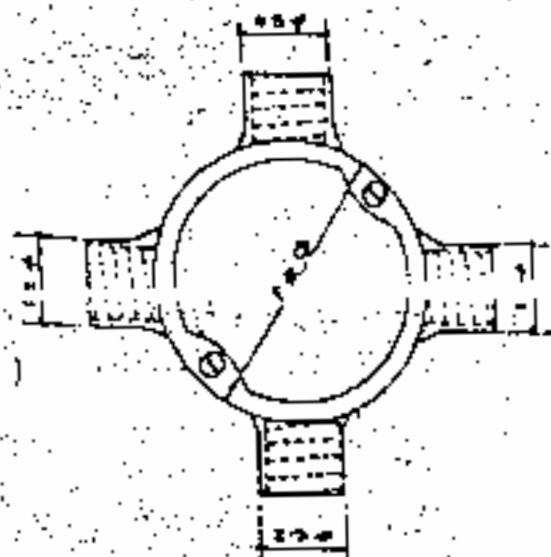
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(STRUCTURE MOUNTING)



RECEPTACLE - TYPE 'R_A'

(WALL MOUNTING)



JUNCTION BOX ROUND (TYP.)

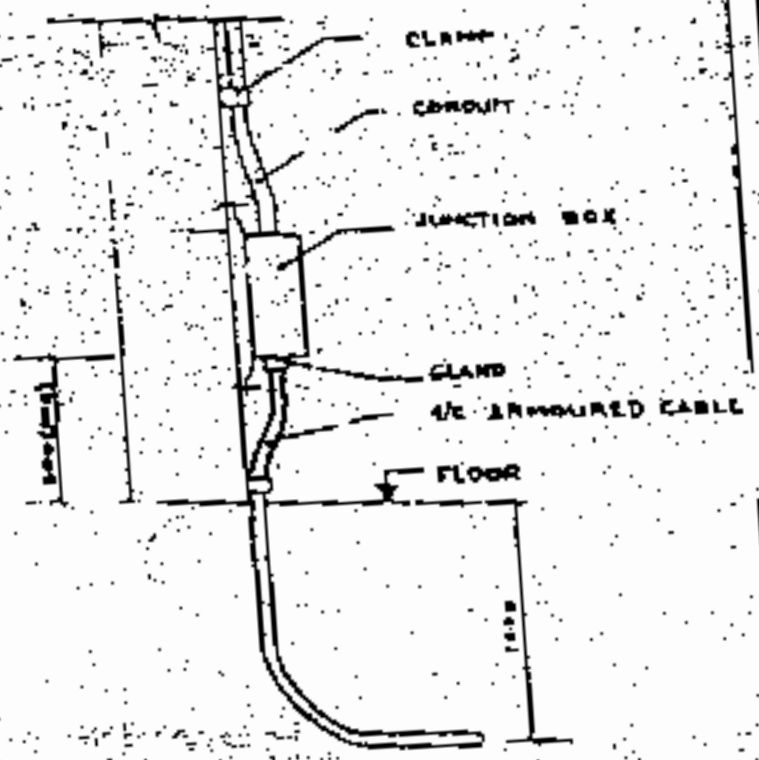
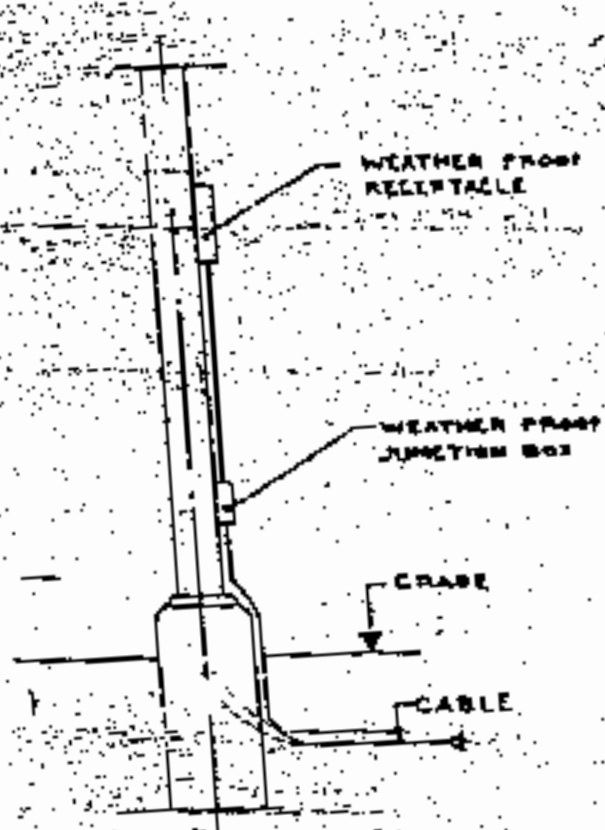


LIGHTING NOTES & DETAILS

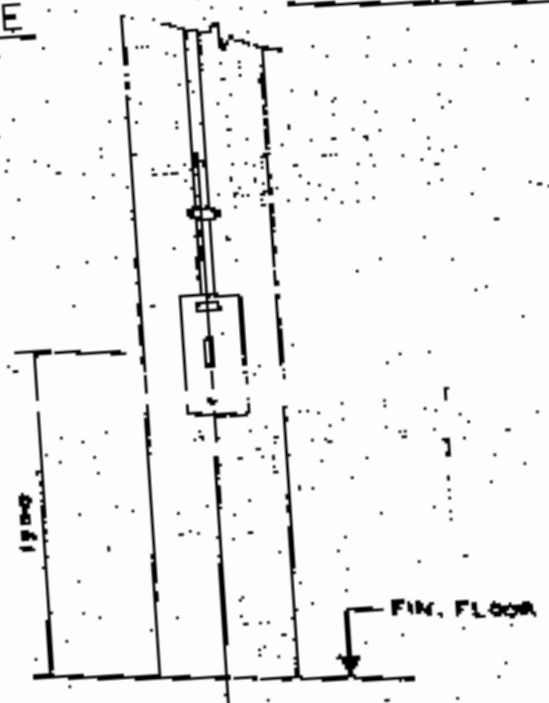
DRG. No.
PE-DG-~~XXX~~358-0004

REV. No. 0

SHEET 13 OF 15



JUNCTION BOX
MOUNTING (TYP)



SWITCH ON COLUMN

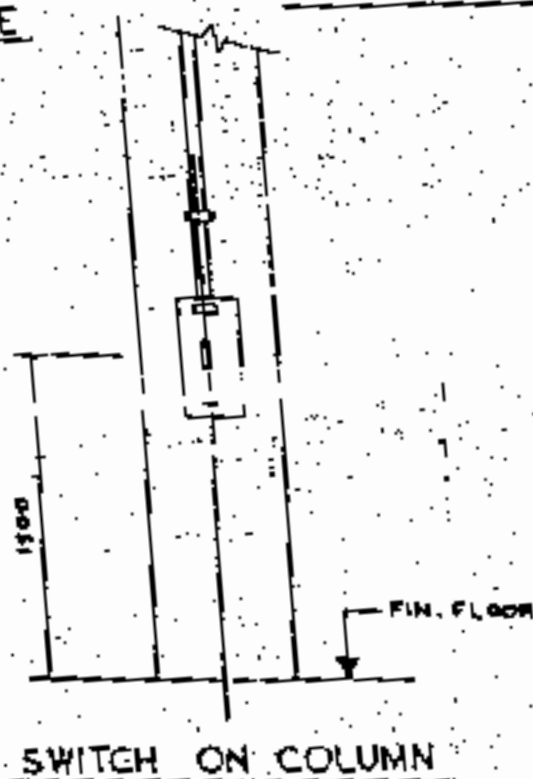
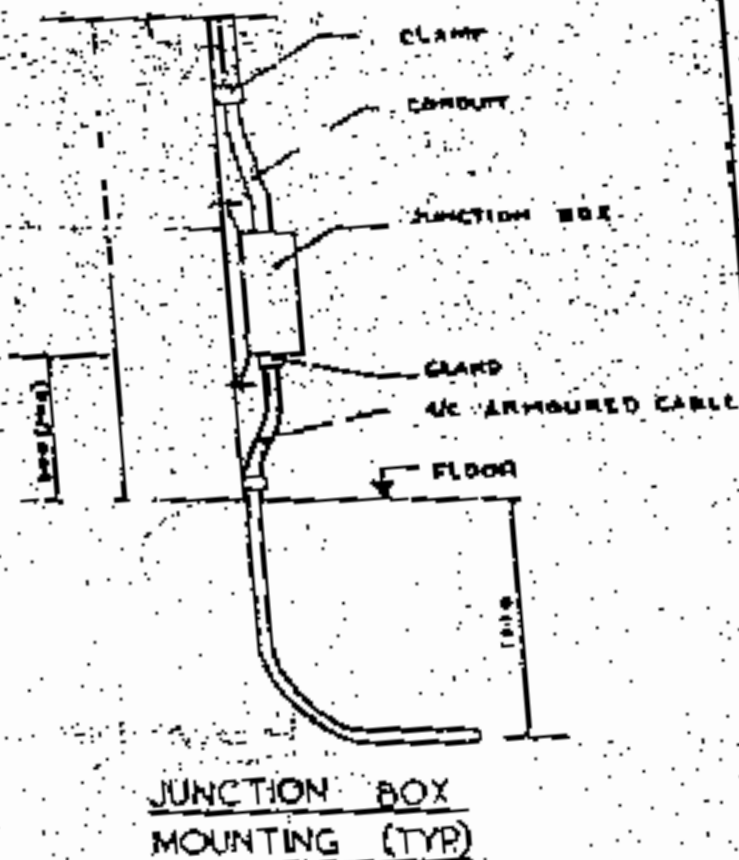
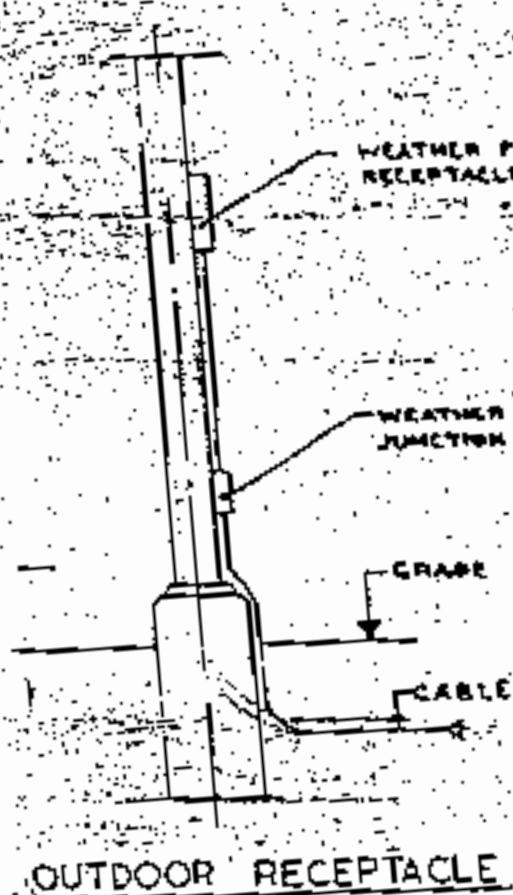


LIGHTING NOTES & DETAILS

DRG. No.
PE-DG-~~XXX~~558-0004

REV. No.
0

SHEET 14 OF 15

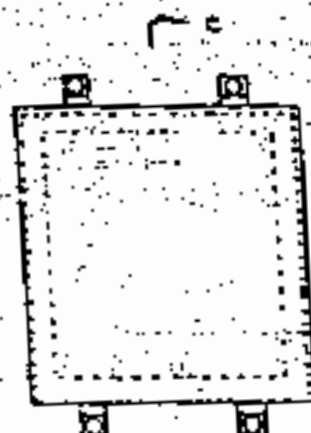


LIGHTING NOTES & DETAILS

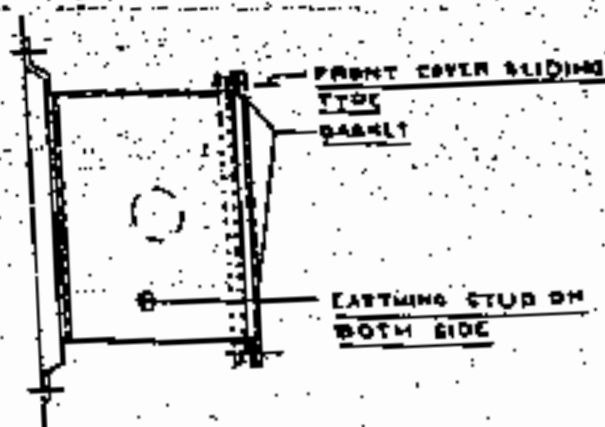
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REV. No. 0

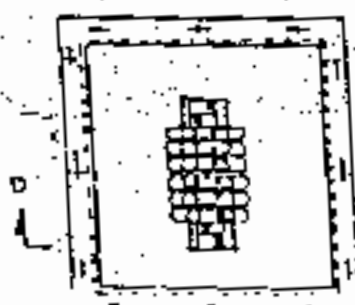
SHEET 14 OF 15



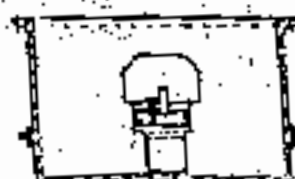
TYP. FIXING DETAIL
OF JUNCTION BOX



SECTION: C-C'



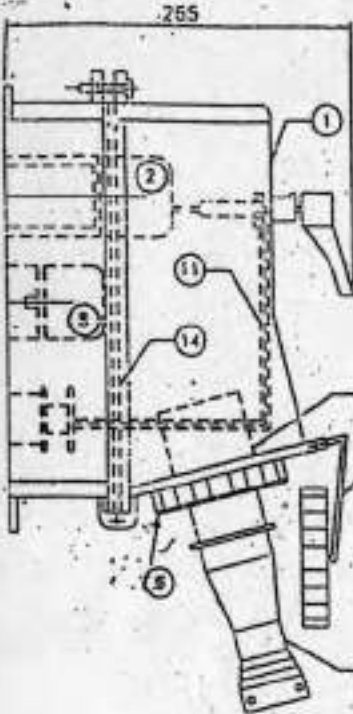
JUNCTION BOX (TYP)
FRONT VIEW



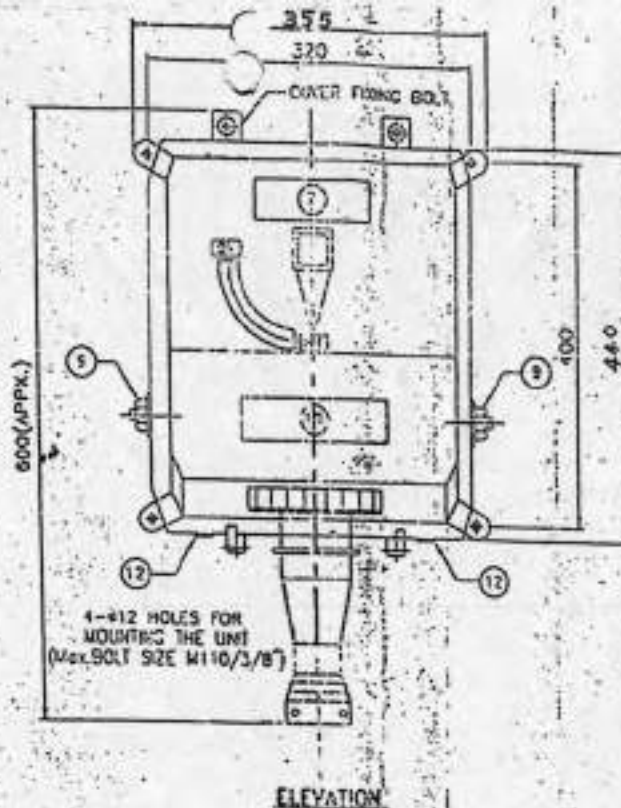
SECTION: D-D'



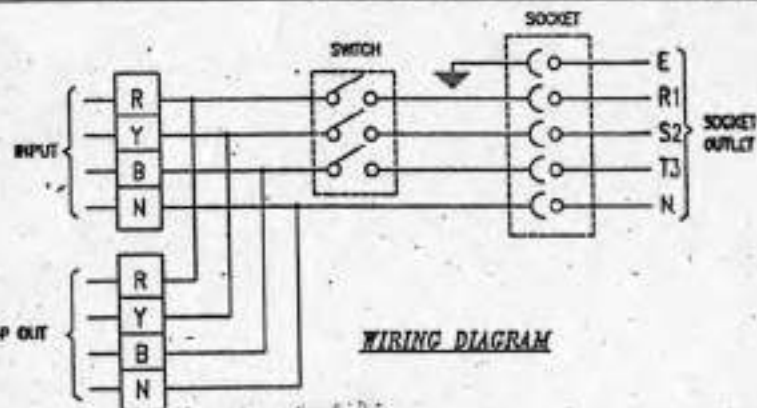
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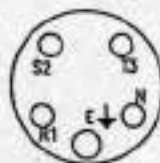
END VIEW



ELEVATION



WIRING DIAGRAM



SHOWING TERMINAL POSITION

COLOR CODED SLEEVE WILL BE PROVIDED ON BOTH ENDS ON COPPER FLEIBLE
 R PHASE - RED COLOUR
 Y PHASE - YELLOW COLOUR
 B PHASE - BLUE COLOUR
 NEUTRAL - BLACK COLOUR

SPECIFIC ION

- 1] ALUMINIUM ALLOY HOUSING (MIN THICKNESS 3mm)
- 2] GE POWER CONTROL TP ON/OFF SWITCH DOUBLE BREAK TYPE SP02, AC23 CATEGORY CONFORMING TO IS-13947-3
- 3] BEST & CROMPTON MAKE-63A, 415V, 5 PIN TRIPLE POLE, NEUTRAL & EARTH SOCKET
- 4] BEST & CROMPTON MAKE-63A, 415V, 5 PIN TRIPLE POLE, NEUTRAL & EARTH PLUG
- 5] PLUG RING
- 6] SPRING LOADED COVER FOR SOCKET OUTLET
- 7] NAME PLATE
- 8] 4 WAY STUD TYPE TERMINAL BLOCK 2 Nos. FOR LOOP IN LOOP OUT, ARRANGEMENT TO TERMINATE 3.5x70 sq.mm STUD TYPE BEST & CROMPTON MAKE
- 9] ELECTROPLATED EARTHING TERMINAL 2 Nos. COMPLETE WITH 6mm BOLT, NUT & WASHER SUITABLE FOR 14 SWG. GL. EARTHING CONDUCTOR
- 10] CAUTION STICKER
- 11] MECHANICAL INTERLOCKING ARRANGEMENT
- 12] DETACHABLE GLAND PLATE 0 TAKE 2 Nos. GLAND SUITABLE FOR 3.5x70 sq.mm. CABLES.

NOTES

- 1] ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED SUBJECT TO TOLERANCE ± 5 mm
- 2] EACH UNIT PROVIDED WITH INTERNAL WIRING SIZE 16 sq.mm. CABLE
- 3] THE ENCLOSURE IS PAINTED WITH SHADE GREY RAL 9002 - POWER COATING
- 4] THE UNIT ARE SUITABLE FOR OUTDOOR USE, IP-55 AS PER IS-13947
- 5] SWITCH CAN NOT BE MADE 'ON' UNLESS PLUG IS INSERTED
PLUG CAN NOT BE WITHDRAWN UNLESS SWITCH IS IN OFF POSITION
- 6] UNIT IS MANUFACTURE BY "BEST & CROMPTON"
- 7] SUITABLE CABLE GRIP SHALL BE PROVIDED

CHIMNEY LIGHTING SPECIFICATION

REV	DATE	DESCRIPTION
01		
02		

NATIONAL THERMAL POWER CORPORATION LTD.
 RIHAND 2X500MW THERMAL POWER PROJECT STAGE-II



BHARAT HEAVY ELECTRICALS LIMITED
 POWER SECTOR, PROJECT ENGINEERING MANAGEMENT
 NEW DELHI



bajaj electricals limited

MUMBAI

Engineering & Projects Division.

DRN	CHKD	APPO	DATE	BHEL DWG. No.
KBM	JS	AP	30.08.03	PE-V0-200-558-E073

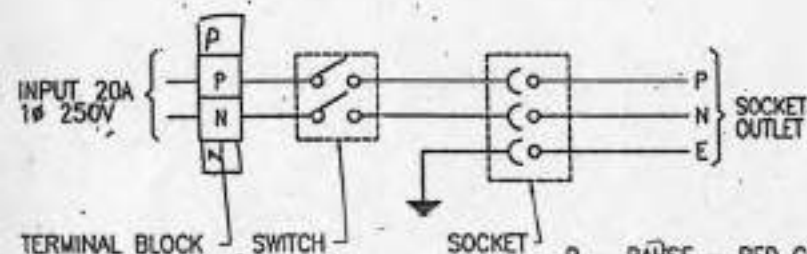
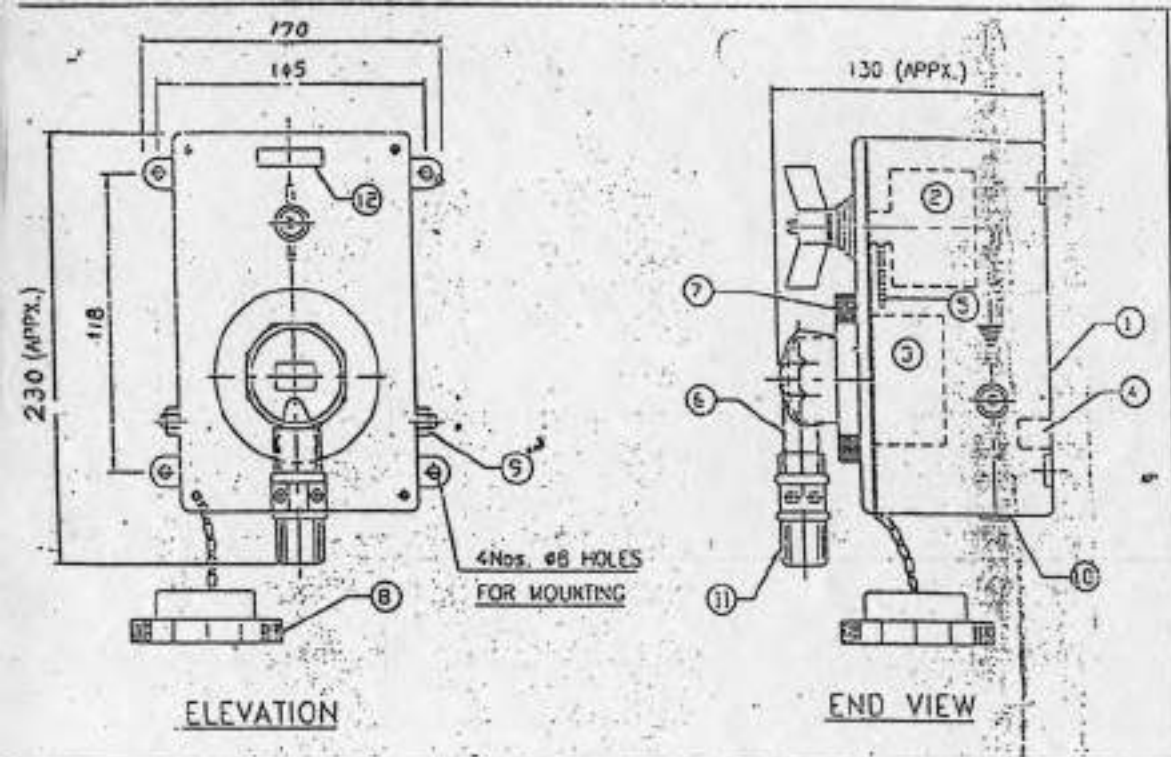
TITLE GENERAL ARRANGEMENT DWG FOR 63 A
 FULLY INTERLOCKED SWITCHED PLUG
 63 AMPS 415 VOLTS (TYPE RC)

DWG. NO. EPBU-03-PS005-04-073

REV.

0

SHT. 1 OF 1



WIRING DIAGRAM
(FOR SINGLE PHASE UNIT)

P - PHASE - RED COLOUR
N - NEUTRAL - BLACK COLOUR
E - GREEN COLOUR

VIEW ON SOCKET
PLUG REMOVED

1230-061-29PE-PVG-B-070

SPECIFICATION

- 1] ALUMINIUM ALLOY ENCLOSURE 3mm THICK
- 2] 25A, 250V, DOUBLE POLE/ OFF ROTARY SWITCH AC 23 CATEGORY IS-4084 - RECON MAKE
- 3] ALUMINIUM ALLOY METAL CLAD SOCKET UNIT "BEST & CROMPTON" MAKE
- 4] BAKELITE STUD TYPE 4 WAY TERMINAL BLOCK TO TERMINATE 2Cx4 sq.mm CABLE
- 5] MECHANICAL INTERLOCKING SYSTEM
- 6] DIE CAST ALUMINIUM ALLOY METAL CLAD PLUG AND SOCKET OF 20A, 240V, 3 PIN (P+N+E), 3rd PIN GROUNDED
- 7] THREADED PLUG LOCKING RING
- 8] SOCKET COVER WITH CHAIN FOR SOCKET OUTLET
- 9] EARTHING TERMINAL 2 Nos. - M6 SIZE
- 10] CABLE ENTRY 25mm DIA - 2Nos.
- 11] PVC CABLE GRIP
- 12] NAME PLATE

NOTES

- 1] ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED SUBJECT TO TOLERANCE OF $\pm 5\text{mm}$
- 2] EACH UNIT PROVIDED WITH INTERNAL WIRING SIZE 4 sq.mm. COPPER CABLE
- 3] THE ENCLOSURE IS PAINTED WITH SHADE GREY RAL 9002 - POWER COATING
- 4] THE UNIT ARE SUITABLE FOR OUTDOOR USE, IP-55 AS PER IS-13947
- 5] SWITCH CAN BE MADE 'ON' ONLY WHEN PLUG IS FULLY ENGAGED WITH SOCKET, PLUG CAN NOT BE WITH DRAWN WHEN SWITCH IS ON
- 6] 2 Nos. CABLE ENTRY AT BOTTOM

CHIMNEY LIGHTING SPECIFICATION

REV	DATE	DESCRIPTION
01		
02		

TITLE GENERAL ARRANGEMENT DWG FOR FULLY INTERLOCKED SWITCHED PLUG 20 AMPS, 250 VOLTS [TYPE RA]

DWG. NO. EPBU-03-PS005-04-070

REV 0

SHT. 1 OF 1

NATIONAL THERMAL POWER CORPORATION LTD.
RIHAND 2X500MW THERMAL POWER PROJECT STAGE-II

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT

bajaj electricals limited		MUMBAI
Engineering & Projects Division		
GRN	CHKD	APPD
DATE	SHEL DWG. No	
10.05.03	PE-V0-200-558-E070	

		QUALITY PLAN			CUSTOMER		PROJECT TITLE		SPECIFICATION NUMBER			
					BIDDER / VENDOR		QUALITY PLAN NUMBER PED-558-00-Q-001 / 01		SPECIFICATION TITLE			
		SHEET 1 OF 3			SYSTEM		ITEM ILLUMINATION		SECTION VOLUME III			
S. NO.	COMPONENT / OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	CABLES & WIRES	1. SURFACE DEFECTS	MA	VISUAL	SAMPLE	BHEL SPEC., IS:694, IS:1554	BHEL SPEC., IS:694, IS:1554	INSPN. REPORT & TEST REPORT FROM MANUFACTURER	3/2	2	1	TO BE PROCURED FROM APPROVED SOURCE
		2. DIMENSIONS	MA	MEASUREMENT	SAMPLE	-DD-	-DD-	-DD-	3/2	2	1	
		3. TYPE TESTS	CR	ELEC. TESTS	ONE / TYPE & SIZE	BHEL SPEC., IS:694, IS:1554	BHEL SPEC., IS:694, IS:1554	TEST CERT.	3	2	1	
		4. ACCEPTANCE TESTS	MA	-DD-	SAMPLING	-DD-	-DD-	-DD-	3	2	1	
		5. ROUTINE TESTS	MA	-DD-	100%	-DD-	-DD-	-DD-	3	-	2,1	
		6. FRLS PROPS.	CR	FRLS TESTS	SAMPLES	BHEL SPEC.	BHEL SPEC.	-DD-	3	2	1	
2.0	JUNCTION BOXES, LIGHTING PANELS AND DISTRIBUTION BOARDS											
2.1	JUNCTION BOXES	1. DIMENSIONS	MA	MEASUREMENTS	100%	BHEL DRG.	BHEL DRG.	INSP. REPORT	3	-	2	COMPONENTS TO BE OF APPROVED MAKE.
		2. PAINT SHADE / THICKNESS	MA	VISUAL / MEAS.	SAMPLE	BHEL SPEC. / DRG.	BHEL SPEC. / DRG.	-DD-	3	-	2	
		3. HV / IR / HV	MA	ELECT. TESTS	100%	2KV AC FOR 1 MINUTE IS:2147	2KV AC FOR 1 MINUTE IS:2147	-DD-	3	-	2	
		4. DEGREE OF PROTECTION	MA	TESTS	1 / SIZE			TEST CERT.	-	-	2,1	
		5. SPECIAL TESTS IF ANY, EXPLOSION PROOF ETC.	MA	-DD-	-DD-	IS:2148	IS:2148	-DD-	-	-	2,1	
2.2	LIGHTING PANELS AND LIGHTING DISTRIBUTION BOARDS	1. DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DRG.	BHEL DRG.	INSPT. REPORT	3	2,1	-	COMPONENTS TO BE OF APPROVED MAKE.
BHEL			PARTICULARS			BIDDER / VENDOR						
			NAME									
			SIGNATURE									

		QUALITY PLAN			CUSTOMER			PROJECT TITLE		SPECIFICATION NUMBER		
					BIDDER / VENDOR			QUALITY PLAN NUMBER PED-558-00-Q-001 / 01		SPECIFICATION TITLE		
		SHEET 2 OF 3			SYSTEM			ITEM ILLUMINATION		SECTION VOLUME III		
S. NO.	COMPONENT / OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
3.0	TUNGSTEN FILAMENT LAMPS, TUBULAR FLUORESCENT LAMPS, H.P. MERCURY VAPOUR LAMPS, SODIUM VAPOUR LAMPS, BALLASTS, LUMINAIRES	2. PAINT SHADE / THICKNESS	MA	VISUAL / MEASUREMENT	-DD-	BHEL SPEC. / DRG.	BHEL SPEC. / DRG.	INSPT. REPORT	3	2,1	-	BHEL SHALL WITNESS ON RANDOM ONE SAMPLE, THOUGH EACH ITEM SHALL BE CHECKED BY THE MANUFACTURER.
		3. DEGREE OF PROTECTION (INCLUDING EXPLOSION PROOF IF ANY)	MA	TESTS	1 / SIZE	BHEL SPEC. / RELEVANT IS	BHEL SPEC. / RELEVANT IS	TEST CERTF.	-	-	2,1	
		4. PERFORMANCE TESTS	MA	ELEC.	100%	BHEL SPEC.	BHEL SPEC.	INSPT. REPORT	3	2,1	-	
		5. HV / IR / HV	MA	ELEC.	100%	2.5 KV AC FOR 1 MINUTE	2.5 KV AC FOR 1 MINUTE	-DD-	3	2,1	-	
		6. TEMP. RISE TEST (FOR COMPLETE ASSEMBLED LDB)	MA	ELEC.	1 / RATING	BHEL SPEC.	BHEL SPEC.	-DD-	3	2	1	
		1. - ACCEPTANCE TESTS	MA	TESTS	SAMPLE	BHEL SPEC. / RELEVANT IS	BHEL SPEC. / RELEVANT IS	TEST CERTF.	3,2	-	1	
BHEL			PARTICULARS		BIDDER / VENDOR							
			NAME									
			SIGNATURE									

		QUALITY PLAN			CUSTOMER		PROJECT TITLE		SPECIFICATION NUMBER			
					BIDDER / VENDOR		QUALITY PLAN NUMBER PED-558-00-Q-001 / 01		SPECIFICATION TITLE			
		SHEET OF 3			SYSTEM		ITEM ILLUMINATION		SECTION VOLUME III			
S. NO.	COMPONENT / OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
4.0	CONDUITS	1. MATERIAL	MA	VISUAL, MECH. AND CHEMICAL	AS PER SPEC./ IS: 9537	IS:9537	IS:9537	INSPT. REPORT	3	2	1	
		2. DIMENSIONS	MA	MEASUREMENT	AS PER SPEC./ IS: 9537	IS:9537	IS:9537	-DD-	3	2	1	
		3. OTHER TESTS	MA	TESTS	AS PER SPEC./ IS:9537,	AS PER SPEC./ IS:9537,	IS:9537,	-DD-	3	2	1	
5.0	ELECTRIC POLES											
5.1	MATERIAL	1. CHEMICAL COMP.	MA	CHEM. ANALYSIS	SAMPLE	IS:2713, IS:228 & IS:1894	IS:2713 IS:228 & IS:1894	-DD-	3/2	-	2,1	
		2. PHYSICAL PROP.	MA	PHYS. TESTS	-DD-	-DD-	-DD-	-DD-	3/2	-	2,1	
5.2	FINAL INSPECTION	1. WORK-MANSHIP & FINISH	MA	VISUAL & MEAS.	SAMPLES	BHEL DRG./IS:2713	BHEL DRG./IS:2713	-DD-	3/2	2,1	-	
		2. DIMENSIONS	MA	-DD-	-DD-	-DD-	-DD-	-DD-	3/2	2,1	-	
		3. WEIGHT	MA	-DD-	-DD-	-DD-	-DD-	-DD-	3/2	2,1	-	
		4. TESTS AS PER IS:2713	MA	-DD-	-DD-	IS:2713	IS:2713	-DD-	3/2	2,1	-	
NOTE : IN CASE TYPE TEST CERTIFICATE FOR DEGREE OF PROTECTION / EXPLOSION PROOFNESS FROM INDEPENDENT LAB. IS NOT AVAILABLE, THE ITEM SHALL BE TESTED AT AN INDEPENDENT LAB.												
BHEL			PARTICULARS			BIDDER / VENDOR						
			NAME									
			SIGNATURE									

	TITLE:		SPECIFICATION NO. PE-TS-Q11-600-C051	
	SPECIFIC TECHNICAL REQUIREMENT		VOLUME - IIB	
			SECTION "C"	Sub Sec-II
			REV. 00	DATE: 22 – 10 - 2003
			SHEET 1 of 3	
1.00.00	CODES AND STANDARDS	IS:1554, IS:7098, IEC:502, IS:6380, IS:9968		
2.00.00	TYPE	All cable shall be Flame retardent low smoke type		
3.00.00	RATING	As p er requirement specified in Gen eral Electrical Requirements.		
4.00.00	OPERATIONAL REQUIREMENTS			
	All cable s shall be suita ble for high ambient, hig h humid tro pical India n climati c conditions. All cabl es shall be d esigned to withstand the me chanical, ele ctrical and thermal stresses under the foreseen steady state and tr ansient/fault conditions, and shall be suitable for the proposed method of installation.			
5.00.00	DESIGN AND CONSTRUCTIONAL FEATURES			
5.01.00	Parameters of the cables are as follows :			
--				
Particul	ars	Power cables	Control cables	Trailing cables
		XLPE PVC		
--				
a	) Conductor			
	i) Material	Stranded Aluminium	Stranded plain annealed copper	Tinned copper of class 5 of IS:8130
	ii) Size	As required, but Min. 6 sq.mm size.	As required, but min. 1.5 sq.mm. size.	As required, but min. 1.5 sq.mm. size.
	iii) Shape	Circular/ sector shaped. Circular only for HT cables	Circular/ sector shaped	
b)	Main Insulation			
	i) Material	XLPE PVC	PVC	Heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR)



TITLE:
SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION NO. PE-TS-Q11-600-C051

VOLUME - IIB

SECTION "C"	Sub Sec-II

REV. 00 DATE: 22 - 10 - 2003

SHEET 2 of 3

Particul	ars	Power cables			Control cables	Trailing cables
		XLPE	PVC			
ii)	Continuous withstand temperature (deg.C)	90	70	70	90	
iii)	Short circuit withstand temperature (deg.C)	250	160	160	250	
iv)	Colour identification	As per relevant codes and standards				
c)	Inner Sheath	All armoured and multicore unarmoured cables have distinct extruded inner sheath				
	i) Material	PVC	PVC	PVC		Heat resistant elastomeric compound.
	ii) Colour	Black		Black	Black	Black
d)	Armour, wherever provided					
	i) Material	Aluminium wire for single core cable and GS wire/flat for multi-core cables as per relevant IS. Minimum Coverage of 90%			GS wire/flat as per relevant IS. Min. coverage of 90%.	Nylon cord reinforcement
	ii) Breaking load of joint	95% of normal armour			95% of normal armour	
e)	Outer sheath	All power & control cable shall have extruded outer sheath.				
	i) Material (Polyethylene based halogen free material not acceptable)	PVC	PVC	PVC		Heat resistant, oil resistant & flame retardant heavy duty elastomeric compound



TITLE:
SPECIFIC TECHNICAL REQUIREMENT

SPECIFICATION NO. PE-TS-Q11-600-C051

VOLUME - IIB

SECTION "C"	Sub Sec-II

REV. 00 DATE: 22 – 10 - 2003

SHEET 3 of 3

Particul	ars	Power cables		Control cables	Trailing cables
		XLPE	PVC		

ii) Colour	Black	Black	Grey	Black

iii) Marking	- Cable size & voltage grade (by embossing) - Word "FRLS" @5by (embossing) - Sequential marking @1m		Same as for Power Cables	Same as for Power Cables

f) FRLS properties on outer sheath	Oxygen Index : Acid gas generation: Smoke density rating:	Min. 29 (As per ASTM D 2863) Max. 20% (As per IEC 754-I) 60% (As per ASTM D 2843)

g) Flamability test on all types of cables	As per Swedish chimney test F3 as per SEN 4241475 As per IEC 332 Part-3 (Category B)	

5.01.02 HT cables

For HT cables conductor screen and insulation screen shall be of extruded semi-conducting compound and shall be applied along with XLPE insulation in a single operation by triple extrusion process. Method of curing for 11kV/6.6kV cables shall be "Dry curing/gas curing/steam curing" whereas for 33KV cables it shall be "Dry/Gas curing". 11kV/6.6kV cables shall be provided with copper metallic screen suitable for carrying allowable earth fault current for 2 secs. All other voltage grade HT cables shall be provided with copper metallic screen suitable for carrying earth fault current as per E0. For single core armoured cables, the armouring shall constitute the metallic part of screening.

5.01.03 LT Cables of size 150 sq.mm. and above shall be with XLPE insulation.

5.01.04 Core identification

For cables having more than five (5) cores, each core shall be identified by number marking. However, for cables upto five (5) cores, the same shall be by colour as per IS.

5.01.05 Armouring

Cables buried direct in ground and cables in switchyard shall be armoured.

Clause No.	POWER AND CONTROL CABLES		
	 (Bidder's Name) POWER AND CONTROL CABLES (Use separate sheet for each type and size of cables)		
1.00.00	Make	.....	.....
1.02.00	Country of Manufacturer	.....	.....
1.03.00	Type & designation	.....	.....
1.04.00	Applicable standard	.....	.....
1.05.00	Cable size & no. of cores	.....	.....
1.06.00	Rated voltage	.....	.....
1.07.00	Catalogue attached as Annexure No.	.....	.....
1.08.00	Continuous current rating for max. conductor temperature	.....	.....
	a) When laid in air at an ambient temperature of 50 deg. C	.....	.....
	b) When buried in soil having thermal resistivity of 150 deg.C cm/n at a depth of 1000 mm at ground ambient temperature of 40 deg. C	.....	.....
1.09.00	Short circuit withstand capacity and duration for	.....	.....
	a) Conductor	.....	.....
	b) Screen	.....	.....
	c) Armour	.....	.....
1.10.00	Conductor	.....	.....
	a) Material	.....	.....
	b) Nominal cross section area in sq. mm	.....	.....
TECHNICAL DATA REQUIREMENTS SHEETS FOR POWER PLANT TURNKEY PACKAGE		VOLUME - III	BOOK 2 SECTION - DE-3 PAGE 1 OF 2

Clause No.	POWER AND CONTROL CABLES		
		 (Bidder's Name)	
1.11.00	c) Shape of conductor	.....	.....
	d) DC resistance at 20°C	.....	.....
	Insulation		
	a) Material	.....	.....
	b) Nominal thickness (in mm)	.....	.....
	c) Type of curing (for XLPE)	.....	.....
1.12.00	Metallic screen (wherever applicable)		
	a) Material	.....	.....
	b) Type	.....	.....
	c) Rating KA, Sec		
1.13.00	Material & Type of Inner sheath	.....	.....
1.14.00	Armour material & shape	.....	.....
1.15.00	Outer sheath material & type	.....	.....
1.16.00	Over all dia of cable (in mm)	.....	.....
1.17.00	Guaranteed value of minimum oxygen index of outer sheath	.....	.....
1.18.00	Maximum acid-gas generation by weight (%) of outer sheath	.....	.....
1.19.00	Smoke Density rating of outer sheath	.....	.....
TECHNICAL DATA REQUIREMENTS SHEETS FOR POWER PLANT TURNKEY PACKAGE		VOLUME - III	BOOK 2 SECTION - DE-3
			PAGE 2 OF 2

44		QUALITY PLAN			CUSTOMER		PROJECT TITLE		SPECIFICATION NUMBER			
					BIDDER / VENDOR		QUALITY PLAN NUMBER PED-507-00-Q-002 / 02		SPECIFICATION TITLE			
		SHEET 1 OF 6			SYSTEM		ITEM PVC POWER & CONTROL CABLE		SECTION VOLUME III			
S. NO.	COMPONENT / OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL											
1.1	PVC COMPOUND (FOR INSULATION- AND SHEATH)	1. PHYSICAL PROPERTIES	MA	PHYS TESTS	SAMPLE	IS:5831/ BHEL SPECIFICATION	IS:5831/ BHEL SPECIFICATION	LOG BOOK / TEST CERT	3/2	-	2	* SAMPLE FROM EACH BATCH / LOT
		2. ELEC. PROPERTIES	MA	ELEC TEST	-DO-	-DO-	-DO-	-DO-	3/2	-	2	
		3. MAKE & TYPE	MA	VISUAL	100 %	PLANT STD.	PLANT STD.	DO	2	-	-	
1.2	GALVANIZED STEEL WIRE / STRIP	1. PHY. AND ELEC PROPERTIES	MA	PHY. ELEC. TESTS	SAM-*	IS:3975, BHEL SPEC	IS:3975 BHEL SPEC	-DO-	3/2	-	2	
		2. DIMENSION	MA	MEASUREMENT	-DO-	-DO-	-DO-	-DO-	3/2	-	2	
		3. GALVANIZATION QUALITY	MA	GALV. TESTS	-DO-	-DO-	-DO-	-DO-	3/2	-	2	
1.3	COPPER / ALUMINIUM RODS / WIRES	1. PHYSICAL PROPERTIES.	MA	PHY. TESTS	-DO-	IS:613 IS:5484 IS:8130 AND BHEL SPEC.	IS:613 IS:5484 IS:8130 AND BHEL SPEC.	-DO-	3/2	-	2	
		2. CHEM COMPOSITION & PURITY	MA	CHEM ANALYSIS	-DO-	-DO-	-DO-	-DO-	3/2	-	2	
		3. ELECTRICAL PROPERTIES	MA	ELECTRICAL TESTS	-DO-	-DO-	-DO-	-DO-	3/2	-	2	
		4. DIMENSION	MA	MEASUREMENT	-DO-	-DO-	-DO-	-DO-	3/2	-	2	
BHEL			PARTICULARS			BIDDER / VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S / VENDOR'S COMPANY SEAL			

		QUALITY PLAN			CUSTOMER		PROJECT TITLE		SPECIFICATION NUMBER			
					BIDDER / VENDOR		QUALITY PLAN NUMBER PED-507-00-Q-002 / 02		SPECIFICATION TITLE			
		SHEET 2 OF 6			SYSTEM		ITEM PVC POWER & CONTROL CABLE		SECTION VOLUME III			
S. NO.	COMPONENT / OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	WIRE DRAWING, TINNING AND ANNEALING	1. PHYSICAL, ELECT. FINISH & DIMEN.	CR	PHY. & ELECT-TESTS VISUAL, MEAS.	SAMPLE	BHEL SPEC., IS-8130	BHEL SPEC., IS-8130	LOG BOOK	2	-	1	
		2. CHEMICAL TEST FOR TINNING	CR	CHEMICAL TEST	-DO-	-DO-	-DO-	-DO-	2	-	-	
2.2	STRANDING OF WIRES	1. NO. OF WIRES	MA	COUNTING	SAMPLE	VENDORS/ BHEL SPEC. & APPD. DATA SHEET & RELEVANT IS	VENDORS/ BHEL SPEC. & APPD. DATA SHEET & RELEVANT IS	LOG BOOK	2	-	-	
		2 SEQUENCE, LAY LENGTH AND DIRECTION	MA	VISUAL, MEAS	-DO-	-DO-	-DO-	-DO-	2	-	-	
		3. SURFACE FINISH	MA	VISUAL	-DO-	-DO-	-DO-	-DO-	2	-	-	
		4. DIMENSION	MA	MEASUREMENT	-DO-	-DO-	-DO-	-DO-	2	-	-	
2.3	CORE - INSULATION (NO REPAIR PERMITTED)	1 SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM BULGING, BURNT PARTICLES LUMPS, CUTS & SCRATCHES	-DO-	2	-	1	
		2. INSULATION THICKNESS	CR	MEASUREMENT	SAMPLE	APPD. DATA SHT. IS : 1554	APPD. DATA SHT. IS : 1554	-DO-	2	-	-	
BHEL			PARTICULARS		BIDDER / VENDOR							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S / VENDOR'S COMPANY SEAL			

		QUALITY PLAN			CUSTOMER		PROJECT TITLE		SPECIFICATION NUMBER			
					BIDDER / VENDOR		QUALITY PLAN NUMBER PED-507-00-Q-002 / 02		SPECIFICATION TITLE			
		SHEET 3 OF 6			SYSTEM		ITEM PVC POWER & CONTROL CABLE		SECTION VOLUME III			
S. NO.	COMPONENT / OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.4	CORE - LAYING	3. CONCENTRICITY. #	CR	MEASUREMENT	SAMPLE	MFR. STD. / APPD. DATA SHEET. -DO-	MFR. STD. / APPD. DATA SHEET. -DO-	-DO-	2	-	1	# TO BE CHECKED AT STARTING & FINISH END OF EXTRUDED LENGTH
		4. DIA OVER INSULATION	MA	MEASUREMENT	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		5. SPARK TEST OR WATER IMMERSION TEST	CR	ELECTRICAL	100%	MFR. STD.	MFR. STD.	-DO-	2	-	1	
		6. CORE IDENTIFICATION.	MA	VISUAL	100%	IS:1554	IS:1554	-DO-	2	-	-	
		1.DIA OVER LAID UP CORE	MA	MEASUREMENT	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
2.5	INNER SHEATH EXTRUSION	2.SEQUENCE OF LAY, LAY LENGTH & DIRECTION UP CORE	MA	VISUAL & MEAS.	SAMPLE	MFR. STD/ RELEVANT IS	MFR. STD/ RELEVANT IS	LOG BOOK	2	-	-	
		1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM BULGING, BURNT PARTICLES, LUMPS CUTS & SCRATCHES	-DO-	2	-	-	
2.6	ARMOURING	2. SHEATH THICKNESS	MA	MEASUREMENT	SAMPLE	IS:5831 & DATA SHEET IS-1554 -DO-	IS:5831 & DATA SHEET IS-1554 -DO-	-DO-	2	-	-	
		3. DIA OVER INNER SHEATH	MA	-DO-	-DO-	-DO-	-DO-	-DO-	2	-	-	
		1. NO. OF WIRES/ STRIPS	MA	COUNTING	AT THE START OF THE PROCESS -DO-	BHEL SPEC./ APPD.DATA SH. IS:3975 & IS:1554 -DO-	BHEL SPEC./ APPD.DATA SH. IS:3975 & IS:1554 -DO-	-DO-	2	-	-	
		2. LAY DIRECTION	MA	VISUAL	-DO-	-DO-	-DO-	-DO-	2	-	-	
BHEL			PARTICULARS		BIDDER / VENDOR							
			NAME									
			SIGNATURE									
			DATE									
BIDDER'S / VENDOR'S COMPANY SEAL												

		QUALITY PLAN			CUSTOMER		PROJECT TITLE		SPECIFICATION NUMBER			
					BIDDER / VENDOR		QUALITY PLAN NUMBER PED-507-00-Q-002 / 02		SPECIFICATION TITLE			
		SHEET 4 OF 6			SYSTEM		ITEM PVC POWER & CONTROL CABLE		SECTION VOLUME III			
S. NO.	COMPONENT / OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.7	OUTER SHEATH EXTRUSION	3. LAY LENGTH	MA	VISUAL, MEAS.	-DO-	-DO-	-DO-	-DO-	2	-	-	
		4. COVERAGE	MA	MEASUREMENT	-DO-	-DO-	-DO-	-DO-	2	-	-	
		5. DIA OVER - ARMOURING	MA	MEASUREMENT	-DO-	-DO-	-DO-	-DO-	2	-	-	
		1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM BULGING, BURNT PARTICLES, LUMPS CUTS & SCRATCHES.	LOG BOOK	2	-	-	
		2. SHEATH THICKNESS	MA	MEASUREMENT	SAMPLE	IS:5831 & IS-1554 DATA SHEET	IS:5831 & IS-1554 DATA SHEET	-DO-	2	-	-	
		3. DIA OVER OUTER SHEATH	MA	-DO-	-DO-	-DO-	-DO-	-DO-	2	-	-	
2.8	FINISHED CABLE	4. MARKING	MA	VISUAL	100%	IS:1554 & BHEL SPEC.	IS:1554 & BHEL SPEC.	TEST REPORT	2	-	-	SEQUENTIAL MARKING SHALL BE DONE BY PRINTING.
		1. ROUTINE TEST	CR	ELEC. & MEAS.	100%	IS:1554 & BHEL SPEC.	IS:1554 & BHEL SPEC.	TEST REPORT	2	-	1	
3.0	FINAL INSPECTION	2. TYPE AND FRLS TESTS	CR	ELEC. PHY & MEAS	SAMPLE *	-DO-/APPD. DATA SHEET.	-DO-/APPD. DATA SHEET.	-DO-	2	-	1	*ONE DRUM / SIZE / LOT
		1. FINISH & LENGTH	MA	VISUAL	(SEE REMARK)	BHEL SPEC. IS: 1554	FREE FROM BULGING, BURNT PARTICLES LUMPS CUTS & SCRATCHES.	-DO-	2	1	-		ONE DRUM EACH FOR POWER AND CONTROL CABLES IN A LOT
BHEL			PARTICULARS		BIDDER / VENDOR							
			NAME									
			SIGNATURE									
			DATE									
BIDDER'S / VENDOR'S COMPANY SEAL												

		QUALITY PLAN			CUSTOMER		PROJECT TITLE		SPECIFICATION NUMBER			
					BIDDER / VENDOR		QUALITY PLAN NUMBER PED-507-00-Q-002 / 02		SPECIFICATION TITLE			
		SHEET 5 OF 6			SYSTEM		ITEM PVC POWER & CONTROL CABLE		SECTION VOLUME III			
S. NO.	COMPONENT / OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		2. DIMENSION	MA	MEASUREMENT	AS PER IS	APPD.DATA SHEET. IS:1554 IS:10810	APPD.DATA SHEET. IS:1554 IS:10810	-DO-	2	1	-	TYPE TEST SHELL BE WITNESSED ON ONE SAMPLE PER TYPE (POWER / CONTROL) OF EVERY LOT.
		3. ARMOURING- COVERAGE NO.OF WIRES /STRIPS	MA	VISUAL & MEAS.	AS PER IS	-DO-	-DO-	-DO-	2	1	-	
		4.MARKING/COLOR CODING	MA	VISUAL	-DO-	-DO-	-DO-	-DO-	2	1	-	
		5 ACCEPTANCE TESTS	CR	PHY. & ELECT. TESTS	-DO-	-DO-	-DO-	-DO-	2	1	-	
		6. TYPE & FRLS TESTS	CR	MEASUREMENT	(SEE REMARK)	BHEL SPEC. , APPD. DATA SHEET	BHEL SPEC. APPD. DATA SHEET	-DO-	2	1	-	
BHEL			PARTICULARS		BIDDER / VENDOR							
			NAME									
			SIGNATURE									
			DATE									
BIDDER'S / VENDOR'S COMPANY SEAL												

		QUALITY PLAN				CUSTOMER		PROJECT TITLE		SPECIFICATION NUMBER		
						BIDDER / VENDOR		QUALITY PLAN NUMBER PED-507-00-Q-002 / 02		SPECIFICATION TITLE		
		SHEET 6 OF 6				SYSTEM		ITEM PVC POWER & CONTROL CABLE		SECTION VOLUME III		
S. NO.	COMPONENT / OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE / METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
NOTES: A) JOINTS IN WIRES SHALL BE AS PERMITTED BY IS/BHEL SPECIFICATION. VENDOR TO CERTIFY THE SAME B) NO REPAIR OF CORE INSULATION FERMITTED. C) CABLE ENDS SHALL BE SEALED AS PER BHEL SPECIFICATION. D) PURCHASER SHALL HAVE RIGHT TO WITNESS THE SPARK TEST AT CORE STAGE. E) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDOR'S Q.C. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER. F) FILLERS / DUMMY CORES ETC. SHALL BE AS PER BHEL SPECIFICATION. G) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS SAMPLES, THE SAME SHALL BE AS PER VENDOR'S SAMPLING PLAN. H) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER BHEL SPECIFICATION. LEGEND :- P – PERFORMER : W–WITNESSER : V – VERIFYER: 1–BHEL/BHEL'S CUSTOMER: 2– VENDOR: 3–SUB VENDOR												
BHEL			PARTICULARS			BIDDER / VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S / VENDOR'S COMPANY SEAL			



TITLE

SPECIFICATION NO. PES-506-05

VOLUME II B

SECTION D

REV NO. 0 DATE 11.02.2002

SHEET 1 OF 1

E2
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GENERAL TECHNICAL REQUIREMENTS
OF
415 V AC DISTRIBUTION BOARD

SPECIFICATION NO. PES-506-05
(7 SHEETS)



TITLE

415 V AC DISTRIBUTION BOARD

SPECIFICATION NO. PES-506-05

VOLUME II B

SECTION D

REV NO. 0 DATE 11.02.2002

SHEET 1 OF 3

1.0 SCOPE

This specification covers the design, manufacture, assembly, testing, packing & despatch of AC Distribution Boards complete in all respect with all components, fittings & accessories for efficient and trouble free operation.

2.0 STANDARDS

Major standards which shall be followed are listed below. Other applicable standards for any component, if not covered in the listed standards, shall also be followed.

- IS:375 Marking & arrangement for swgr. busbars, main connections & aux. Wiring
- IS:4064 Air-break switches, disconnectors switch-disconnectors & fuse combination units
- IS:2147 Degree of protection provided by enclosures
- IS:8623 Factory built assemblies of switchgear & controlgear

3.0 CONSTRUCTIONAL FEATURES

3.1 GENERAL REQUIREMENTS

ACDBs shall be of single front construction having a continuous line-up of vertical sections housing switch-fuse modules only. ACDBs shall have duplicate incomers and a bus-section. In-cubicle rating of incomer and bus-section switches shall be identical to the associated busbar rating. Outgoing feeders shall be such so as to ensure uniform loading on each section DB.

ACDBs shall be indoor, air insulated, metal-clad and fixed type suitable for floor mounting. It shall conform to the degree of protection IP:54. Panels shall be fabricated from minimum 2mm thick CRCA sheet steel.

DB shall be front wired and front connected. They shall be fully compartmentalised with metal insulating partitions between compartments. Working height shall be limited between 450mm and 1800mm from floor level.

All instruments, switches etc. mounted on the front face of the panels shall be of flush type.

Each panel shall be provided with internal illumination lamp operated by door switch, space heater and switchfuse unit and plug socket with switch for hand lamp.

DBs shall be supplied with base frame made out of structural steel sections along with all necessary mounting hardware required for bolting/welding the base frames to the foundation.

3.2 BUSBARS & CONNECTIONS

Busbars shall be sized to carry continuously the total running load of the ACDB plus a 20% margin. The minimum clearance in air between phases and between phases and



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415 V AC DISTRIBUTION BOARD

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SECTION D

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SHEET 2 OF 3

earth for entire run of horizontal and vertical busbars shall be 25mm. Horizontal and vertical busbars and bus connections shall be of high conductivity copper/ aluminium alloy. Maximum temperature shall be limited to 90 deg C.

3.3 PANEL WIRING

All panels shall be fully wired at the factory to ensure proper functioning of all control, protection and interlock schemes. All wiring for external connection shall be brought to terminal blocks and numbered.

Panel wiring shall be carried out with flexible heat resistant 650V grade, PVC insulated stranded copper wire of minimum 2.5sq.mm cross-section.

Solderless compression /clamp type connection shall be used for wire terminals. Wiring shall be continuous between terminals without splicing. Each wire shall be identified at both ends with permanent markers having wire numbers as per approved wiring drawings.

Terminal blocks shall be box clamp type with marking strip. Not more than two wires shall be connected to one terminal. Spare terminals equal in number to 20% of active terminals shall be furnished.

3.4 GROUNDING

A copper ground bus, sized to carry maximum short circuit current shall run along the entire length of panel structure and shall have terminal connection at each end for connection to station ground grid (50x6 mm GI flat).

3.5 NAME PLATE

Name plates of approved design shall be furnished on each panel and for each instrument or device mounted on panel.

The material shall be lanucoid or approved equal 3mm thick with white letters on black background.

Name plates shall be held by self tapping screws. Name plates size shall be minimum 20x75mm for instruments devices and 40x50mm for panels.

4.0 SWITCHGEAR COMPONENTS

4.1 SWITCHES

Switches shall be triple/double pole air break type.

The switch shall have a quick-make, quick-break mechanism operated by a suitable external handle, complete with position indicator. This handle shall have provision for padlocking in ON & OFF position.



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415 V AC DISTRIBUTION BOARD

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SHEET 3 OF 3

The compartment door shall be interlocked mechanically with the switch such that the door cannot be opened unless the switch is in OFF position. Means shall be provided for releasing the interlock at any time.

Switches shall be capable of withstanding the through fault current of back up fuse.

Wherever two incoming switches and one bus-section switch are provided for an assembly, these shall be mechanically/key interlocked to ensure that only two out of three can be closed at a time.

4.2 FUSES

Fuses shall be HRC, preferably link type with a minimum interrupting capacity equal to short circuit current of the LV system.

Fuses shall be furnished complete with fuse bases and fittings of such design as to permit easy and safe replacement of fuse element. Visible indication shall be provided on blowing of the fuse.

The fuse on incoming feeder wherever provided shall be chosen to provide discrimination with outgoing feeder fuses.

4.3 METERS & METER SELECTOR SWITCHES

All indicating instruments (96x96mm) shall be switchboard types with 250deg. Scale, antiglare glass and accuracy class of $\pm 2\%$ full scale. Each meter shall have zero adjuster on the front.

Meter selector switches shall be maintained contact, stay-put type with knob handle. Voltmeter selector switches shall be four position type.

5.0 PAINTING

All metal surface shall be cleaned, phosphated and given two coats of rust-resistant primer followed by two coats of synthetic enamel paint in light grey shade (IS:5 shade 631).

6.0 TESTS

Each panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment. The test shall include wiring continuity tests, insulation tests and functional tests to ensure satisfactory operation and control of individual equipment.



TITLE

415 V AC DISTRIBUTION BOARD

(DATA SHEET - A)

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. DATE

SHEET 1 OF 1

1.0 GENERAL

1.1 Type : Fixed Type

1.2 Service : Indoor

1.3 Enclosure : IP-54

2.0 SYSTEM

2.1 Voltage : 415 V $\pm$ 10%

2.2 Phase : 3

2.3 Frequency : 50Hz $\pm$ 5%

2.4 System : Solidly grounded

3.0 RATED CURRENT AT 50 DEG.C

3.1 Busbar : to be decided by tenderer

3.2 Switches : to be decided by tenderer

4.0 SHORT CIRCUIT RATING

4.1 Interrupting : 50kA

4.2 Short time for 1sec. : 50kA

5.0 INSULATION LEVEL : 2.5kV for 1min



TITLE

415 V AC DISTRIBUTION BOARD

DATA SHEET C/B

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. DATE

SHEET 1 OF 3

1.0 EQUIPMENT

1.1 Make :

1.2 Type :

1.3 Reference Standard :

1.4 Construction

a/ Degree of protection :

b/ Sheet metal thickness (mm):

c/ Floor channel sills vibration

damping pads & kick

plate furnished

1.5 Whether all equipment are flush:

Mounted

1.6 Name plate

a/ Material :

b/ Thickness :

c/ Size for

-Equipment :

-Panels :

1.7 Internal illumination

a/ Volt :

b/ Watt :

c/ Door switch controlled :

1.8 Space Heater :

a/ Volt :

b/ Watt :

c/ Thermostat controlled :

1.9 Plug Socket :

a/ Type :

b/ Rating :



TITLE

415 V AC DISTRIBUTION BOARD

DATA SHEET C/B

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. DATE

SHEET 2 OF 3

1.10 Type & rating of isolating
Switch-fuse units for incoming
AC supply

1.11 Internal Wiring :

- a/ Wire type :
- b/ Voltage grade :
- c/ Conductor material :
- d/ Conductor size for :
- Current control circuit :
- Voltage circuit :

1.12 Terminal Block

- a/ Make :
- b/ Type :
- c/ 20% spare terminals furnished

1.13 Ground Bus

- a/ Material
- b/ Size

1.14 Painting

- a/ Type of finish
- b/ Colour shade

2.0 SWITCHES

- 2.1 Make
- 2.2 Type
- 2.3 Reference standard
- 2.4 Breaking current at 415V AC

3.0 FUSE

- 3.1 Make
- 3.2 Type



TITLE

415 V AC DISTRIBUTION BOARD

DATA SHEET C/B

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO.

DATE

SHEET 3 OF 3

- 3.3 Reference standard
- 3.4 Rupturing capacity (kA rms)
- 3.5 Cont. current at 50deg.C ambient
and within cubicle (Amp.)

- 3.6 Cut-off currents (kA peak)
- 3.7 Whether fuse characteristics

furnished

4.0 METER SELECTOR SWITCH

- 4.1 Make
- 4.2 Type
- 4.3 Reference standard
- 4.4 Contact rating
 - a/ Make & continuous (Amp.)
 - b/ Break inductive (Amp.)

5.0 INDICATING INSTRUMENT

- 5.1 Make
- 5.2 Type
- 5.3 Reference Standard
- 5.4 Type of movement
- 5.5 Accuracy class
- 5.6 Scale in degrees
- 5.7 VA barden



TITLE:

**LIGHTING DISTRIBUTION BOARD
& LIGHTING PANEL**

SPECIFICATION NO. PES-558-01A

VOLUME - II B

SECTION - D

REV.NO. 0 DATE

SHEET 1 OF

GENERAL TECHNICAL REQUIREMENTS
OF
LIGHTING DISTRIBUTION BOARD
&
LIGHTING PANEL
SPECIFICATION NO. PES-559-01A



TITLE

LIGHTING DISTRIBUTION BOARD
&
LIGHTING PANEL

SPECIFICATION NO. PES-558-01A

VOLUME II B

SECTION D

REV NO. 0 DATE 11.02.2002

SHEET 1 OF 14

1.0 SCOPE

This specification covers the design, manufacture, assembly, testing, packing & despatch, installation & commissioning of AC Lighting Distribution Boards complete in all respect with all components, fittings & accessories for efficient and trouble free operation.

2.0 STANDARDS

Unless specified otherwise, the latest revisions of standards, codes and other applicable statutory rules and regulations specified in Annexure-I of Data Sheet A are applicable and shall be referred to.

3.0 Light Distribution Boards (LDBs)

3.1 General Requirements

3.1.1 LDBs shall be totally enclosed, modular in construction, indoor type and suitable for electrical system data as specified in Data Sheet A. The LDB shall be free standing type suitable for installation on cable trenches / floor.

3.1.2 LDBs shall be constructed from CRCA sheet and structural sections. Sheet thickness for load bearing members shall be 2.0 mm and that for non-load bearing members shall be 1.6 mm, unless specified otherwise in Data Sheet A. The design and construction of LDBs shall ensure adequate rigidity.

3.1.3 Vertical cable chambers / alleys of adequate width but not less than 250 mm shall be provided for incoming / outgoing cables of each panel.

3.1.4 LDBs shall have only one operational front. Door shall be provided at the front of each module to give full access to all the components.

3.1.5 LDBs shall consist of dust and vermin proof cubicles without the use of louvers (except the transformer compartment, where applicable).

3.1.6 Good quality synthetic rubber / neoprene gaskets shall be put around the door, cover edges and cutout edges for pushbutton, lamps etc. for protection against dust. The door when closed, shall compress the gasket uniformly.

3.1.7 Cutout edges for instruments, relays etc. shall have sufficient overlap surface to minimize the dust entry. The arrangement for the front mounting of switch handles shall render the LDB reasonably dust free such that the normal operations are not affected.

3.1.8 Degree of protection for completed LDBs (Distribution Board) shall be IP:52 unless mentioned otherwise in Data Sheet A.

3.1.9 The LDBs shall be designed to prevent contact with live parts both within the modules and in the cable alley.



TITLE

LIGHTING DISTRIBUTION BOARD
&
LIGHTING PANEL

SPECIFICATION NO. PES-558-01A

VOLUME II B

SECTION D

REV NO. 0 DATE 11.02.2002

SHEET 2 OF 14

- 3.1.10 The ratings of all components shown in the enclosed drawings are indicative only. The bidder shall be responsible to check and coordinate the MCB characteristic with back up fuses etc. provided. Any change in size / ratings of components required for final arrangement may be complied with and provided by the vendor at no extra cost.
- 3.1.11 All equipment shall be constructed of non-hygroscopic and non-inflammable materials.
- 3.1.12 All components mounted in the LDBs shall be accessible and shall not impede access to wiring or terminals. All faults except busbar fault which may occur within any individual unit shall be confined within that unit only and shall not cause shutdown of any section of the board other than the affected unit itself. Maintenance and inspection shall be possible in any individual unit without affecting other units.
- 3.1.13 Incoming unit shall comprise of either switch-fuse / composite fuse-switch unit or MCCB as per scheme / Data Sheet A. Outgoing units shall be a switch-fuse / composite fuse-switch unit / MCB.
- 3.1.14 The rated continuous current of the equipment and components shall be as given in the schemes. These ratings shall be obtained with the components mounted in their housing as in service without exceeding the permissible temperature rise.
- 3.1.15 Interlock between compartment door and modules shall be provided such that the door cannot be opened without switching off the power supply to the module.
- 3.1.16 Defeat interlock shall be provided for the units comprising of switch or moulded case circuit breaker as a means of isolation device, such that it is possible to open the door with device ON. It shall not be possible to close the door till the interlock has been reinstated.
- 3.1.17 Each LDB shall be fitted with base frame made of angle or channel.
- 3.1.18 All fixing nuts and bolts together with grounding bolts shall be provided.
- 3.1.19 Lifting lugs shall be provided for each shipping section of LDB. Removal of such lugs or hooks shall leave no opening in the LDB.
- 3.2 LDBs with transformers (Additional Features)
- 3.2.1 The lighting distribution board shall be arranged in two adjacent but separate compartments, one compartment for the lighting transformer and the other for the incoming & outgoing feeders etc.
- 3.2.2 The transformer shall be mounted on the base channel and it shall be possible to easily remove the transformer from the cubicle after opening the door. Necessary portable ramp made of mild steel shall be supplied along with each LDB.

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	3.2.3 Independent gasketted hinged door with operating handle shall be provided for access to transformer & its taps. Operating handle shall have built-in key locking arrangement. 3.2.4 Suitable ventilation arrangement for the transformer compartment to dissipate the heat of the transformer shall be provided. The arrangement shall be in the form of louvers and the same shall be provided with galvanized wire mesh with dust catchers on the inside. 3.2.5 The degree of protection for transformer compartment shall be IP:42 unless mentioned otherwise in Data Sheet A. 3.2.6 Connections between transformer secondary terminals and the busbars shall be made by using PVC insulated flexible copper cables or busbars. 3.2.7 Warning plate shall be provided on transformer enclosure. The inscription of warning plate shall be as given below: - DO NOT OPEN DOORS WHEN ENERGISED - KEEP TAPS AT SAME POSITION FOR ALL PHASES 3.2.8 Transformer enclosure shall be provided with a danger plate. 3.3 Lighting Transformer 3.3.1 Lighting transformer, where specified shall form an integral part of lighting distribution board. 3.3.2 Lighting transformer shall be dry type, natural air cooled and suitable for mounting inside the lighting distribution board. Transformer shall be non-encapsulated type, unless specified otherwise in Data Sheet A. 3.3.3 Rating of transformer shall be 50 kVA as per type of LDB. 3.3.4 Voltage rating shall be given in Data Sheet A. 3.3.5 Percentage impedance shall be 3% for 50kVA and 4% for 100 kVA transformers, unless specified otherwise in Data Sheet A. 3.3.6 Off circuit tap changers/links shall be provided for $\pm 5\%$ in steps of 2.5%. 3.3.7 Transformer winding insulation shall be class “F” or better. 3.3.8 Transformer shall be of vector group Dyn1.	

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3.3.9 Winding shall be of copper material maximum winding temperature at full load and under site conditions shall not exceed 120 Deg. C. 3.3.10 Transformer shall be suitable for cable connections on the primary side and flexible cable or busbar connectin on the secondary side. 3.3.11 The secondary neutral of the transformer shall be brought out for getting a grounded 4 wire supply system. 3.3.12 The transformer neutral shall be brought outside the LDB for earthing. The neutral busbar shall be insulated from the LDB enclosure. 3.3.13 Transformer shall be provided with the rollers, pulling holes, lifting lugs, jacking positions etc. 3.4 Busbars, Connections and Joints 3.4.1 Busbars shall be made of aluminium grade E 91E or high conductivity copper (ETC), Busbar material shall generally be aluminium unless mentioned otherwise in Data Sheet A. 3.4.2 Busbars shall be supported on non-hygroscopic and non-inflammable insulators of material such as glass reinforced moulded plastic material, epoxy cast resin etc. Separate supports shall be provided for each phase of the busbars, Insulation level of neutral busbar shall be same as that of phase busbars. 3.4.3 Busbars shall be contained in a separate vermin-proof compartment within the LDB and shall have bolted sheet steel covers for providing suitable access. 3.4.4 Busbar clearances in the air shall be as per applicable standard for 500V, 3 phase system. 3.4.5 Temperature of busbars, droppers and connections shall not exceed 90 Deg. C for an ambient of 50 Deg. C while carrying maximum continuous current. 3.4.6 The busbar, busbar connections and supports shall have sufficient strength to withstand thermal and electromechanical stresses produced by the specified short circuit level of the system. 3.4.7 Busbars (including neutral busbar) shall be capable of carrying the short-time current specified in Data Sheet A. The duration of short-time current shall be 1 sec unless mentioned otherwise in Data Sheet A. For the specified current and duration, there shall be no damage to the equipment. 3.4.8 The neutral bus shall be rated same as phase bus.		

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3.4.9 Main busbars and connections shall be prominently marked and displaced for standard sequence counting from rear to front top to bottom, or left to right as viewed from the switching device operating mechanism side.

3.4.10 Busbars and connections shall be provided with colour coded PVD sleeves. All live parts shall be properly shrouded with insulating material.

3.4.11 Earth busbar shall be provided separately. Material of earth busbar shall be GI unless mentioned otherwise in Data Sheet A.

3.4.12 Busbar Joints

- a) Busbar and tap off joints shall be bolted type.
- b) Busbars shall be thoroughly cleaned before jointing. Suitable contact grease shall be applied to remove oxide film just before jointing.
- c) For copper busbars, the connecting portion shall be tinned or silver plated.

3.5 Wiring and Terminals

3.5.1 All internal wiring for connections to remote equipment shall be brought to terminal boards. Spare contacts of devices shall also be wired upto terminal board as per schemes. Wires shall not be jointed or teed-off except at terminal points.

3.5.2 Wiring shall be made by 1000 volt grade three / seven strand PVC insulated copper wire having a cross-sectional area of not less than 1.5 sq.mm. All connections from CT leads upto instruments, terminals shall be made by copper wires of minimum 2.5 sq.mm. size.

3.5.3 All wiring shall be made with the Colour Codes specified below:

a) 3 phase AC Connections

Phase 1 (R)	Red
Phase 2 (Y)	Yellow
Phase 1 (B)	Blue
Neutral	Black

b) 1 phase AC Connections

Phase Red/ Yellow / Blue
(as per associated circuit)
Neutral Black

c) DC Connections

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	Positive Negative While Grey d) Earth Connection Green 3.5.4 Where wiring passes from one compartment to another, the aperture shall be 'Bushed' to prevent damage to wires against sheet metal edges. Bushes may comprise of good quality rubber/ PVC grommets. 3.5.5 Every wire end shall be fitted with numbered ferrules of white or yellow colour having glossy finish with identification number engraved in black, Ferrules shall be made of moisture and oil resisting insulating material. Ferrules shall be of interlocked type or tight fitting type. Ferrules shall be so fitted that they will not get detached, when the wire is removed from the terminal. 3.5.6 System of marking of wiring shall be as per applicable standard. 3.5.7 All wires used internally shall have crimped on tinned copper lugs for terminations. 3.5.8 Terminal boards shall be stud type with insulating barriers of adequate height. 3.5.9 Terminal boards shall have separate terminals for incoming and outgoing wires with not more than two wires connected to any one terminal. 3.5.10 Terminal boards shall be mounted vertically or in the horizontal rows and properly spaced to have clean wiring arrangement, adequate access for putting ferrules, making terminations etc. It shall be possible to read the ferrule numbers when the wiring is complete. Where terminals may be live when the equipment is isolated from the main supply, these shall be clearly marked near the terminal boards. 3.6 Controls The controls shall be provided as per purchaser's requirements covered in the specification and control schemes. 3.7 Switch Fuse Units 3.7.1 These units shall preferably comprise of switches having integral fuses, called composite units. Alternatively, combination units of separate switch and fuse may also be acceptable. 3.7.2 These units shall be provided for general purpose i.e. incoming or outgoing units. 3.7.3 The units shall be of the air break air insulated type and designed to ensure safety to operating personnel.	

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3.7.4 Composite units shall have integral fuses i.e. fuse carrier with fuse link (fuse link forming the moving contact). The design shall ensure that the moving contact is not live when switch is open i.e. in OFF position, so as to facilitate removal of fuse.

3.7.5 The switch shall be capable making and carrying the system prospective fault current, but limited in magnitude and duration by the cut off characteristics of the largest HRC fuse link that may be fitted to that unit.

3.7.6 The fixed contact shall be so shrouded that maintenance of the unit can be carried out in safety with the busbars live.

3.7.7 Where one isolating switch is used as the incoming device, the incoming side fixed contacts shall be shrouded to ensure that maintenance can be carried out with the remote fuse and switch closed.

3.7.8 Composite switch-fuse or the combination of switch and fuse shall meet the requirements of its components as follows:

3.7.9 Isolating Switch

- a) Switches shall be air-break, quick make, quick break heavy duty type conforming to applicable standard.
- b) All switches shall have visible ON / OFF position indication and shall be padlockable in any (ON /OFF) position.
- c) Switches shall be door interlocked such that it shall not be possible to gain access to inside the unit unless the isolating switch is in OFF position.
- d) The switches shall be suitable for independent manual operation.
- e) The switch contacts shall be of silver alloy or silver plated copper and springs of non corrosive material.
- f) Inter-phase barriers shall be provided to prevent possibilities of phase to phase fault in the switch. The switch shall also be shrouded from all sides to prevent access to live parts on the switch after opening the unit door. The barriers and shrouding shall extend upto the height of switch to fully enclose both side terminals of the device. The arrangement shall permit easy maintenance.

3.7.10 High Rupturing Capacity (HRC) Fuses

- a) The fuse serving as the short-circuit protective device in isolating fuse-switch units shall be of HRC cartridge, current limiting and plug-in non-deteriorating type.

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	b) The fuse carriers shall be easily withdrawable for replacement of fuse, Insulated fuse pullers shall be provided where fuses are not mounted in insulating carriers to remove and replace fuses in live conditions. c) Fuses shall preferably be fitted with a device to indicate operation (i.e. when the fuse has blown). d) Live terminals of fuse bases shall be shrouded to prevent contact with personnel where fuse links are not mounted in carriers and are directly plugged into the fuse base. Inter-phase barriers extending throughout the length of the fuse base shall be provided to prevent inter-phase short circuit. They shall be shrouded from all sides to prevent accidental contact. e) Fuse carriers and bases shall be of good quality moulded insulating material. Porcelain fuse bases and carriers will not be accepted. 3.8 Cable Terminations 3.8.1 All cable, either incoming or outgoing to the LDB, shall be terminated in a cable chamber. For each panel, there shall be a cable chamber on the side. The door of cable chamber should open or be locked with the help of a tool. Unless stated otherwise in Data Sheet A, all cables shall enter from the bottom. 3.8.2 Removable undrilled gland plates of sheet steel shall be provided in the cable chamber for entry of cables. Minimum thickness of gland plate shall be 3mm. The gland plate shall be of adequate size for connecting requisite number of cable glands for power and control cables. 3.8.3 Heavy duty bolt-on termination tinned copper lugs of compression type shall be used in for power cable termination. 3.8.4 For supporting and clamping of cable cores at regular interval in cable alleys, suitable slotted angle upto the respective terminal blocks shall be provided. 3.8.5 The supply of tinned copper cable lugs for power cables from part the supply of equipment. 3.9 Earthing 3.9.1 An earth busbar of adequate size of galvanized MS shall be provided at the bottom for the entire length of the LDB.	

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3.9.2 Every metal part other than those forming parts of an electrical circuit shall connected to the earth bus by means of high conductivity copper wire of size not less than 2.5 sq. mm cross-sectional area.

3.9.3 Doors shall have a flexible copper wire for earth connection to fixed unit.

3.9.4 Each LDB shall be fitted with two earthing studs located in accessible position on sides for connection of internal earth busbar to the external earthing connection.

3.9.5 Earth busbar shall be brought outside LDB for making external connections.

3.10 Type of LDBs

The LDBs shall be of following type:

- a) LDB-H (n) - AC LDB with 100 kVA transformer
- b) LDB-F (n) - AC LDB with 50 kVA transformer
- c) LDB-N (n) - AC LDB with no transformer
- d) LDB-D (n) - DC LDB

NOTE: (n) indicates number of outgoing feeders.

3.10.1 AC LDBs (LDB-H, LDB-F, LDB-N)

Each LDB shall comprise of the following and comply with the enclosed single line diagrams:

- a) One lighting transformer (LDB-H & LDB-F)
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- b) One incomer of TP / TPN switch-fuse unit or MCCB / MCCB with neutral link as per Data Sheet A. It shall be provided on the primary side of transformer for LDB type LDB-H & LDB-F.
- c) Set of busbars with 3 phase and neutral.
- d) TPN switchfuse units for each outgoing circuit.
- e) Three indicating lamps with fuses for indicating bus supply ON.
- f) CT operated ammeter with selector switch.
- g) VT operated voltmeter with selector switch.



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- h) Power & control terminals, earth-stud, earth busbar, designation labels, internal wiring, power cable lugs, glands etc. shall be provided to complete the LDB in all respects.

3.10.2 DC LDBs (LDB-D)

Each LDB shall comprise of the following and comply with the enclosed single line diagrams::

- a) One incomer of two pole switch-fuse unit.
- b) Two pole DC contactor on the incoming circuit for changeover to DC in case of AC normal supply failure.
- c) One under voltage relay of suitable range, if specified in Data Sheet A.
- d) One ON delay timer.
- e) One test push button.
- f) Set of busbars for positive and negative.
- g) Two pole switch-fuse units / MCB for outgoing feeders.
- h) Two indicating lamps with fuses for indicating but supply ON.
- i) Power & control terminals, earth busbar, designation labels, internal wiring, power cable lugs, glands etc. shall be provided to complete the LDB in all respects.

4.0 LIGHTING PANELS (LPs)

4.1 General Requirements of Lighting Panels

- 4.1.1. LPs shall be totally enclosed, suitable for electrical system data as specified in Data Sheet A.
- 4.1.2. Panels shall be suitable for indoor / outdoor application as per Data Sheet A and BOQ. Outdoor panels shall have a sloping canopy.
- 4.1.3. LPs shall be constructed from CRCA sheet. Sheet thickness shall be 2.0mm, unless mentioned otherwise in Data Sheet A. The construction of LPs shall ensure adequate rigidity.

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4.1.4 All components of the LP shall be fully mounted inside the panel, LPs shall have only one operational front. Door shall be provided to give full access to all the components. Door shall have padlocking arrangement. 4.1.5 LPs shall consist of dust and vermin proof cubicles without the use of louvers. 4.1.6 Good quality synthetic rubber / neoprene gaskets shall be put around the door. The door when closed, shall compress the gasket uniformity. 4.1.7 Unless mentioned otherwise in Data Sheet A, degree of protection for completed LPs shall be IP:52 for indoor LPs and IP:55 (with weather-proof protection & canopy) for outdoor LPs. 4.1.8 The LPs shall be designed to prevent contact with live parts when the front door is open. 4.1.9 All busbars (phase, neutral, positive, negative as applicable) within a panel shall be of the same size. 4.1.10 All control wiring inside the panels shall be carried out with 1100 V grade, PVC insulated flexible copper wire of 2.5 sq.mm size. 4.1.11 The rated continuous current of the equipment and components 4.1.12 Each LP shall be fitted with MS. Mounting brackets. 4.1.13 Panel shall be suitable for top / bottom cable / conduit entries. However, outdoor LPs shall have bottom cable / conduit entry. Removable undrilled undrilled gland plate of sheet steel shall be provided for entry of cables. Minimum thickness of gland plate shall be 3 mm. The gland plate shall be of adequate size having knock-outs for requisite number cable connections. Gland plate shall be provided with gasket. 4.1.14 The lighting panel shall be complete with copper busbars, and shall incorporate switch fuse or MCB on the incoming side, single pole miniature circuit breakers (MCBs) for AC outgoing circuits and double pole MCBs for DC outgoing circuits. Number of outgoing circuits shall be as per BOQ. 4.1.15 Each lighting panel shall be fitted with two GI earth studs located in accessible position on the outside of the panel on opposite sides. 4.1.16 All metal parts of the panel except current carrying parts shall be bonded together electrically to the earthing stud. 4.1.17 Each panel shall be fitted with phase barriers of fireproof insulating material in such a manner that it is not readily possible for personnel to touch the phase busbars.		

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Insulating sheet shall be fitted around the MCBs such that only the surface and toggle of the MCBs are available on the front.

4.1.18 The supply of cable lugs for power and control cable connections forms part the supply of equipment.

4.1.19 Each panel shall be provided with a circuit directory plate with inscriptions neatly typed and laminated fitted on the inside of door.

4.2 Type of Lighting Panels

a)	LP-A (n)	-	AC	Lighting Panel
b)	LP-D (n)	-	DC	Lighting Panel
c)	LP-F (n)	-	Fancy	Lighting Panel (Decorative)
d)	LP-V (n)	-	Aviation	Lighting Panel

NOTE: (n) indicates number of outgoing circuits.

4.3 AC Lighting Panel (LP-A)

4.3.1 LPs shall be provided with TPN switch as incomer.

4.3.2 Requisite number of single pole MCBs shall be provided for outgoing circuits.

4.3.3 Separate neutral shall be available at terminal block for each outgoing circuit.

4.3.4 Construction of AC Normal and AC Emergency panels shall be same.

4.4 DC Lighting Panels (LP-D)

4.4.1 LPs shall be provided with double pole switch as incomer.

4.4.2 Requisite number of double pole MCBs shall be provided for outgoing circuits.

4.5 Decorative Type Lighting Panels (LP-F)

4.5.1 Decorative lighting panels shall be designed for use in areas like administrative building, service building, canteen, residential premises etc.

4.5.2 Thickness of sheet steel shall be as per manufacturer's practice.

4.5.3 LPs shall be of tone colour with elegant finish.

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4.5.4 LPs shall be provided with TPN switch as incomer and requisite number of MCBs shall be provided for outgoing circuits.

4.5.5 LPs shall be suitable for either surface or flush mounting as per Data Sheet A and BOQ. Flush mounted panels shall have the collared door suitable for matching with the wall.

4.5.6 Lighting Panels may be provided with transparent acrylic cover for operation of MCBs, if asked for in Data Sheet A.

4.5.7 LPs shall be provided with knockouts on the top, bottom and sides.

4.6 Aviation Lighting Panel (LP_V)

4.6.1 Aviation Lighting Panels shall be provided for feeding power supply to Aviation obstruction luminaries.

4.6.2 Each Aviation Lighting Panel shall comprise of the following:

a) One TPN door interlocked switch-use unit. Interlock defeat feature shall also be provided.

b) Three pole AC Contactor

c) 00-24 hrs timer and a photo-electric switch for automatic switching of contactor

d) Three phase & neutral busbars

e) Single pole or three pole MCBs for each outgoing circuit as per Data Sheet A

f) Two lamps for bus supply ON & OFF indications

g) Complete wiring arrangement as per control scheme.

h) Auto-Manual selector switch

i) ON push button

j) OFF push button

k) Photo switch

4.6.3 Switching ON and switching OFF shall be through both 00-24 hrs timer and light sensor in automatic mode.

4.6.4 One number light sensor in weather proof enclosure having IP:55 degree of protection shall be supplied loose along with each SLP.



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4.6.5 Internal power wiring shall be done with PVC insulated Cu wire of suitable size. All control wiring inside the panel shall be carried out with 1100 V grade, PVC insulated flexible copper wires.

5.0 Guaranteed Performance Requirements

5.1 The vendor shall guarantee satisfactory performance of the equipment under all conditions and requirement as laid down by this specification.

5.2 For the general requirements of performance guarantees refer to other parts of the specification.

6.0 PAINTING

(All metal surface shall be cleaned, phosphated and given two coats of rust-resistant primer followed by two coats of synthetic enamel paint in light grey shade (IS:5 shade 631).

7.0 TESTS

Each panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment. The test shall include wiring continuity tests, insulation tests and functional tests to ensure satisfactory operation and control of individual equipment.



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1.0 SYSTEM DESIGN DATA

1.1 Design Ambient : 50 Deg.C

1.2 Relative humidity :

a) Average : As per project synopsis
b) Maximum : -do-

1.3 Details of Operating parameters

a) AC Supply

i. Rated voltage : 415 V

ii. Rated frequency : 50 Hz

iii. Voltage variation : $\pm 10\%$
(Permissible)

iv. Frequency variation : $\pm 5\%$
(Premissible)

v. Combined voltage & : 10%
Frequency variation
(sum of absolutes
permissible)

vi. System fault level : 50 kA for 0.25 sec.
At rated voltage

vii. System grounding : Solidly

b) DC Supply Not applicable

i. Rated voltage : V

ii. Voltage variation : %
(Permissible)

iii. System fault level :
at rated voltage

c) AC Emergency luminaries : Not applicable %
as per percentage of total luminaries

2.0 APPLICABLE STANDARDS : As per Annexure I

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3.0	LIGHTING DISTRIBUTION BOARDS	
3.1	Sheet thickness	: 2.0 mm
3.2	Degree of protection	:
a)	Main panel	: IP 54
b)	Transformer cubicle	: IP 33
3.3	Type of Incomer	: Switch-Fuse
3.4	Type of Outgoing Feeders	: Switch-Fuse
3.5	Voltage rating of transformer	: 415 V
3.6	Whether transformer is encapsulated:	No
3.7	Transformer impedance	
a)	100 kVA	: - %
b)	50 kVA	: 4.0 %
3.8	Bus bar material	: Aluminium
3.9	Earth busbar material	: GI (50X6 mm)
3.10	Cable entry	: Bottom
3.11	Whether under voltage relay required in DC LDB	: Not applicable
4.0	LIGHTING PANEL	
4.1	Application	: Both Indoor & outdoor
4.2	Sheet thickness	: 2.0 mm
4.3	Degree of protection	:
a)	Indoor	: IP : 54
b)	Outdoor (weather-proof	: IP : 55 protection with canopy)
4.4	Type of Incomer	: Switch-Fuse
4.5	No. of poles for Aviation lighting panel MCBs	: 1 / 3

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- 4.6 Type of mounting of decorative lighting panel : Not applicable
- 4.7 Whether decorative lighting panel required with acrylic panel : Not applicable
- 5.0 LABELING : As per specification
- 6.0 PAINTING :
- 6.1 Shade (as per IS:5)
- | | Interior | Exterior |
|-----------|--------------|-------------|
| a) LDBs : | Glossy white | 631 of IS:5 |
| b) LPs : | -do- | -do- |
- 6.2 FINISH
- | | |
|---------------|-------------|
| a) Interior : | Semi-glossy |
| b) Exterior : | Semi-glossy |
- 6.3 Paint thickness (min.) : 50 microns
- 7.0 MAKE OF COMPONENTS : Shall be subject to BHEL approval



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LIGHTING PANEL
(DATA SHEET - B)

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1.0 SYSTEM DESIGN DATA

1.1 Design Ambient : °C

1.2 Details of Operating parameters

a) AC Supply

- i. Rated voltage : V
- ii. Rated frequency : Hz
- iii. Voltage variation : %
(Permissible)
- iv. Frequency variation : %
(Permissible)
- v. Combined voltage & : %
frequency variation
(sum of absolutes
permissible)
- vi. System fault level :
at rated voltage

b) DC Supply

- i. Rated voltage : V
- ii. Voltage variation : %
(Permissible)
- iii. System fault level :
at rated voltage

2.0 APPLICABLE STANDARDS : As per Annexure I

3.0 Lighting Distribution Boards

3.1 Sheet thickness : mm

3.2 Degree of protection

a) Main panel :

b) Transformer cubicle :



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&
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- 3.3 Type of Incomer : ☐ MCCB
☐ Switch-Fuse
- 3.4 Type of Outgoing Feeders : ☐ Switch-Fuse
☐ MCB
- 3.5 Bus bar material : ☐ Aluminium ☐ Copper
- 3.6 Cable entry : ☐ Bottom ☐ Top
- 3.7 Whether under voltage relay required in DC LDB : ☐ Yes ☐ No
- 3.8 Range of time delay relay :
- 3.9 Whether hinged door with locking facility provided : ☐ Yes ☐ No
- 3.10 Whether earth busbar provided : ☐ Yes ☐ No
- 3.11 Earth busbar material : ☐ GI ☐ Copper
- 3.12 Fault current and duration : kA
- 3.13 Lighting Transformer
- a) kVA Rating(s) : 50 100
- b) Type of cooling :
- c) Rated current
- i. Primary : Amp.
- ii. Secondary : Amp.
- d) Rated voltage
- i. Primary : Volts
- ii. Secondary : Volts
- e) Rated frequency : Hz
- f) No. of phases :
- g) Temperature rise above ambient in winding by resistance : °C



TITLE

LIGHTING DISTRIBUTION BOARD
&
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h) Vector Group :

i) Tap changer

i. Type :

ii. Range :

iii. No. of taps :

iv. Voltage of each tap :

j) Type of ventilation arrangement provided for transformer enclosure :

k) Iron loss at 50 Hz and 100% rated voltage : kW

l) Regulation at full load and at 75 °C and 0.8 p.f. lagging :

m) Copper loss at rated load and 75 °C : kW

n) Impedance at rated current, frequency and at 75 °C :

o) Winding conductor material :

p) Whether transformer is encapsulated : ☐ Yes ☐ No

q) Insulation class :

r) Weight : kg

4.0 Lighting Panel

4.1 Application : ☐ Indoor ☐ Outdoor ☐ Both

4.2 Sheet thickness : mm

4.3 Degree of protection

a) Indoor : IP :



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- b) Outdoor : IP :
- 4.4 Type of Incomer : ☐ Switch-Fuse
☐ MCB
- 4.5 MCB type for street lighting panel. : ☐ 1 pole ☐ 3 pole
- 4.6 Busbar material :
- 4.7 Whether hinged door with locking facility provided : ☐ Yes ☐ No
- 4.8 Whether earthing studs provided : ☐ Yes ☐ No
- 5.0 LABELING
- Requirement of specification complied with : ☐ Yes ☐ No
- 6.0 PAINTING
- 6.1 Shade (as per IS:5)
- | | Interior | Exterior |
|-----------|----------|----------|
| a) LDBs : | | |
| b) LPs : | | |
- 6.2 Finish
- a) Interior : ☐ Matt ☐ Semi-glossy
- b) Exterior : ☐ Semi-glossy ☐ Full-glossy
- 6.3 Paint thickness (min.) : microns
- 7.0 O&M SPARES
- 7.1 Duration for which O&M spares considered : years



TITLE

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&
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1.0 SYSTEM DESIGN DATA

1.1 Design Ambient : °C

1.2 Details of Operating parameters

a) AC Supply

- i. Rated voltage : V
- ii. Rated frequency : Hz
- iii. Voltage variation : %
(Permissible)
- iv. Frequency variation : %
(Permissible)
- v. Combined voltage & : %
frequency variation
(sum of absolutes
permissible)
- vi. System fault level :
at rated voltage

b) DC Supply

- i. Rated voltage : V
- ii. Voltage variation : %
(Permissible)
- iii. System fault level :
at rated voltage

2.0 APPLICABLE STANDARDS : As per Annexure I

3.0 LIGHTING DISTRIBUTION BOARDS

3.1 Sheet thickness : mm

3.2 Degree of protection

a) Main panel :

b) Transformer cubicle :

3.3 Type of Incomer : [] MCCB



TITLE

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&
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- [] Switch-Fuse
- 3.4 Type of Outgoing Feeders : [] Switch-Fuse
[] MCB
- 3.5 Bus bar material : [] Aluminium [] Copper
- 3.6 Cable entry : [] Bottom [] Top
- 3.7 Whether under voltage relay required in DC LDB : [] Yes [] No
- 3.8 Range of time delay relay :
- 3.9 Whether hinged door with locking facility provided : [] Yes [] No
- 3.10 Whether earth busbar provided : [] Yes [] No
- 3.11 Earth busbar material : [] GI [] Copper
- 3.12 Fault current and duration : kA
- 3.13 Lighting Transformer
- a) kVA Rating(s) : 50 100
- b) Type of cooling :
- c) Rated current
- i. Primary : Amp.
- ii. Secondary : Amp.
- d) Rated voltage
- i. Primary : Volts
- ii. Secondary : Volts
- e) Rated frequency : Hz
- f) No. of phases :
- g) Temperature rise above ambient in winding by resistance : °C
- h) Vector Group :



TITLE

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i) Tap changer

i. Type :

ii. Range :

iii. No. of taps :

iv. Voltage of each tap :

j) Type of ventilation
arrangement provided for
transformer enclosure :k) Iron loss at 50 Hz and
100% rated voltage : kWl) Regulation at full load
and at 75 °C and 0.8
p.f. lagging :m) Copper loss at rated
load and 75 °C : kWn) Impedance at rated
current, frequency and
at 75 °C :o) Winding conductor
material :p) Whether transformer is
encapsulated : ☐ Yes ☐ No

q) Insulation class :

r) Weight : kg

4.0 LIGHTING PANEL

4.1 Application : ☐ Indoor ☐ Outdoor ☐ Both

4.2 Sheet thickness : mm

4.3 Degree of protection

a) Indoor : IP :

b) Outdoor : IP :



TITLE

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- 4.4 Type of Incomer : ☐ Switch-Fuse
☐ MCB
- 4.5 MCB type for street lighting panel. : ☐ 1 pole ☐ 3 pole
- 4.6 Busbar material :
- 4.7 Whether hinged door with locking facility provided : ☐ Yes ☐ No
- 4.8 Whether earthing studs provided : ☐ Yes ☐ No
- 5.0 LABELING
- Requirement of specification complied with : ☐ Yes ☐ No
- 6.0 PAINTING
- 6.1 Shade (as per IS:5)
- | | Interior | Exterior |
|-----------|----------|----------|
| a) LDBs : | | |
| b) LPs : | | |
- 6.2 FINISH
- a) Interior : ☐ Matt ☐ Semi-glossy
- b) Exterior : ☐ Semi-glossy ☐ Full-glossy
- 6.3 Paint thickness (min.) : microns
- 7.0 MAKE
- | EQUIPMENT | MAKE | TYPE DESIGNATION OF MANUFACTURER |
|-----------|------|----------------------------------|
| 7.1 LDBs | | |
| a) AC | | |
| b) DC | | |



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7.2 LPs

- a) AC
- b) DC
- c) Decorative
- d) Street Lighting

8.0 QUANTITY VARIATION (Limited to the value of the contract)

- a) Till the "Engineering" : %
is complete
- b) Till the "Erection" is : %
complete

9.0 O&M SPARES

- 9.1 Duration for which O&M : years
spares considered

10.0 DOCUMENTATION

Whether following enclosed :

- a) General Arrangement : ☐ Yes ☐ No
drawings of all types
of LDBs
- b) General Arrangement : ☐ Yes ☐ No
drawing of Lighting
Transformer
- c) Bar chart of activities : ☐ Yes ☐ No
of manufacture, testing,
inspection and dispatch

The above documents shall be submitted in the form of Annexure- A to Annexure - C in the exact order listed above along with this Data Sheet C duly filled up.



TITLE

**LIGHTNING PROTECTION OF CHIMNEY
(SUPPLY & INSTALLATION)****DATA SHEET - C
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)**

SPECIFICATION NO.

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- 1.0 Name of manufacturer :
- 2.0 Place & country of manufacture :
- 3.0 Standards applicable :
 - i/ For materials & sizes :
 - ii/ For galvanisation/Electroplated coating :
 - iii/ For testing uniformity of Galvanization :
 - iv/ For code of practice :
 - v/ For temporary lightning protection during construction :
- 4.0 Thickness of galvanizing on steel (microns) :
- 5.0 Thickness of Electroplated coatings (microns) :
- 6.0 Thickness of Lead coating on copper (mm) :
- 7.0 Materials and sizes offered :
 - i/ Below ground annular ring conductor :
 - ii/ Electrodes :
 - iii/ Below ground interconnection conductor :
 - iv/ Down Conductors :
 - v/ Vertical air terminations :
 - vi/ Horizontal air termination :
 - vii/ Test Pit :
 - viii/ Earthing band ring (above landing platform) :
 - ix/ Test Link :
 - x/ Conductor for equipment earthing :



LIGHTING SYSTEM

SPECIFIC TECHNICAL REQUIREMENTS

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ANNEXURE-I

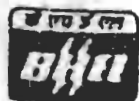
LIST OF APPLICABLE STANDARDS

Illumination

1.	Code of practice for interior illumination	[]	IS 3646
		[]	
2.	Code of practice for industrial lighting	[]	IS 6665
		[]	
3.	Code of practice for design of electrical street lighting installations	[]	IS 1944
		[]	

Luminaires

4.	General and safety requirement for electric lighting fittings	[]	IS 1913
		[]	
5.	Luminaires	[]	IS 10322
		[]	
6.	Industrial lighting fittings with metal reflector	[]	IS 1777
		[]	
7.	Industrial lighting fittings with plastic reflectors	[]	IS 3287
		[]	
8.	Decorative lighting outfits	[]	IS 5077
		[]	
9.	Water proof electric lighting fittings	[]	IS 3528
		[]	
10.	Water tight electric lighting fittings	[]	IS 3553
		[]	
11.	Dust proof electric lighting fittings	[]	IS 4012
		[]	
12.	Dust tight electric lighting fittings	[]	IS 4013
		[]	
13.	Flameproof electric lgtg. fittings well glass & bulk head types	[]	IS 2206
		[]	
14.	Electric lighting fittings for division 2 areas	[]	IS 8224
		[]	



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DATA SHEET - A

 LIGHTING SYSTEM
 SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION No. PES-558-01

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Lamps

15.	Electric lamps, tungsten filament general service	[] IS 418 []
16.	Tubular fluorescent lamps for general lighting service	[] IS 2418 []
17.	High pressure mercury vapour lamps	[] IS 9900 []
18.	High pressure sodium vapour lamps	[] IS 9974 []

Luminaire Components

19.	Ballast for fluorescent lamps for switch start circuits	[] IS 1534 []
20.	Ballast for high pressure mercury vapour lamps	[] IS 6616 []
21.	Capacitors for electric discharge lamps (fluorescent and MV)	[] IS 1569 []
22.	Bi-pin lamp holders for tubular fluorescent lamps	[] IS 3223 []
23.	Methods of measurement of lamp cap temp. rise	[] IS 8913 []
24.	Starters for fluorescent lamps	[] IS 2215 []
25.	Holders for starters for tubular fluorescent lamps	[] IS 3324 []
26.	Cast acrylic sheets for use in luminaires	[] IS 7569 []

Assembled Equipment and Components

27.	General requirements for swgr. and control gear for voltage not exceeding 1000 V AC or 1200 V DC	[] IS 4237 []
28.	Code of practice for selection, installation & maintenance of switchgear & control gear	[] IS 10118 []
29.	Flame proof enclosures for electrical apparatus	[] IS 2148 []



P E M

LIGHTING SYSTEM SPECIFIC TECHNICAL REQUIREMENTS

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30.	Classification of hazardous areas for electrical installations	[] IS 5572 []
31.	Degree of protection provided by enclosures for LV switchgear & control gear	[] IS 2147 []
32.	Dry type transformers	[] IS 11171 []
33.	Air break switches, disconnectors etc. and fuse combinations units	[] IS 4064 []
34.	Miniature air break circuit breaker for voltages not exceeding 1000 V	[] IS 8828 []
35.	Low voltage Fuses	[] IS 9224 []
36.	Contactors for voltages not exceeding 1000 V AC or 1200V DC	[] IS 2959 []
37.	Indicator lamps (visual)	[] IS 1901 []

Poles, Sockets and Other Miscellaneous

38.	Tubular steel poles for over head power lines	[] IS 2713 []
39.	Three pin plugs and sockets	[] IS 1293 []
40.	Switch socket outlets (non-interlocking)	[] IS 4615 []
41.	Interlocking switch socket outlet	[] IS 4160 []
42.	Structural steel (Standard quality)	[] IS 226 []
43.	Danger notice plates	[] IS 2551 []
44.	Boxes for enclosure of electric accessories steel & cast iron boxes	[] IS 5133 []
45.	Code of practice for general construction in steel	[] IS 800 []



PE-6666-6

P E M

LIGHTING SYSTEM

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46.	Wrought aluminium and aluminium alloy bars, rods, tubes and sections for electrical purposes	[] IS 5082 []
47.	Code of practice for phosphating of iron and steel	[] IS 6005 []
48.	Colour for ready mixed paints & enamels	[] IS 5 []
49.	Recommended practice for hot dip galvanising of iron & steel	[] IS 2629 []
50.	Method of testing uniformity of coating on zinc coated articles	[] IS 2603 []



TITLE:

**TECHNICAL SPECIFICATION
STACK ELEVATOR**

SPECIFICATION NO. PE-TS-417-503-A-001

VOLUME - IIB

SECTION "D"

SUB-SECTION A6

REV. 00

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**SECTION - D
SUB-SECTION – A6**

STACK ELEVATOR

	TECHNICAL SECIFICATION STACK ELEVATOR	SPECIFICATION NO. PE-TS-410-503-A-001	
		VOLUME II B	
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1.

DESIGN AND CONSTRUCTION

1.1

Stack Elevator - General

1.1.1

The stack elevator including mechanical and electrical components shall be installed outside/inside Single flue/ multi flue chimney. Since chimney is a free standing structure, deflection of chimney top is expected during the normal operation, so the design of the elevator shall be in such a way that the elevator operation will be safe even with the expected maximum deflection of the chimney structure. The stack elevator shall lift a pay load as indicated against rated load as mentioned in Data sheet-A or its nearest as per manufacturer's present standard in addition to the weight of the car and its accessories and shall travel at a rated speed as indicated in the data sheet-A. Travel of the elevator car, number of landings and levels shall be as per Data sheet-A attached to this section.

1.1.2

Stack elevator mechanical and electrical operating devices and trailing cable shall be designed for operation indoors/out door with dusty and high humidity conditions and shall operate equally well in any ambient temperature encountered in the site conditions. Additionally, all mechanical and electrical components of the elevator shall be designed to withstand without damage a temperature of 100°C when the elevator is not operating.

1.1.3

Cage earthing shall be done through trailing cable.

1.1.4

Stack elevator shall be attached to the chimney shell using expansion type anchor bolts drilled in to chimney shell. Elevator shall be capable of operating from the ground floor to the top platform with intermediate stops at all platforms. Landing for elevator parking shall be one (1) metre above the stack ground floor. Suitable concrete/brick steps leading to the landing for entry to cabin shall also be provided,

1.1.5

The stack elevator shall be designed in line with recommendations contained in the latest editions of the applicable codes and standards.

1.2

Equipment Specification

1.2.1

Enclosures

i.

A three-sided enclosure with one access door shall be provided at graded level. At each platform landing above graded level, a one sided enclosure with access door shall be provided. Enclosures shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high and one coat of epoxy primer coated. Enclosure access doors shall be electrically and mechanically interlocked so that they remain closed and locked except when the Cab is at the landing. Doors shall be bi-parting and swinging type.

ii.

Base of three-sided enclosure shall be securely anchored to the grade level floor slab using expansion type anchors.

1.2.2

Mast

i.

Mast shall be provided in sections approximately 1.52 m in lengths considering of tubular sections and/or structural shapes welded together to form a frame work to which the rack is bolted. Mast shall be securely anchored to the concrete chimney walls.

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1.2.3

Cab

i.

Cab frame shall be fabricated from tubular steel and enclosed with expanded metal or wire mesh.

ii.

Cab floor shall be of skid resistant glass fibre reinforced plywood or approved equal. Cab shall be attached to a framed structure and form integral part with the drive mechanism located atop the cab.

Framed structure shall include guide rollers and safety hooks to ensure positive engagement of the rack and pinion to prevent cab disengagement in case of roller failure.

1.2.4

Buffers

i.

Sufficient numbers of buffers of spring loaded/hydraulic type shall be fitted below the cab. The buffers shall be capable of stopping the cab without permanent damage or deformation to themselves or any other part of the equipment. The number of buffers shall be so fixed as to ensure proper sharing of impact loads by all of them.

1.2.5

Drive unit and safety Device

i.

Drive unit located on the top of the cab shall be complete with Ac squirrel cage induction motor, reduction gear, drive pinion and an over speed governor. Drive unit shall incorporate an electric disc brake and an external manual brake release. The brake on the electric motor will be of the electromagnetic single disc self-adjusting type with the mechanical compression spring being held off by the electromagnet.

ii.

The hoist shall be provided with a centrifugal brake to prevent accidental tripping of safety device when the cage shall be taken to the ground by gravity in case of power failure.

1.2.6

Power and Control

i.

All electrical components furnished with the elevator shall be completely wired, energised and checked. Necessary power distribution arrangement shall be provided by the contractor to feed the electrical power to the elevator.

ii.

All electrical control devices shall be in enclosures. Equipment furnished shall also include the following:

a)

Momentary contact push button for raise lower control.

b)

Reversing combination motor starter with a moulded case circuit breaker for the motor. Starter shall be equipped with three thermal overload relays for motor protection. Operating handle for the combination starter circuit breaker shall be accessible from inside the cab and shall also serve as an emergency stop switch.

c)

Electrical and mechanical interlocks on cab access door and landing level enclosure doors.

d)

Over travel protection, emergency stop push button, over speed governors.

e)

All electrical and mechanical interlocks on cab access door and landing level enclosure doors, phase reversal protection shall be provided.

**TECHNICAL SPECIFICATION****STACK ELEVATOR****SPECIFICATION NO. PE-TS-410-503-A-001****VOLUME II B****SECTION D****SUB-SECTION A6****REV. 0****Sheet 4 of 8**

- f) An alarm push button shall be provided in the cage connected to a battery-operated alarm at the elevator base. Simultaneous alarm shall also sound at the plant control room in the event of any fault in the stack elevator for which one potential free contact shall be provided in each elevator for audiovisual alarm in PCR for "Stack Elevator fault" indication.
- g) Reverse phase relay connected to prevent operation of the cab with improper phase rotation or failure in any phase in the power supply.
- h) Continuous duty electric torque motor recoil cable reels as required to maintain electrical power service to all elevator electrical components throughout the limits of travel.
- i) One auxiliary panel shall be furnished and mounted on the grade level enclosure. Panel shall be equipped with a main 'ON-OFF' isolating switch, main contactor, relays, control transformer and fuses, tone frequency transfer, terminal blocks and all other accessories required for normal operation of the elevator.
- j) One main control panel shall be furnished and mounted on the top of the cab. Panel shall be equipped with necessary, equipped like rectifier, battery, charger, tone frequency receiver, contactors, MCBs, control transformer and fuses, thermal overload relays, and all other equipment and accessories required for normal operation of the elevator.
- k) Control cabinets shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be cold rolled and at least 2.0 mm thick and properly braced to prevent wobbling. Degree of protection of the control cabinets shall be IP-52 as per IS:2147. Control cabinets shall be provided with hinged door(s) with padlocking arrangement. All doors, removable covers and plates shall be gasket all around with neoprene gaskets, louvers, when provided, shall have screeners and filters. The screens shall be of fine wire mesh made of brass or GI wire. Suitable cable gland plate shall be supplied fitted on to this gland plate. All cable glands shall be screwed on type and made of brass.
- l) Each motor to be controlled from the control cabinet shall be provided with 3 pole isolating switch. HRC fuses, contactors of AC4 duty class with thermal overload relays with single phasing preventer and other equipment required for satisfactory control motor. The isolating switch and contractor shall be rated at least 20% more than the connected motor full load current. Motors of 0.2 KW and above shall be rated for 415 V 3 Phase and below 0.2 KW will be 240 V single phase supply.
- m) The controllers and resistors for motors shall conform to IS-8544 (latest edition) and IS-2959 (latest edition) and shall be continuously rated for 150% full load current of the motor. Switches shall be hand operated, air breaker heavy duty, quick make, quick break type conforming to IS-4064. The rating of switch shall be so chosen as to get complete protection by associated O/L relay or fuse under all normal / abnormal conditions such as full load, overload, locked rotor, short circuit. The incoming power supply isolating switch shall



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be inter-locked with the control cabinet door so as to prevent opening of the door when the switch is closed. Device for bypassing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions.

- n) All fuses shall be of the HRC cartridge type mounted on plug in type of fuse base having a prospective current rating of not less than 80 KA. Fuses shall be provided with visible operation indicators to show that they have operated. All accessible live connections shall be adequately shrouded and it shall be possible to change fuses with the circuit alive without danger of contact with live metal.
- o) Contractor shall provide dry type transformers with class B insulation for control power supply, lighting and space heating. Control supply will be 240 V AC. Transformer for control supply shall be provided with a control tap at 110 V, which will be earthed. Power and control supply to individual drives and users shall be distributed with separate isolating switches and primary and secondary fuses.
- p) All push buttons shall be of push to actuate type having 2 "NO" and 2 "NC" self reset contacts. They shall be provided with integral escutcheon on plate engraved with their functions. Push button contacts shall be rated for 5 Amp at 415 V AC and 1 Amp. Inductive breaking at 250 V, DC. Mushroom type emergency push button to open the main contactor shall be provided in the operator's cabin and two on the bridge platform within easy reach indicating lamps shall be of the filament type and low watt consumption lamps shall be provided with series resistors.
- q) Strip type space heaters of adequate capacity shall be provided inside in each cabinet.
- r) Control cabinets shall be supplied completely wired. All wiring shall be carried out with 650 V grade PVC insulated, stranded conductors. Power circuits shall be wired with stranded aluminum conductors of adequate sizes to suit the rated circuit shall be wired with stranded copper conductors of sizes not small than 1.5 Sq.mm. Control circuits shall be isolated from power circuits.
- s) Cab shall be controlled by a semi-automatic floor selection control system. Cab shall be furnished with 240 Volt grounding type receptacle, emergency alarm push button with a normally open contact rated 0.5 ampere at 220 VDC volts, indicating light, limit switches, and all other necessary control devices required to ensure safe and continuous cab operation. One trailing cable shall connect the cab main control panel to the auxiliary panel at ground level. Cable shall supply the cab with all power requirements. Cable guides shall be installed at every 6 metres to avoid entanglement of this cable. Control signals between the auxiliary panel at ground level and the main control panel on the cab. Will be provided with the tone frequency receiver. However control and interlocks from the landings shall be connected to the auxiliary panels located at ground level through fixed armoured cables. The power and control cables and training power cables shall be FRLS type.



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- t) Each landing assembly shall include a limit switch for door interlock and push button control station installed and wired to a landing junction box.
- u) Cable trolley with cable guides for recoil of cable on to cable reel to maintain electrical power service to all elevator components throughout the limits of travel.
- v) Contractor shall furnish, install, and connect a system equipment ground to the Owner's existing chimney ground system. System equipment ground shall electrically connect panels and junction boxes, which contain electrical devices, motors, and elevator platforms and support structure. Raceway system shall not be considered as an equipment ground.
- w) All enclosures containing electrical devices shall be provided with 240 Volt, single-phase space heaters with adjustable thermostat control.
- x) All power cables and race way shall be furnished and installed by the Contractor for interconnection of the main control panel, auxiliary panel and landing junction boxes etc. Conductors included in the cable shall be as required to energise all electrical equipment furnished with the elevator. Transmission of alarm signals is done by means of tone frequency equipment. Hence communication conductors are not required.

1.2.7 Electric Motor

- i. Elevator drive motor shall be squirrel-cage induction type designed and fabricated to conform to the requirements indicated below.
- ii. Motor shall be designed for operation at the required speed: 415 Volts, 3 phase, 50 hertz. And shall be suitable for full voltage starting, S4 duty class as per IS-4722 with CDF of 25% and maximum number of 120 starts per hour in 55 Deg. C ambient temperature. Motor shall be tested at the factory to determine that it is free from electrical or mechanical defects.

1.2.8 Raceway

- i. General
 - a) Complete raceway system for the elevator shall be furnished and installed in accordance with this section and the Contractor's shop drawings as reviewed and accepted by the Engineer-in-Charge. The Contractor shall provide drawings for acceptance showing the routing of conduit and wiring for the control circuits associated with the elevator.
 - b) Raceway system is defined to include conduit and all related materials and devices required to support, secure and provide a complete system for support and protection of electrical cable and wiring.
- ii. Materials



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- a) Raceway shall be rigid galvanized steel conduit, provided in accordance with IS-1653 (latest edition).
- b) Steel conduit, couplings, and elbows shall be hot-dip galvanized rigid mild steel. Each length of threaded conduit shall be complete with a coupling on one end and a thread protector on the other. Thread protector shall have sufficient mechanical strength to protect the threads during normal handling and storage. Flexible conduits shall be plastic jacketed, liquid tight galvanized steel.
- c) Galvanized iron or galvanized cast steel fittings shall be used with galvanized steel conduit. Fittings installed outdoors or in damp locations shall be sealed and gasketed. Outdoor fittings shall be of heavy cast construction.

1.2.9 PVC Insulated FRLS Cable

i. Materials

- a) Electrical part of this specification shall be referred for FRLS cable. Unless specified otherwise, Contractor shall submit to the Engineer-in-Charge four copies of the manufacturer's test report on each cable furnished. Conductor accessories including terminal materials like glands, lugs etc. makers, tying materials and cable support shall be furnished and installed. Wire termination materials for conductors 10 Sq. mm and larger shall be pressure or bolted type. Terminals for conductors smaller than 10 Sq. mm shall be an insulated pressure connection in the shape of a ring.

ii. Installation

- a) Power and control cable shall be routed as required by the drawings. Cables pulled into the wrong conduit or cut too short shall be replaced. Cables removed from one conduit shall not be installed in another conduit.

1.2.10 Earthing

i. General

- a) Earthing system furnished and installed and include a complete earthing system for the elevator. Earthing equipment and materials shall be furnished and installed in accordance with the reference codes and standards these specification and the contractor's shop drawings as reviewed and accepted by the Engineer-in-Charge.

ii. Materials

- a) The earthing of all electrical items being supplied by the Bidder shall be in his scope. For earthing the various equipment, conductor sizes shall be as listed below:

- MCCs Motor above 90 KW : 50 x 6 Sq.mm G.I. flat



TECHNICAL SECIFICATION

STACK ELEVATOR

SPECIFICATION NO. PE-TS-410-503-A-001

VOLUME II B

SECTION D

SUB-SECTION A6

REV. 0

Sheet 8 of 8

- Motors above 30 KW, upto 75 KW and lighting panel/ control panels/auxiliary panels : 25 x 6 Sq. mm G.I. flat
- Motor above 5 KW upto 30 KW : 25 x 3 mm G.I. flat
- Motors upto 5 KW and misc. : 8 SWG GI wire
- Small item like conduits,
- Junction boxes etc..

	Title		Spec. No.: PE-TS-411-503-A-001	
	STACK ELEVATOR		Volume III	SUB SECTION A6
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SUB-SECTION - A6

STACK ELEVATORS

	Title		Spec. No.: PE-TS-417-503-A-001			
	STACK ELEVATOR		Volume III		SUB SECTION A6	
	DATA SHEET 'B'		Sheet	2	of	11

1.01.00 ELEVATOR PARTICULARS

- i) Load Carrying Capacity in Kg
- ii) Type of loading for which the stack elevator is designed
- iii) Type of stack elevator
- iv) Rated Load in Kg
- v) Speed in metre/minute
- vi) Chimney height in metre
- vii) Total travel height in metre
- viii) No. of floors to be served
- ix) Elevations of the floors to be served
- x) Method of control
- xi) Details of indicators and control
- xii) Weight of cab complete without load in Kg
- xiii) Weight of hoist cab in Kg
- xiv) Efficiency of Elevator

1.02.00 GROUND ENCLOSURE

- i) Size of the enclosure
(Length x breadth x height)
- ii) Material of construction
- iii) Size of landing entrance
- iv) Method of door operation
- v) Electrical & mechanical interlocking
Of the door provided.
- vi) Method of fixing enclosure to chimney
- vii) Any other details not covered above

1.03.00 LANDING ENCLOSURES

- viii) Size of the enclosure
(Length x breadth x height)

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	Title		Spec. No.: PE-TS-417-503-A-001			
	STACK ELEVATOR		Volume III		SUB SECTION A6	
	DATA SHEET 'B'		Sheet	3	of	11

- ix) Material of construction
- x) Size of landing entrance
- xi) Method of door operation
- xii) Electrical & mechanical interlocking
Of the door provided.
- xiii) Method of fixing enclosure
- xiv) Any other details not covered above

1.04.00 MAST

- i) Material of mast
- ii) Section of mast
- iii) Size of each piece of mast
- iv) Method of fixing of mast
- v) Type of mast

1.05.0 CAB

- i) Internal size
(Length x breadth x height)
- ii) Material of construction
- iii) Type of floor
- iv) Size of the cab door
- v) Method of operation of cab door
- vi) Electrical & mechanical interlocking provided
- vii) Escape hatch, electrically interlocked
- viii) Guide roller and safety hooks provided
- ix) Arrangement of light/fan inside the cab.
- x) Indicators & controls inside the cab.

1.06.00 ELEVATOR DRIVE UNIT

- i) Location of drive unit
- ii) Name of components of drive unit

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	Title		Spec. No.: PE-TS-417-503-A-001			
	STACK ELEVATOR		Volume III		SUB SECTION A6	
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1.07.00 DETAILS OF ELECTRIC MOTOR

- i) Manufacturer
- ii) Equipment driven by motor
- iii) Type
- iv) Frame size, type & designation
- v) Maximum load considered for
Sizing of motor
- vi) Margin considered for sizing motor
- vii) Rated power in KW
- viii) Service factor
- ix) Speed in rpm
- x) Rated voltage in V
- xi) Current at rated voltage
 - Full load
 - Locked rotor
- xii) Insulation class
- xiii) Type of bearing and type of lubricant
- xiv) Space heater rating
- xv) Duration considered for specified
Ambient temperature
- xvi) Applicable standard to which motor conforms
- xvii) Degree of protection
- xviii) Efficiency at rated output
- xix) Power factor
- xx) Type of mounting

1.08.00 DETAILS OF REDUCTION GEAR

- i) Make
- ii) Material of the gears and hardness in BHN
- iii) Type of gear
- iv) Gear ratio

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	Title		Spec. No.: PE-TS-417-503-A-001			
	STACK ELEVATOR		Volume III		SUB SECTION A6	
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v) Gear power transmitted

vi) Input and output speed

1.09.0 DETAILS OF DRIVE AND PINION

i) Material

ii) Hardness

iii) Fixing arrangement

1.10.0 DETAILS OF RACK

i) Material

ii) Hardness

iii) Fixing arrangement

1.11.00 SAFETY DEVICE

i) Make

ii) Type of safety device

iii) Speed at which the safety device
Come into action

iv) Method operation

v) Other details

vi) Remote control for testing
The safety device

1.12.00 BRAKES

i) Manufacturer

ii) Types of brakes provided

iii) Method of operation

iv) Interlocking if any

v) Electromagnetic brake and external
Manual brake release

vi) Degree of protection

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	Title		Spec. No.: PE-TS-417-503-A-001			
	STACK ELEVATOR		Volume III		SUB SECTION A6	
	DATA SHEET 'B'		Sheet	6	of	11

1.13.00 CENTRIFUGAL BRAKE

- i) Make
- ii) Details
- iii) Remote control for testing
The safety device provided.
- iv) Any other details of drive unit
Not covered above.

1.14.00 BUFFERS

- i) No. and location of the buffers provided
- ii) Type of buffers
- iii) If the buffers are spring type
Furnish the following:

- Diameter of the spring in mm
- Max. Compression under extreme cond.
- No. of spring coil
- Sectional dimension
- Material of spring
- Compression /unit load

1.15.00 POWER CABLES

Fixed

Trailing

- i) Manufacturer
- ii) Type and material
- iii) Rated voltage
- iv) Rated current
- v) Type of insulation
- vi) No. of strands
- vii) No. of cores
- viii) Short circuit current rating
- ix) Resistance per 1000 metres

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	Title		Spec. No.: PE-TS-417-503-A-001			
	STACK ELEVATOR		Volume III		SUB SECTION A6	
	DATA SHEET 'B'		Sheet	7	of	11

x) Applicable standards

1.16.00 CONTROL CABLES

- xi) Manufacturer
- xii) Type and material
- xiii) Rated voltage
- xiv) Rated current
- xv) Type of insulation
- xvi) No. of strands
- xvii) No. of cores
- xviii) Short circuit current rating
- xix) Resistance per 1000 metres
- xx) Applicable standards

1.17.00 CONDUITS/ACCESSORIES AND FITTINGS

- i) Material
- ii) Manufacturer
- iii) Applicable standard

1.18.00 CONTACTORS

- i) Make
- ii) Type
- iii) Applicable standards
- iv) No. of poles
- v) Rated voltage
- vi) Rated frequency
- vii) Rated current
- viii) Closing coil
 - Rated voltage
 - Current consumption

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
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Date						

	Title		Spec. No.: PE-TS-417-503-A-001			
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	DATA SHEET 'B'		Sheet	8	of	11

- Power consumption in KW
- Insulation class for electromagnet

ix) Rated duty

- Rated insulation category
- No. of operations per hour
- Rated breaking capacity
- Rated making capacity
- Short time rating in sec

ix) Limits of operation

- Supply voltage variations (%)
- Supply frequency variations (%)
- Drop out voltage (%)
- Min. pick up voltage (%)

x) Thermal overload relay setting range available

xi) Auxiliary contacts

- Numbers
- Current rating (Make and break)

xi) Rated utilization category as per IS 2459

xii) Max. recommended back up HRC fuse size

1.19.00 FUSES

- i) Make
- ii) Type
- iii) Continuous current
- iv) Rated voltage
- v) Rated frequency
- vi) Rupturing capacity
- vii) Mounting details
- viii) Fixing and removing arrangement
- ix) Visual indication for fuses
- x) Applicable standards

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	Title		Spec. No.: PE-TS-417-503-A-001			
	STACK ELEVATOR		Volume III		SUB SECTION A6	
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1.20.00 INDICATING LAMPS

- i) Make
- ii) Type
- iii) Rated voltage
- iv) Rated power consumption in Watt
- v) Permissible voltage variation
- vi) Series resistance provided

1.21.00 PUSH BUTTONS

- i) Make
- ii) Type
- iii) Rating
 - Voltage
 - Continuous current
- iv) No. of aux. Contacts
 - Normally open
 - Normally closed
- v) Contact rating
- vi) Colours
- vii) Mounting arrangement

1.22.00 OVER TRAVEL LIMIT SWITCH

- i) Make
- ii) Type
- iii) Material of contacts
- iv) Contact rating
- v) Numbers furnished

1.23.00 CONTROL TRANSFORMER

- i) Make
- ii) Type
- iii) Output rating (VA)
- iv) Ratio

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	Title		Spec. No.: PE-TS-417-503-A-001			
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- v) Class of insulation
- vi) Max. temp rise of winding over
Specified ambient temperature.
- vii) One minute power frequency test voltage
- viii) Applicable standards

1.24.00 CIRCUIT BREAKER AND ISOLATOR

- i) Make
- ii) Type
- iii) Current rating in amps
- iv) Interruption duty
- v) Max. breaking capacity
- vi) Operating voltage of tripping and closing coils
- vii) Max. permissible variation of operating voltage

1.25.00 RACEWAY

- i) Raceway as per specification
- ii) Material of
 - Indoor fittings
 - Outdoor fittings
 - Raceway support
 - Junction boxes

1.26.0 EARTHING

- i) Earthing conductor
 - Size
 - Material
- ii) Material of earthing cable
- iii) Clamps. Bolts, washers, nuts and another
Hardware of iron steel are galvanized.

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						

	Title		Spec. No.: PE-TS-417-503-A-001	
	STACK ELEVATOR		Volume III	SUB SECTION A6
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1.27.00 MOTOR STARTER

- i) Make & Size
- ii) Rating]
- iii) Mechanically latched type
- iv) Single phase prevention feature provided
- v) Degree of protection

1.28.00 DETAILS OF CONTROL PANELS

- i) No. of panels
- ii) Type of enclosures (Degree of protection)
- iii) Thickness of sheet metal
- iv) Painting
 - Colour
 - Finish
- v) Cable entry
- vi) Manufacturer

Name of Bidder / Vendor						
Project						
Revision No.	0	1	2	3	4	5
Signature of Bidder / Vendor / Authorised Representative						
Date						



BH NO. :		45	EGL(EXISTING GROUND LEVEL) R.L.(+)		84.067										
LOCATION :		N = 0, E = 408	WATER TABLE below EGL (m) :		4.90										
			CASING Depth (m) :		0.50										
START DATE :		3/8/2016	BORING/ DRILLING METHOD :		Rotary										
END DATE :		3/9/2016	DRILLING : NX SIZE double tube core barrel												
Depth,m	RL, m	Graphical Log	Description	Sample		Penetration,			SPT N value	Core Recovery (CR)%	Rock Quality Designation (RQD)				
				Depth	Type	cm									
						m	15	30		45	%	%			
0.00	84.07		Moderately weathered grey, fine grained Quartzite	0.00						24	Nil				
0.50	83.57			0.75											
1.00	83.07														
1.50	82.57			1.50										34	16
2.00	82.07			2.25										45	29
2.50	81.57														
3.00	81.07			3.00										45	45
3.50	80.57			3.75										29	20
4.00	80.07		Slightly weathered grey, fine grained Quartzite							42	26				
4.50	79.57			4.50											
5.00	79.07														
5.50	78.57			5.25										20	Nil
6.00	78.07			6.00										22	Nil
6.50	77.57														
7.00	77.07			6.75										36	36
7.50	76.57			7.50										36	13
8.00	76.07														
8.50	75.57			8.25										38	24
9.00	75.07			9.00										38	28
9.50	74.57			9.75										62	Nil
10.00	74.07			10.0										40	40
THE BOREHOLE IS TERMINATED AT 10.00m BELOW G.L.															



BH NO. :		46	EGL(EXISTING GROUND LEVEL) R.L.(+)		83.363						
LOCATION :		N= 0, E= 454	WATER TABLE below EGL (m) :		3.10						
			CASING Depth (m) :		1.50						
START DATE :		4/25/2016	BORING/ DRILLING METHOD :		Rotary						
END DATE :		4/26/2016	DRILLING : NX SIZE double tube core barrel								
Depth,m	RL, m	Graphical Log	Description	Sample		Penetration,			SPT N value	Core Recovery (CR)%	Rock Quality Designation (RQD)
				Depth	Type	cm					
						m		15		30	45
0.00	83.36		Highly weathered grey, fine grained Limestone								
0.50	82.86										
1.00	82.61			0.75						21	Nil
1.50	81.86			1.50						25	Nil
2.00	81.36										
2.50	81.11			2.25						25	13
3.00	80.36			3.00						24	13
3.50	79.86		Moderately weathered grey, fine grained Limestone								
4.00	79.61			3.75						24	Nil
4.50	78.86			4.50						24	Nil
5.00	78.36										
5.50	78.11			5.25						21	Nil
6.00	77.36			6.00						22	Nil
6.50	76.86										
7.00	76.61			6.75						34	Nil
7.50	75.86			7.50						24	Nil
8.00	75.36										
8.50	74.86			8.25						33	Nil
9.00	74.36			9.00						38	Nil

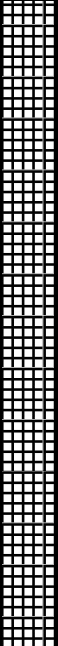


BH NO. :		46	EGL(EXISTING GROUND LEVEL) R.L.(+)		83.363						
LOCATION :		N= 0, E= 454	WATER TABLE below EGL (m) :		3.10						
			CASING Depth (m) :		1.50						
START DATE :		4/25/2016	BORING/ DRILLING METHOD :		Rotary						
END DATE :		4/26/2016	DRILLING : NX SIZE double tube core barrel								
Depth,m	RL, m	Graphical Log	Description	Sample		Penetration,			SPT N value	Core Recovery (CR)%	Rock Quality Designation (RQD)
				Depth	Type	cm					
						m	15	30		45	%
9.50	73.86		Moderately weathered grey, fine grained Quartzite								
10.00	73.61			9.75					37	Nil	
10.50	72.86			10.50					32	Nil	
11.00	72.36										
11.50	71.86			11.25					37	13	
12.00	71.36			12.00					28	Nil	
12.50	70.86										
13.00	70.61			12.75					36	Nil	
13.50	69.86			13.50					32	Nil	
14.00	69.36										
14.50	68.86			14.25					54	30	
15.00	68.36			15.00					50	Nil	
15.50	67.86										
16.00	67.61			15.75					33	Nil	
16.50	66.86			16.50					40	Nil	
17.00	66.36										
17.50	65.86			17.25					50	16	
18.00	65.36		Slightly weathered black, fine grained Shale	18.00					40	Nil	
18.50	64.86										
19.00	64.61			18.75					37	13	
19.50	63.86			19.50					54	Nil	
20.00	63.36			20.00					44	24	
THE BOREHOLE IS TERMINATED AT 20.00m BELOW G.L.											



BH NO. :		2	EGL(EXISTING GROUND LEVEL) R.L.(+)		81.496						
LOCATION :		N = 00, E = -25	WATER TABLE below EGL (m) :		5.50						
			CASING Depth (m) :		1.50						
START DATE :		1/5/2016	BORING/ DRILLING METHOD :		Rotary						
END DATE :		1/10/2016	DRILLING : NX SIZE double tube core barrel								
Depth,m	RL, m	Graphical Log	Description	Sample		Penetration,			SPT N value	Core Recovery (CR)%	Rock Quality Designation (RQD)
				Depth	Type	cm					
						m		15		30	45
0.00	81.50		Dark Brownish Grey Highly weathered Quartzite								
0.50	80.75			0.75						24	Nil
1.00	80.50		Moderately weathered grey, fine grained Quartzite								
1.50	80.00			1.50						38	38
2.00	79.50			2.25						34	Nil
2.50	79.25			3.00						38	13
3.00	78.50		Fresh grey, fine grained Quartzite								
3.50	78.00			3.75						91	79
4.00	77.75			4.50						95	66
4.50	77.00										
5.00	76.50										
5.50	76.00			6.00						66	25
6.00	75.50		Fresh black, fine grained Shale								
6.50	75.00										
7.00	74.50			7.50						60	Nil
7.50	74.00		Fresh black, fine grained Shale								
8.00	73.50										
8.50	73.00										
9.00	72.50		9.00						73	Nil	



BH NO. :		2		EGL(EXISTING GROUND LEVEL) R.L.(+)		81.496					
LOCATION :		N = 00, E = -25		WATER TABLE below EGL (m) :		5.50					
				CASING Depth (m) :		1.50					
START DATE :		1/5/2016		BORING/ DRILLING METHOD :		Rotary					
END DATE :		1/10/2016		DRILLING : NX SIZE double tube core barrel							
Depth,m	RL, m	Graphical Log	Description	Sample		Penetration,			SPT N value	Core Recovery (CR)%	Rock Quality Designation (RQD)
				Depth	Type	cm					
						m	15	30		45	%
9.50	72.00		Slightly weathered black, fine grained Shale	10.50					50	Nil	
10.00	71.50										
10.50	71.00										
11.00	70.50										
11.50	70.00										
12.00	69.50		12.00					49	Nil		
12.50	69.00		Fresh black, fine grained Shale						71	Nil	
13.00	68.50										
13.50	68.00										
14.00	67.50										
14.50	67.00										
15.00	66.50										
15.50	66.00										
16.00	65.50										
16.50	65.00										
17.00	64.50										
17.50	64.00										
18.00	63.50										
18.50	63.00										
19.00	62.50										
19.50	62.00										
20.00	61.50		20.00					90	20		
THE BOREHOLE IS TERMINATED AT 20.00m BELOW G.L.											



BH NO. :		3	EGL(EXISTING GROUND LEVEL) R.L.(+)		81.699						
LOCATION :		N = 00, E = 29	WATER TABLE below EGL (m) :		4.50						
			CASING Depth (m) :		1.50						
START DATE :		1/14/2016	BORING/ DRILLING METHOD :		Rotary						
END DATE :		1/16/2016	DRILLING : NX SIZE double tube core barrel								
Depth,m	RL, m	Graphical Log	Description	Sample		Penetration,			SPT N value	Core Recovery (CR)%	Rock Quality Designation (RQD)
				Depth	Type	cm					
						m	15	30		45	%
0.00	81.70		Moderately weathered grey, fine grained Quartzite	0.75					29	Nil	
0.50	80.95			1.50					26	Nil	
1.00	80.70			2.25					27	Nil	
1.50	80.20			3.00					21	Nil	
2.00	79.70										
2.50	79.45										
3.00	78.70										
3.50	78.20		Fresh grey, fine grained Quartzite	3.75					85	19	
4.00	77.95			4.50					89	61	
4.50	77.20										
5.00	76.70		Slightly weathered grey, fine grained Quartzite	6.00					52	20	
5.50	76.20			7.50					56	17	
6.00	75.70										
6.50	75.20										
7.00	74.70										
7.50	74.20										
8.00	73.70		Slightly weathered grey, fine grained Limestone	9.00					53	Nil	
8.50	73.20			10.50					47	Nil	
9.00	72.70			12.00					49	7	
9.50	72.20										
10.00	71.70										
10.50	71.20										
11.00	70.70										
11.50	70.20										
12.00	69.70		Slightly weathered black, fine grained Shale	13.50					59	Nil	
12.50	69.20			15.00					78	44	
13.00	68.70										
13.50	68.20										
14.00	67.70										
14.50	67.20										
15.00	66.70										
THE BOREHOLE IS TERMINATED AT 15.00m BELOW G.L.											



BH NO. :		48		EGL(EXISTING GROUND LEVEL) R.L.(+)		84.354					
LOCATION :		N = 0, E = 627		WATER TABLE below EGL (m) :		3.70					
				CASING Depth (m) :		NA					
START DATE :		3/13/2016		BORING/ DRILLING METHOD :		Rotary					
END DATE :		3/17/2016		DRILLING : NX SIZE double tube core barrel							
Depth,m	RL, m	Graphical Log	Description	Sample		Penetration,			SPT N value	Core Recovery (CR)%	Rock Quality Designation (RQD)
				Depth	Type	cm					
						m	15	30		45	%
0.00	84.35		Moderately weathered grey, fine grained Quartzite	0.00						21	Nil
0.50	83.85			0.75							
1.00	83.35										
1.50	82.85			1.50							
2.00	82.35			2.25							
2.50	81.85										
3.00	81.35	3.00					34	14			
3.50	80.85		Slightly weathered grey, fine grained Quartzite	3.75						53	17
4.00	80.35										
4.50	79.85			4.50							
5.00	79.35		Moderately weathered black, fine grained Shale							33	16
5.50	78.85			5.25							
6.00	78.35			6.00							
6.50	77.85										
7.00	77.35			6.75							
7.50	76.85			7.50							
8.00	76.35		Fresh black, fine grained Shale							88	Nil
8.50	75.85			8.25							
9.00	75.35			9.00							
9.50	74.85										
10.00	74.35										
10.50	73.85			10.50							
11.00	73.35		Slightly weathered black, fine grained Shale							54	10
11.50	72.85										
12.00	72.35			12.00							
12.50	71.85										
13.00	71.35										
13.50	70.85			13.50							
14.00	70.35		Fresh grey, fine grained Quartzite								
14.50	69.85										
15.00	69.35			15.00							
THE BOREHOLE IS TERMINATED AT 15.00m BELOW G.L.											



BH NO. :		49		EGL(EXISTING GROUND LEVEL) R.L.(+)						
LOCATION :		N = 0, E = 666		WATER TABLE below EGL (m) :						
				CASING Depth (m) :						
START DATE :		3/18/2016		BORING/ DRILLING METHOD :						
END DATE :		3/22/2016		DRILLING : NX SIZE double tube core barrel						
Depth,m	RL, m	Graphical Log	Description	Sample		Penetration,			SPT N value	Core Recovery (CR)%
				Depth	Type	cm				%
						15	30	45		
0.00	84.90		Highly weathered grey, fine grained Quartzite	0.00						
0.50	84.40			0.75						21
1.00	83.90									
1.50	83.40			1.50						24
2.00	82.90			2.25						25
2.50	82.40		Moderately weathered grey, fine grained Quartzite							
3.00	81.90			3.00						28
3.50	81.40			3.75						29
4.00	80.90									
4.50	80.40			4.50						26
5.00	79.90		Moderately weathered grey, fine grained Limestone							
5.50	79.40			5.25						26
6.00	78.90			6.00						25
6.50	78.40									
7.00	77.90			6.75						33
7.50	77.40		7.50						28	
8.00	76.90		Moderately weathered grey, fine grained Limestone							
8.50	76.40			8.25						42
9.00	75.90			9.00						32
9.50	75.40									
10.00	74.90			9.75						32
10.50	74.40		10.50						33	



BH NO. :		49		EGL(EXISTING GROUND LEVEL) R.L.(+)		84.900					
LOCATION :		N = 0, E = 666		WATER TABLE below EGL (m) :		4.20					
				CASING Depth (m) :		NA					
START DATE :		3/18/2016		BORING/ DRILLING METHOD :		Rotary					
END DATE :		3/22/2016		DRILLING : NX SIZE double tube core barrel							
Depth,m	RL, m	Graphical Log	Description	Sample		Penetration,			SPT N value	Core Recovery (CR)%	Rock Quality Designati on (RQD)
				Depth	Type	cm					
						m		15		30	45
11.00	73.90		Highly weathered black, fine grained Shale	11.25						24	Nil
11.50	73.40			12.00						24	Nil
12.00	72.90										
12.50	72.40		Moderately weathered black, fine grained Shale	12.75						26	Nil
13.00	71.90			13.50						30	30
13.50	71.40										
14.00	70.90			14.25						34	Nil
14.50	70.40		Slightly weathered black, fine grained Shale	15.00						42	Nil
15.00	69.90			15.75						58	Nil
15.50	69.40										
16.00	68.90		Fresh black, fine grained Shale	16.50						80	Nil
16.50	68.40										
17.00	67.90			17.25						86	13
17.50	67.40		Fresh black, fine grained Quartzite								
18.00	66.90			18.75						72	18
18.50	66.40										
19.00	65.90			20.00						67	37
19.50	65.40										
20.00	64.90										
THE BOREHOLE IS TERMINATED AT 20.00m BELOW G.L.											



TITLE:
TECHNICAL SPECIFICATION FOR
LABOUR COLONY

SPECIFICATION NO: PS-SR-PMX-CVL

LABCOL/01

REV NO: 00 DATE: 08.08.2017

SHEET : 1 OF 8

TECHNICAL SPECIFICATION FOR LABOUR COLONY



Bharat Heavy Electricals Limited

Project Management Department

Power Sector – Southern Region

690, Anna Salai, Nandanam

Chennai – 600 035



TITLE:
TECHNICAL SPECIFICATION FOR
LABOUR COLONY

SPECIFICATION NO: PS-SR-PMX-CVL

LABCOL/01

REV NO: 00 DATE: 08.08.2017

SHEET : 2 OF 8

1 BROAD DESCRIPTION OF WORK

Providing labour colony is in the scope of the bidder. The labour colony area is divided in to various blocks and Bidder shall be allotted the blocks according to the size of the man power planned for mobilisation of the awarded work. The following are the broad description of the labour facilities to be provided by the bidder.

1. Pre-Fabricated shed of Standard size of 40m x 11 m consisting 10 Nos of rooms sizing 4mx4m each as per the specification/drawing No. BHEL/PSSR/CVL/LABCOL/03, Rev-00. Bidder may alter size of the shed according to the size of the manpower.
2. Toilet blocks, each sizing 1.5m x 1.5m as per the specification/drawing No. BHEL/PSSR/CVL/LABCOL/02, Rev-00
3. Washing Area & Bathing Area as per the specification/drawing No. BHEL/PSSR/CVL/LABCOL/02, Rev-00
4. Cooking cum Dining Area as per the specification/drawing No. BHEL/PSSR/CVL/LABCOL/02, Rev-00

2 FACILITIES PROVIDED BY BHEL

- A. Land for labour colony shall be allotted by BHEL
- B. BHEL shall provide water at one point in the Plant Premises. Further tapping the water from for the labour colony shall be under the scope of the bidder.
In case of non-availability of water, the contractor shall make his own arrangements of water suitable for labours at their own cost. No separate payment shall be made for any contingency arrangement made by contractor, due to delay / failure for providing water supply.
- C. Power will be provided to the contractor free of cost at one single point within the labour colony area. The contractor shall make his own arrangement for further distribution with necessary isolator/LCB etc. Necessary "Capacitor Banks" to improve the Power factor to a minimum of 0.8 shall be provided by the contractor at his cost.



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TECHNICAL SPECIFICATION FOR
LABOUR COLONY

SPECIFICATION NO: PS-SR-PMX-CVL

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SHEET : 3 OF 8

Penalty if any levied by customer on this account will be recovered from contractor's bills. Any duty, deposit involved in getting the Electricity shall be borne by the bidder. Provision for distribution of electrical power from the given single central common point to the required places with proper distribution boards, approved cables and cable laying including supply of all materials like cables, switch boards, pipes etc., observing the safety rules laid down by electrical authority of the State / BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor. BHEL is not responsible for any loss or damage to the contractor's equipment as a result of variations in voltage / frequency or interruptions in power supply. As there are bound to be interruptions in regular power supply, power cut/ load shedding in any construction sites, contractor should make his own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown / failure to get urgent and important work to go on without interruptions. No separate payment shall be made for this contingency.

- D. Bidder shall provide toilet blocks with necessary septic tanks and soak pits as mentioned in the layout drawing. Bidder shall be responsible for clearing the septic tank at regular intervals.
- E. Main Roads and Drains shall be constructed by BHEL, further interconnection to main road and drain shall be done by the vendor.
- F. Lighting in the roads shall be provided by BHEL, further lighting within the areas allocated to the Bidders shall be taken up by the bidder. The bidder shall provide suitable lighting in their areas.
- G. The layout, specification including dimensions of the facilities of the labour colony as provided in the bid drawings shall be strictly followed.

3.0 FACILITIES TO BE PROVIDED BY BIDDER

- 3.1.1.1 Labour sheds as per the layout, specification shall be provided by the bidder as per the bid drawing including foundations.



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TECHNICAL SPECIFICATION FOR
LABOUR COLONY

SPECIFICATION NO: PS-SR-PMX-CVL

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SHEET : 4 OF 8

3.1.1.2 Toilet, Bath and wash area shall be provided as per the layout and specification provided in the bid drawing including foundations.

3.1.1.3 Kitchen cum dining room as per the layout, specification shall be provided by the bidder as per the bid drawing including foundations.

3.1.1.4 Electrification all the rooms and the Utility areas like toilet, bath area and kitchen.

3.1.1.5 Minimum 2 Nos. of ceiling fans shall be provided per room of the labour shed.

3.1.1.6 Paving shall be provided around labour sheds to avoid stagnation of rain water

4.0 SPECIFICATION FOR THE LABOUR SHED

4.1 MAIN STRUCTURE & WALLS:

- The Structural walls shall be made out of tubular sections. 50mm thick AEROCON panels or equivalent for walls using 1mm thick GI channels, Colour Coated Sheet roof Supported with steel columns, Trusses & Purlins Inclusive of MS Door frames with flush shutters of Size 3' X 7' X 20 Rooms. MS Window frames with 4mm thick Plain glass of Size 4' X 4' X 20 No's, Painting.

4.2 WALLS:

- Pre-fabricated Sandwich Panel 'AEROCON' or equivalent of 50 mm thick Made up of two fiber Reinforced cement sheets on either Side of a lightweight concrete core composed of port land Cement, binders, Siliceous and micaceous material aggregate with tongue & groove arrangement.

4.3 ROOF:

- Roofing with 0.45MM thick Colour coated Sheets of Required size fixed to the purlins in gable Shape with self tapping Screws. The Roof shall either thermal insulated or provided with false ceiling.

4.4 CHANNELS:

- Galvanized iron top & bottom channels of size: 38 x 50 x 38 in 1 mm Thickness.

4.5 STEEL STRUCTURE:

- Fabricated structural steel for Columns with 72 X 72MM MS Square Box.



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LABOUR COLONY

SPECIFICATION NO: PS-SR-PMX-CVL

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SHEET : 5 OF 8

- Trusses with 50 NB MS Pipes for outer frame and 32 NB MS Pipes for internal bracings, & Purlins with 50 NB MS Pipes, Joint Plates 8MM thick, bolts, including one coat of Red- oxide primer.

4.6 COMPONENTS:

- Ridge covers on the roof ridge with plain CGI sheet, all four corners covered with MS Corner covers all fixed with the help of bolts, Nuts, Anchor fasteners, screws etc.

4.7 PAINTING

- (A) Interior: Painting of AEROCON or equivalent internal walls with one coat of cement Primer and two coats of Synthetic/Acrylic paints. (Oil bond distempers) of Asian / ICI make.
- (B) EXTERIOR: Painting of AEROCON or equivalent external walls with one coat of cement Primer and two Coats of exterior plastic emulsion of Asian / ICI make.

4.8 DOOR FRAME:

- Supply & fixing of 1.2 mm thick cold-rolled steel Sections of Size 40 x 50 x 40mm with three mild steel Hinges duly welded on one side as a complete Item of work.

4.9 DOOR SHUTTER:

- Supply & fixing of 30-mm hard core Flush door of boiling Waterproof Grade [BW Grade] including one Al drop, one doorstopper, two handles, one latch in chrome Plated steel.

4.10 WINDOW FRAME:

- Supply & fixing of 1.2 mm thick cold-rolled Steel sections
- In size: 40 x 50 x 28mm 10mm Burglar bars at every 100 mm Center.

4.11 WINDOW SHUTTERS:

- Supply & fixing of mild steel Z section of size: 25 x 25 mm fixed with two
- Hinges and two handles, two Stay rods as Pre required Size with 4mm thick glass In the MS Shutter.



TITLE:
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LABOUR COLONY

SPECIFICATION NO: PS-SR-PMX-CVL

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4.12 ELECTRICAL:

- All light points will be connected with 1/18 wire with PVC casing.
- All power points will be connected with 3/20 gauge Wire & 1/18 earth, all the Cables will be Properly
- Conduited The wire will be any ISI mark, switches shall be Anchor or equivalent make. (Points only without fixtures)
- (Each Room Light Points = 2 No's, Fan Points = 2 No minimum, 5Amp Sockets = 4 No's)

4.13 TOILET, BATH AND KITCHEN AREA:

- The toilet, Bath and kitchen shall be of masonry structures and each toilet shall contain Indian Water Closet (IWC) with self-flushing mechanism, Along with suitable required taps. No of toilets shall be apprx. Minimum 1 No for every 5 persons.

4.14 WATER SUPPLY:

- Sintex/other water tanks shall be placed at suitable heights on top steel structure provided by the bidder for distribution of drinking water and service water. The water tank shall be connected to all taps for continuous supply of water. Measures shall be taken to install water saving devices and to prevent water wastage.

4.15 SEWAGE CONNECTION:

- Sanitary fitting along with sewage pipe shall be provided up to septic tank and soak pit. All internal and external plumbing (from water tank to distribution system like toilet and pantry) shall be provided by bidder.
- The waste water out of bathing shall be let out to nearest drain through masonry drain and stagnation of the waste water is strictly prohibited
- The septic tank and soak pit shall be designed by the bidder to accommodate the labour strength planned by them for mobilisation.

4.16 ELECRICAL WORKS:

Each Room in the prefabricated building shall contain the below mentioned fittings:

- Open Tube light 2 x 36 W



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TECHNICAL SPECIFICATION FOR
LABOUR COLONY

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- 4Nos of 5 Amps Power socket
- Min 2 Nos of Ceiling Fan point with Fan
- The building should also contain DB's, Earth Pits, Outside light fittings and lights
- Suitable lighting shall be installed to illuminate the entire place using LED Sodium Vapour Lamps. Suitable motor room with water pump for pumping water from BHEL point to vendor Tank

4.17 KITCHEN & DINNING HALL:

- Kitchen shall be of masonry or pre-fabricated structures
- Space nearer to the labour shed shall be allocated for kitchen and dining hall which is exclusive for the particular bidder of the package awarded.
- Dining hall shall be common for all the labours of belongs to the bidder executing a particular package of work of BHEL.
- Dining hall shall be semi closed prefabricated structure shed with sides open and brick wall up to 1m from FFL of the shed
- Dining hall shall be provided with the seating arrangements made of wooden/plastic.
- Dining hall shall be provided with adequate lights, Fans
- All design work of prefabricated buildings, foundations, lighting, fittings, etc. shall be as per the latest Indian Standard Codes and in the scope of bidder.
- The waste water out of utensil cleaning shall be let out to nearest drain through masonry drain and stagnation of the waste water is strictly prohibited

4.18 SALIENT TECHNICAL REQUIREMENTS:

- All design work of prefabricated buildings, foundations, lighting, fittings, etc. shall be as per the latest Indian Standard Codes.
- All designs have to be carried out as per relevant IS/International codes.



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LABOUR COLONY

SPECIFICATION NO: PS-SR-PMX-CVL

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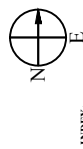
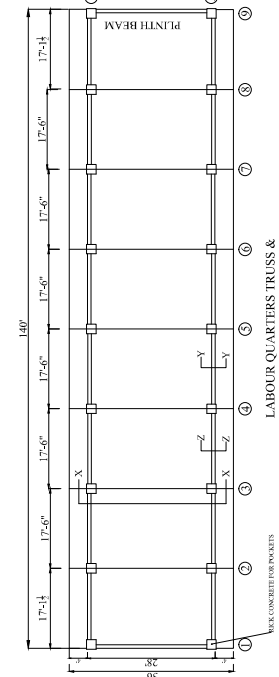
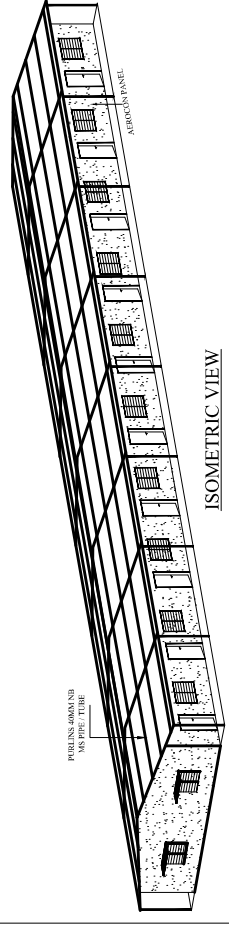
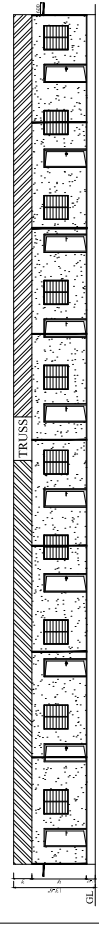
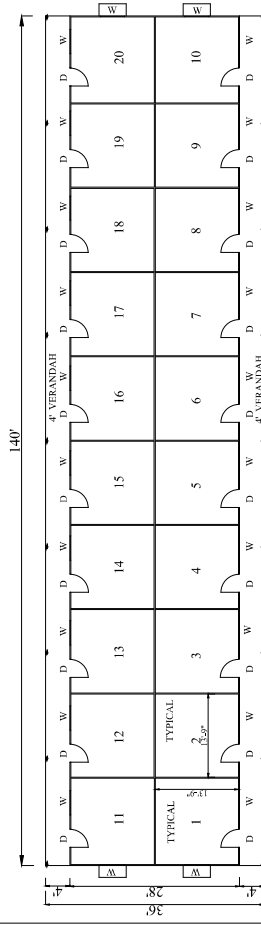
SHEET : 8 OF 8

- Agency shall submit two sets of proposed drawings of labour colony with foundation, Electrical, Plumbing & other fittings etc., to BHEL-Site for approval within fifteen days from the receipt of LOI.
- Bidders should take care of all Indian site conditions, prevailing local laws etc. No claim shall be entertained to lack of knowledge of site condition.
- Hygienic activities of toilets, bath rooms and kitchen area shall be strictly followed by the bidder.
- Transport from Labour colony to work site shall be provided by the bidder daily.

5.0 DRAWINGS & OTHER ENCLOSURES

Following drawings are enclosed strictly for the guidance of the Bidders:

1. Standard Layout of Labour Colony (Typical) Drawing No-BHEL/PSSR/CVL/LABCOL/02, Rev-00
2. Standard drawing of pre-Fabricated Building(Typical) Drawing No-BHEL/PSSR/CVL/LABCOL/03, Rev-00



SPECIFICATION

1. **Walls** - Pre-fabricated Sandwich Panel 'AEROCOR' (Manufactured by Hyderabad Industries Limited) of 50mm thick Middle of two (two) Reinforced cement sheets on either Side of 1kg/cu.ft concrete core composed of port land Cement, binders Siliceous and meaceous material Aggregate with fongite & grove arrangement.
2. **Steel Structure** - Fabricated structural steel for Column, Trusses and rafters.
3. **Bottom Channels** - Galvalini and long jibbed metal Top and bottom Channels of size 38x50x3.8 in 1mm Thickness.
4. **Components** - Ridge covers on the roof length with profiled sheet, all four corners covered with MS corner covers all fixed with the help of bolts/nuts. Anchor fasteners across etc.
5. **Chajja** - 50mm thick AEROCOR Panels fixed to wall with 'L' brackets and bolts.
6. **Flooring** - Screed / Concrete Flooring.
7. **Roof** - Roofing with 0.47mm thick Colour coated sheets of United Galvalini Sheets of 50mm thickness fixed to the rafters in gable Shape with self Tapping Screws.
8. **Door Frame** - Supply and fixing of 12mm thick cold-rolled steel sections of size 40x50x28mm with three mild steel lugs all side in one side to complete frame of work.
9. **Door Shutter** - Supply & fixing of 30mm hardcore Flush door of boiling waterproof Grade (BW Grade) in chrome plated steel one door stopper, two handles one latch in boiling plated steel.
10. **Windows** - Supply & fixing of 10mm thick cold-rolled steel in Size: 40x50x28mm 10mm Burglar bars at every 100mm center.
11. **Window Shutter** - Supply & fixing of Mild steel / Section of size 25x25x2mm with 4mm thick glass in the MS Shutter.
12. **Electrical** - All light points will be connected with 1.5 wire and a Proper earth, with PVC casing.
All power points will be connected with 2.5 gauge wire and 1.5 earth, all the Cables will be Properly Connected. The wire will be Finexcab make, switches shall be Anchorcabe make. (Labour Cuts : Light points = 50/Fan points = 20, Amps = 20)
13. **Painting** (A) Interior: Painting of AEROCOR internal walls with one coat of enamel Primer and two coats of Synthetic / Acrylic paints (B) Oil based distempers of Asatur / ICI Make. (C) Exterior : Painting of AEROCOR External walls with one coat of enamel Primer and two coats of oil based distempers of Asatur / ICI Make.

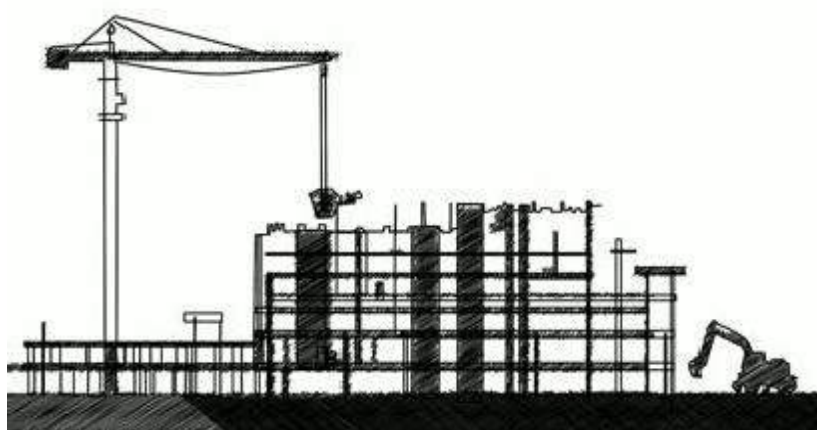
NOTE: ALL DIMENSION ARE IN FEET.

COMPANY: BHEL PPSR

PROJECT:

TITLE: GENERAL LABOUR COLONY DETAILS			
SIZE	SCALE	DRG NO:	REV
	Not to Scale	BHEL : FSSR : CVJ : LAB	0

PREPARED BY	REVIEWED BY	CHICKEN	APPROVED BY



HEALTH, SAFETY and ENVIRONMENT PLAN

for

**SITE
OPERATIONS**

by

**SUB-
CONTRACTORS**

POWER SECTOR

HSE PLAN FOR SITE OPERATIONS BY BHEL'S SUBCONTRACTORS

AT A GLANCE

BEFORE START	SIGNING OF MOU	
	Agree to comply to HSE requirement- Statutory and BHEL’s	
PLAN	HSE ORGANISATION	
	Manpower 1 (one) safety officer for every 500 workers or part thereof 1(one) safety-steward/ supervisor for every 100 workers Qualification As per Cl. 7.1	HSE Roles and responsibilities - Site In-charge- As per clause 7.2.1 - Safety officer- As per clause 7.2.2
	HSE Planning for Man, Machinery/Equipment/Tools & Tackles	
PROVIDE	HSE INFRASTRUCTURE	
	- PPEs - Drinking Water - Washing Facilities - Latrines and Urinals - Provision of shelter for rest - Medical facilities	- Canteen facilities - Labour Colony - Emergency Vehicle - Pest Control - Scrapyard - Illumination
TRAIN	HSE TRAINING , AWARENESS & PROMOTION	
	Training - Induction training - Height work and other critical areas - Tool Box talk & Pep Talk	Awareness & Promotion - Signage - Poster - Banner - Competition - Awards
COMMUNICATE	HSE COMMUNICATION	
	Incident Reporting - Accident- Fatal & Major - Property damage - Near Miss	Event Reporting - Celebrations - Training - Medical camp

EXECUTE SAFELY

OPERATIONAL CONTROL PROCEDURES

PERMIT TO WORK

Height work (above 2 metres), Hot Work, Heavy Lifting, Confined Space, Radiography, excavation (More than 4 metres)

SAFETY DURING WORK EXECUTION

• Welding • Rigging • Cylinder- storage & Movement • Demolition work • T&Ps • Chemical Handling • Electrical works	• Fire • Scaffolding • Height work • Working Platform • Excavation • Ladder • Lifting • Hoisting appliance

HOUSE KEEPING

WASTE MANGEMENT

TRAFFIC MANAGEMENT

ENVIRONMENTAL CONTROL

EMERGENCY PREPAREDNESS AND RESPONSE PLAN

CHECKS

HSE AUDITS & INSPECTION

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

HSE PERFORMANCE EVALUATION PARAMETERS

NON CONFORMANCE

PENALTY for NON CONFORMANCE

Refer Clause 16

Incremental penalty

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

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

	HEALTH, SAFETY AND ENVIRONMENT PLAN FOR SITE OPERATION by SUBCONTRACTORS		Doc no.: HSEP: 14
	POWER SECTOR		REV: 01
			Date: 20.01.2020

REVISION HISTORY SHEET

Date	Revision No.	Details of Changes	Reason	Prepared	Reviewed	Approved
12.08.2014	00	First Issue	First Issue	S. B. Jayant, Dy Manager- FQA & Safety	A. K. Sinha, GM-FQA & Safety	Anuj Bhatnagar, ED-FQA & Safety
20.01.2020	01	Formats added: HSEP:14-F30 – Monthly HSE Planning & Review (Page 11, Clause 8.0 - updated) HSEP:14-F13E-Excavation Inspection Format (part of F30)) HSEP:14-F32B – Job Safety Analysis Format (part of F30) HSEP:14-F31A – Daily HSE Reporting (Page 18, Clause 10.3 – added) HSEP:14-F33 – HSE Performance Evaluation (Page 31, Clause 13 – revised)	IOM No. PSHQHSE/M ONREP/02 Dated 08-Jan-2020	Rohit Kumar	Santosh Nair, GM (MSX & HSE)	



HEALTH, SAFETY AND ENVIRONMENT PLAN FOR SITE OPERATION by SUBCONTRACTORS

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**HEALTH, SAFETY AND ENVIRONMENT
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**HEALTH, SAFETY AND ENVIRONMENT
PLAN FOR
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1.0 PURPOSE

- 1.1** The purpose of this HSE Plan is to provide for the systematic identification, evaluation, prevention and control of general workplace hazards, specific job hazards, potential hazards and environmental impacts that may arise from foreseeable conditions during installation and servicing of industrial projects and power plants.
- 1.2** This document shall be followed by BHEL's subcontractors at all installation and servicing sites. In case customer specific documents are to be implemented, this document will be followed in conjunction with customer specific documents.
- 1.3** Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy relevant statutory guidelines must be followed.
- 1.4** In case the customer has any specific requirement, the same is to be fulfilled.

2.0 SCOPE

The document is applicable for BHEL's Subcontractors at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations.

3.0 OBJECTIVES AND TARGETS

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

- Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
- Ensure protection of environment of the work site.
- Comply at all times with the relevant statutory and contractual HSE requirements.
- Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.
- Provide all personnel with adequate information, instruction, training and supervision on the safety aspect of their work.
- Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including subcontractors in respects of HSE.
- Establish effective communication on HSE matters with all relevant parties involved in the Project works.
- Ensure that all work planning takes into account all persons that may be affected by the work.
- Ensure fitness testing of all T&Ps/Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent person.
- Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
- Ensure continual improvements in HSE performance
- Ensure conservation of resources and reduction of wastage.
- Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
- Ensure timely implementation of correction, corrective action and preventive action.



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HSE TARGETS

EXPLOSION	ZERO
FATALITY	ZERO
LOST TIME INJURY	ZERO
FIRE	ZERO
VEHICLE INCIDENTS	ZERO
ENVIRONMENTAL INCIDENTS	ZERO

4.0 BHEL POWER SECTOR HEALTH, SAFETY & ENVIRONMENT POLICY

Health, Safety & Environment Policy of BHEL

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

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

sd/-

CMD, BHEL

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5.0 MEMORANDUM OF UNDERSTANDING:

After award of work, subcontractors are required to enter into a memorandum of understanding as given below:

Memorandum of Understanding

BHEL, Power Sector _____ Region is committed to Health, Safety and Environment Policy (HSE Policy).

M/s _____ do hereby also commit to comply with the same HSE Policy while executing the Contract Number _____

M/s _____ shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be reached to all workers and supervisors for compliance.

In addition to this, M/S _____ shall comply to all applicable statutory and regulatory requirements which are in force in the place of project and any special requirement specified in the contract document of the principal customer.

M/s _____ shall co-operate in HSE audits/inspections conducted by BHEL /customer/ third party and ensure to close any non-conformity observed/reported within prescribed time limit.

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

Name :

Place & Date:



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6.0 TERMS AND DEFINITIONS

6.1 DEFINITIONS

6.1.1 INCIDENT

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

6.1.2 NEAR MISS

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

6.1.3 MAN-HOURS WORKED

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

6.1.4 FIRST AID CASES

First aids are not essentially all reportable cases, where the injured person is given medical treatment and discharged immediately for reporting on duty, without counting any lost time.

6.1.5 LOST TIME INJURY

Any work injury which renders the injured person unable to perform his regular job or an alternative restricted work assignment on the next scheduled work day after the day on which the injury occurred.

6.1.6 MEDICAL CASES

Medical cases come under non-reportable cases, where owing to illness or other reason the employee was absent from work and seeks Medical treatment.

6.1.7 TYPE OF INCIDENTS & THEIR REPORTING:

The three categories of Incident are as follows:

Non-Reportable Cases:

An incident, where the injured person is given medical help and discharged for work without counting any lost time.



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Reportable Cases:

In this case the injured person is disable for 48 hours or more and is not able to perform his duty.

Injury Cases:

These are covered under the heading of non-reportable cases. In these cases the incident caused injury to the person, but he still continues his duty.

6.1.8 TOTAL REPORTABLE FREQUENCY RATE

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

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

6.1.9 SEVERITY RATE

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

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

6.1.10 INCIDENCE RATE

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

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

7.0 HSE ORGANISATION

Number of safety officers:

The subcontractor must deploy one safety officer for every 500 workers or part thereof in each package. In addition, there must be one safety-steward/safety-supervisor for every 100 workers.

Deployment: The subcontractor should deploy sufficient safety officers and safety-steward/Safety-supervisor, as per requirement given above, since initial stage and add more in proportion to the added strength in work force. Any delay in deployment will attract a penalty of Rs.30,000/- per man month for the delayed period.

7.1 QUALIFICATION FOR HSE PERSONNEL

Sl.no	Designation	Qualification	Experience
1	Safety officer (Construction Agency)	Degree or Diploma in Engineering with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years for degree holder and five years for diploma holder in the field of Construction of power plant/ major industries

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2	Safety-Steward/ Safety-Supervisor	Degree or diploma in any discipline with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years

7.2 RESPONSIBILITIES

7.2.1 SITE IN -CHARGE OF SUBCONTRACTOR

- Shall sign Memorandum of Understanding (MoU) for compliance to BHEL's HSE Plan for Site Operations as per clause 5.0
- Shall engage qualified safety officer(s) and steward (s) as per clause 7.0
- Shall adhere to the rules and regulations mentioned in this code, practice very strictly in his area of work in consultation with his concerned engineer and the safety coordinator.
- Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
- Shall not engage any employee below 18 years.
- Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job. Shall ensure that no working men/women carry excessive weight more than stipulated in Factory Rule Regulation R57.
- Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent person.
- Shall ensure that provisions stipulated in contract Labour Regulation Act 1970, Chapter V C.9, canteen, rest rooms/washing facilities to contracted employees at site.
- Shall adhere to the instructions laid down in Operation Control Procedures (OCPs) available with the site management.
- Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
- Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /HSE officer of BHEL.
- Shall ensure that Horseplay is strictly forbidden.
- Shall ensure that adequate illumination is arranged during night work.
- Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
- Shall ensure display of adequate signage/posters on HSE.
- Shall ensure that mobile phone is not used by workers while working.
- Shall ensure conductance of HSE audit, mockdrill, medical camps, induction training and training on HSE at site.
- Shall ensure full co-operation during HQ/External /Customer HSE audits.



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- ☐ Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- Shall ensure good housekeeping.
- Shall ensure adequate valid fire extinguishers are provided at the worksite.
- Shall ensure availability of sufficient number of toilets /restrooms and adequate drinking water at work site and labour colony.
- Shall ensure adequate emergency preparedness.
- Shall be member of site HSE committee and attend all meetings of the committee
- Power source for hand lamps shall be maximum of 24 v.
- ☐ Temporary fencing should be done for open edges if Hand – railings and Toe-guards are not available.

7.2.2 HEALTH, SAFETY AND ENVIRONMENT OFFICER OF SUBCONTRACTOR

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

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8.0 PLANNING BY SUBCONTRACTOR

Monthly planning and review of HSE activities shall be carried out by subcontractor as per format No. HSEP:14-F30 jointly along with BHEL.

8.1 MOBILISATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR

- As a measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and complies with legislative and owner requirement, inspection shall be arranged by in-house competent authority for acceptance as applicable.
- The machinery and equipment to be embraced for this purpose shall include but not limited to the following:
 - o Mobile cranes.
 - o Side Booms.
 - o Forklifts.
 - o Grinding machine.
 - o Drilling machine.
 - o Air compressors.
 - o Welding machine.
 - o Generator sets.
 - o Dump Trucks.
 - o Excavators.
 - o Dozers
 - o Grit Blasting Equipment.
 - o Hand tools.
- Subcontractor shall notify the engineer, of his intention to bring on to site any equipment or any container, with liquid or gaseous fuel or other substance which may create a hazard. The Engineer shall have the right to prescribe the condition under which such equipment or container may be handled and used during the performance of the works and the subcontractor shall strictly adhere to such instructions. The Engineer shall have the right to inspect any construction tool and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition will be entertained.

8.2 MOBILISATION OF MANPOWER BY SUBCONTRACTOR

- The subcontractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.
- The subcontractor shall take special care of the employees affected with occupational diseases under rule 230 and schedule II of BOCW Rules. The employees not meeting the fitness requirement should not be engaged for such job.
- Ensure that the regulatory requirements of excessive weight limit (to carry/lift/ move weights beyond prescribed limits) for male and female workers are complied with.
- Appropriate accommodation to be arranged for all workmen in hygienic condition.



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8.3 PROVISION OF PPEs

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

Sl. No	Type of work	PPEs
1	Concrete and asphalt mixing	Nose mask, hand glove, apron and gum boot
2	Welders/Grinders/ Gas cutters	Welding/face screen, apron, hand gloves, nose mask and ear muffs if noise level exceeds 90dB. Helmet fitted with welding shield is preferred for welders
3	Stone/ concrete breakers	Ear muffs, safety goggles, hand gloves
4	Electrical Work	Rubber hand glove, Electrical Resistance shoes
5	Insulation Work	Respiratory mask, Hand gloves, safety goggles
6	Work at height	Double lanyard full body harness, Fall arrestor (specific cases)
7	Grit/Sand blasting	Blast suit, blast helmet, respirator, leather gloves
8	Painting	Plastic gloves, Respirators (particularly for spray painting)
9	Radiography	As per BARC guidelines

- The PPEs shall conform to the relevant standards as below and bear ISI mark.

Relevant is-codes for personal protection

IS: 2925 – 1984	Industrial Safety Helmets.
IS: 4770 – 1968	Rubber gloves for electrical purposes.
IS: 6994 – 1973 (Part-I)	Industrial Safety Gloves (Leather & Cotton Gloves).
IS: 1989 – 1986 (Part-I-II)	Leather safety boots and shoes.
IS: 5557 – 1969	Industrial and Safety rubber knee boots.
IS: 6519 – 1971	Code of practice for selections care and repair of Safety footwear.
IS: 11226 – 1985	Leather Safety footwear having direct molding sole.
IS: 5983 – 1978	Eye protectors.
IS: 9167 – 1979	Ear protectors.
IS: 1179-1967	Eye & Face protection during welding
IS: 3521 – 1983	Industrial Safety Belts and Harness
IS: 8519 -1977	Guide for selection of industrial Safety equipment for body protection
IS: 9473-2002, 14166-1994, 14746-1999	Respiratory Protective Devices

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



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- Where workers are employed in sewers and manholes, which are in use, the subcontractor shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manhole, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent incident to the public
- Besides the PPEs mentioned above, the persons shall use helmet and safety shoe. The visitors shall use Helmet and any other PPEs as deemed appropriate for the area of work.

Colour scheme for Helmets:

- Workmen: Yellow
 - Safety staff: Green or white with green band
 - Electrician: Red
 - Others including visitors: White
- All the PPEs shall be checked for its quality before issue and the same shall be periodically checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be repaired/ replaced.
 - The issuing agency shall maintain register for issue and receipt of PPEs.
 - The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.
 - The body harnesses shall be serial numbered.

8.4 ARRANGEMENT OF INFRASTRUCTURE

8.4.1 DRINKING WATER

- Drinking water shall be provided and maintained at suitable places at different elevations.
- Container should be labeled as "Drinking Water"
- Cleaning of the storage tank shall be ensured atleast once in 3 months indicating date of cleaning and next due date.
- Potability of water should be tested as per IS10500 at least once in a year.

8.4.2 WASHING FACILITIES

- In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
- Separate and adequate cleaning facilities shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition and dully illuminated for night use.
- Overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the painters and other workers to wash during the cessation of work.

8.4.3 LATRINES AND URINALS

- Latrines and urinals shall be provided in every work place.
- Urinals shall also be provided at different elevations.
- They shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times, by appointing designated person.
- Separate facilities shall be provided for the use of male and female worker if any.

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8.4.4 PROVISION OF SHELTER DURING REST

Proper Shed & Shelter shall be provided for rest during break

8.4.5 MEDICAL FACILITIES

8.4.5.1 MEDICAL CENTRE (As per Schedule V, X and XI of BOCW central Rules, 1998)

- A medical centre shall be ensured/identified at site with basic facilities for handling medical emergencies. The medical center can be jointly developed on proportionate sharing basis with permission from BHEL
- A qualified medical professional, not less than MBBS, shall be deployed at the medical centre
- The medical centre shall be equipped with one ambulance, with trained driver and oxygen cylinder.
- Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste –Management and Handling Rules, 1998)

8.4.5.2 FIRST AIDER

- Ensure availability of Qualified First-aider throughout the working hours.
- Every injury shall be treated, recorded and reported.
- Refresher course on first aid shall be conducted as necessary.
- List of Qualified first aiders and their contact numbers should be displayed at conspicuous places.

8.4.5.3 FIRST AID BOX (as per schedule III of BOCW)

- The subcontractor shall provide necessary first aid facilities as per schedule III of BOCW. At every work place first aid facilities shall be provided and maintained.
- The first aid box shall be kept by first aider who shall always be readily available during the working hours of the work place. His name and contact no to be displayed on the box.
- The first aid boxes should be placed at various elevations so as to make them available within the reach and at the quickest possible time.
- The first aid box shall be distinctly marked with a Green Cross on white background.
- Details of contents of first aid box is given in Annexure No. 01
- Monthly inspection of First Aid Box shall be carried out by the owner as per format no. HSEP:14-F01
- The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

8.4.5.4 HEALTH CHECK UP (As per schedule VII and Form XI)

The persons engaged at the site shall undergo health checkup as per the format no. HSEP:14-F02 before induction. The persons engaged in the following works shall undergo health checkup at least once in a year:

- a. Height workers
- b. Drivers/crane operators/riggers



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- c. Confined space workers
- d. Shot/sand blaster
- e. Welding and NDE personnel

8.4.6 PROVISION OF CANTEEN FACILITY

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

8.4.7 PROVISION OF ACCOMODATION/LABOUR COLONY

- ☐ The subcontractor shall arrange for the accommodation of workmen at nearby localities or by making a labour colony.
- ☐ Regular housekeeping of the labour colony shall be ensured.
- ☐ Proper sanitation and hygienic conditions to be maintained.
- ☐ Drinking water and electricity to be provided at the labour colony.
- ☐ Bathing/ washing bay
- ☐ Room ventilation and electrification.

8.4.8 PROVISION OF EMERGENCY VEHICLE

- Dedicated emergency vehicle shall be made available at workplace by each subcontractor to handle any emergency

8.4.9 PEST CONTROL

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

8.4.10 SCRAPYARD

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

8.4.11 ILLUMINATION

- The subcontractor shall arrange at his cost adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. at various levels for safe and proper working operations at dark places and during night hours at the work spot as well as at the pre-assembly area.
- Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II). Some recommended values are given below:



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S. No.	Location	Illumination (Lux)
A. Construction Area		
1.	Outdoor areas like store yards, entrance and exit roads	20
2.	Platforms	50
3.	Entrances, corridors and stairs	100
4.	General illumination of work area	150
5.	Rough work like fabrication, assembly of major items	150
6.	Medium work like assembly of small machined parts	300
	rough measurements etc.	
7.	Fine work like precision assembly, precision measurements etc.	700
8.	Sheet metal works	200
9.	Electrical and instrument labs	450
B. Office		
1.	Outdoor area like entrance and exit roads	20
2.	Entrance halls	150
3.	Corridors and lift cars	70
4.	Lift landing	150
5.	Stairs	100
6.	Office rooms, conference rooms, library reading tables	300
7.	Drawing table	450
8.	Manual telephone exchange	200

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

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

9.0 HSE TRAINING& AWARENESS

9.1 HSE INDUCTION TRAINING

All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL /subcontractor before being assigned to work.

In-house induction training subjects shall include but not limited to:

- Briefing of the Project details.
- Safety objectives and targets.
- Site HSE rules.
- Site HSE hazards and aspects.
- First aid facility.
- Emergency Contact No.
- Incident reporting.
- Fire prevention and emergency response.
- Rules to be followed in the labour colony (if applicable)



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- Proper safety wear & gear must be issued to all the workers being registered for the induction (i.e., Shoes/Helmets/Goggles/Leg guard/Apron etc.)
- They must arrive fully dressed in safety wear & gear to attend the induction.
- Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.
- On completing attending subcontractor's in-house HSE induction, each employee shall sign an induction training form (format no. HSEP:14-F03) to declare that he had understood the content and shall abide to follow and comply with safe work practices. They may only then be qualified to be issued with a personal I.D. card, for access to the work site.

9.2 HSE TOOLBOX TALK

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

9.3 TRAINING ON HEIGHT WORK

Training on height work shall be imparted to all workers working at height by in-house/external faculty at least twice in a year. The training shall include following topics:

- Use of PPEs
- Use of fall arrester, retractable fall arrester, life line, safety nets etc.
- Safe climbing through monkey ladders.
- Inspection of PPEs.
- Medical fitness requirements.
- Mock drill on rescue at height.
- Dos & Don'ts during height work.

9.4 HSE TRAINING DURING PROJECT EXECUTION

- Other HSE training shall be arranged by BHEL/ subcontractor as per the need of the project execution and recommendation of HSE committee of site.
- The topics of the HSE training shall be as follows but not limited to:
 - o Hazards identification and risk analysis (HIRA)
 - o Work Permit System
 - o Incident investigation and reporting
 - o Fire fighting
 - o First aid
 - o Fire-warden training
 - o EMS and OHSMS
 - o T & Ps fitness and operation



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- o Electrical safety
- o Welding, NDE & Radiological safety
- o Storage, preservation & material handling.
- A matrix shall be maintained to keep an up-to-date record of attendance of training sessions carried out.

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

9.5.1 Display of HSE posters and banners

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

9.5.2 Display of HSE signage

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

9.5.3 Competition on HSE and award

- Site will arrange different competition (slogan, poster, essay etc.) on HSE time to time (Safety day, BHEL day, World Environment Day etc.) and winners will be suitably awarded.

9.5.4 HSE awareness programme

- Subcontractor shall arrange HSE awareness programme periodically on different topics including medical awareness for all personnel working at site

10.0 HSE COMMUNICATION

10.1 INCIDENT REPORTING

- The subcontractor shall submit report of all incidents, fires and property damage etc to the Engineer immediately after such occurrence, but in any case not later than 24 hours of the occurrence. Such reports shall be furnished in the manner prescribed by BHEL. (Refer HSE procedure for incident investigation, analysis and reporting for details)
- In addition, periodic reports on safety shall also be submitted by the subcontractor to BHEL from time to time as prescribed by the Engineer. Compiled monthly reports of all kinds of incidents, fire and property damage to be submitted to BHEL safety officer as per prescribed formats.
- HSE incidents of site shall be reported to BHEL site Management as per Procedure for Incident Investigation and Reporting in format no. HSEP:14-F15. Corrective action shall be immediately implemented at the work place and compliance shall be verified by BHEL HSE officer and until then, work shall be put on hold by Construction Manager.

10.2 HSE EVENT REPORTING

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

10.3 DAILY HSE ACTIVITY REPORTING

Daily HSE activities shall be reported by subcontractor to BHEL as per Format No. HSEP:14-F31A



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11.0 OPERATIONAL CONTROL

All applicable OCPs (Operational control procedures) will be followed by subcontractor as per BHEL instructions. This will be done as part of normal scope of work. List of such OCPs is given below. In case any other OCP is found to be applicable during the execution of work at site, then subcontractor will follow this as well, within quoted rate. These OCPs (applicable ones) will be made available to subcontractor during work execution at site. However for reference purpose, these are kept with Safety Officer of BHEL at the Power Sector Regional HQ, or available in downloadable format in the website, which may be refereed by subcontractor, if they so desire.

LIST OF OCPs

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

11.1 HSE ACTIVITIES

HSE activities shall be conducted at site based on the HSEMSM developed by Power Sector and issued to site by Regions.

While planning for any activity the following documents shall be referred for infrastructural requirements to establish control measures:

- 1) HSE Procedure for Register of OHS Hazards and Risks
- 2) HSE Procedure for Register of Environmental Aspects and Impacts
- 3) HSE Procedure for Register of Regulations



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- 4) Operational Control Procedures
- 5) HSE Procedure for Emergency Preparedness and Response Plan
- 6) Contract documents

11.2 WORK PERMIT SYSTEM

- ☐ The following activities shall come under Work Permit System
 - a. Height working above 2 metres
 - b. Hot working at height
 - c. Confined space
 - d. Radiography
 - e. Excavation more than 4 meter depth
 - f. Heavy lifting above 50 tonRefer Annexure 05 for Work permit formats.
- "HSE Procedure for Work Permit System" shall be followed while implementing permit system. Where customer is having separate Work Permit System the same shall be followed.
- ☐ Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with Job Hazard Analysis.
- ☐ Permit signatory shall check that all the control measures necessary for the activity are in place and issue the permit to the permit holder.
- ☐ Permit holder shall implement and maintain all control measures during the period of permit .He will close the permit after completion of the work. The closed permit shall be archived in HSE Department of site.

11.3 SAFETY DURING WORK EXECUTION

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

11.3.1 WELDING SAFETY

All safety precautions shall be taken for welding and cutting operations as per IS-818. All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

11.3.2 RIGGING

Rigging equipment shall not be loaded in excess of its recommended safe working load. Rigging equipment, when not in use, shall be removed from the original work area so as not to present a hazard to employees.

11.3.3 CYLINDERS STORAGE AND MOVEMENT

All gas cylinders shall be stored in upright position. Suitable trolley shall be used. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced. No of cylinders shall not exceed the specified quantity as per OCP

Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dragged, struck or permitted to strike each other violently.

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When cylinders are transported by powered vehicle they shall be secured in a vertical position.

11.3.4 DEMOLITION WORK

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

- All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- No electric cable or apparatus which is liable to be a source of danger nor a cable or an apparatus used by the operator shall remain electrically charged.
- All practical steps shall be taken to prevent danger to persons employed from the risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render them unsafe.

11.3.5 T&Ps

All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test/calibration certificates bearing endorsement from competent authority of BHEL..Subcontractor to also submit monthly reports of T&Ps deployed and validity test certificates to BHEL safety Officer as per the format/procedure of BHEL.

11.3.6 CHEMICAL HANDLING

Displaying safe handling procedures for all chemicals such as lube oil, acid, alkali, sealing compounds etc , at work place.Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the subcontractor shall be responsible for carrying out such provision / storage in accordance with the rules & regulations laid down in the relevant petroleum act, explosive act and petroleum and carbide of calcium manual, published by the chief inspector of explosives of India. All such storage shall have prior approval if necessary from the chief inspector of explosives or any other statutory authority. The subcontractor shall be responsible for obtaining the same.

11.3.7 ELECTRICAL SAFETY

- Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts.
- Fulfilling safety requirements at all power tapping points.
- High/ Low pressure welders to be identified with separate colour clothings. No welders will be deployed without passing appropriate tests and holding valid welding certificates. Approved welding procedure should be displayed at work place.
- The subcontractor shall not use any hand lamp energized by Electric power with supply voltage of more than 24 volts in confined spaces like inside water boxes, turbine casings, condensers etc.
- All portable electric tools used by the subcontractor shall have safe plugging system to source of power and be appropriately earthed. Only electricians licensed by appropriate statutory authority shall be employed by the subcontractor to carry out all types of electrical works. Details of earth resource and their test date to be given to BHEL safety officer as per the prescribed formats of BHEL
- The subcontractor shall use only properly insulated and armored cables which conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site.



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- BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the cost of the subcontractor.
- All electrical appliances used in the work shall be in good working condition and shall be properly earthed.
- No maintenance work shall be carried out on live equipment.
- The subcontractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
- Area wise Electrical safety inspection is to be carried out on monthly basis as per "Electrical Safety Inspection checklist" and the report is to be submitted to BHEL safety officer
- Adequate precautions shall be taken to prevent danger for electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public
- The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.

11.3.8 FIRE SAFETY

- Providing appropriate fire fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
- Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labor colony etc. Such fire protection equipment shall be easy and kept open at all times.
- The fire extinguishers shall be properly refilled and kept ready which should be certified at periodic intervals. The date of changing should be marked on the Cylinders.
- All other fire safety measures as laid down in the "codes for fire safety at construction site" issued by safety coordinator of BHEL shall be followed.
- Non-compliance of the above requirement under fire protection shall in no way relieve the subcontractor of any of his responsibility and liabilities to fire incident occurring either to his materials or equipment or those of others.
- Emergency contacts nos must be displayed at prominent locations
- Tarpaulin being inflammable should not be used (instead, only non-infusible covering materials shall be used) as protective cover while preheating, welding, stress relieving etc. at site.

11.3.9 SCAFFOLDING

- Suitable scaffolds shall be provided for workman for all works that cannot safely be done from the ground, or from solid construction except in the case of short duration of work which can be done safely from ladders.
- When a ladder is used, it shall be of rigid construction made of steel. The steps shall have a minimum width of 45 cm and a maximum rise of 30 cm. Suitable handholds of good quality wood or steel shall be provided and the ladder shall be given an inclination not steeper than $\frac{1}{4}$ horizontal and 1 vertical.
- Scaffolding or staging more than 3.6 m above the ground floor, swung or suspended from an overhead support or erected with stationery support shall have a guard rail properly bolted, braced or otherwise secured, at least 90 cm above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from savor, from swaying, from the building or structure.

11.3.10 WORK AT HEIGHT:

- Guardrails and toe-board/barricades and sound platform conforming to IS:4912-1978 should be provided.



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- Wherever necessary, life-line (pp or metallic) and fall arrestor along with Polyamide rope or Retractable lifeline should be provided.
- Safety Net as per IS:11057:1984 should be used extensively for prevention/ arrest of men and materials falling from height. The safety nets shall be fire resistant, duly tested and shall be of ISI marked and the nets shall be located as per site requirements to arrest or to reduce the consequences of a possible fall of persons working at different heights.
- Reaching beyond barricaded area without lifeline support, moving with support of bracings, walking on beams without support, jumping from one level to another, throwing objects and taking shortcut must be discouraged.
- Use of Rebar steel for making Jhoola and monkey-ladder (Rods welded to vertical or inclined structural members), temporary platform etc. must be avoided.
- Monkey Ladder should be properly made and fitted with cages.
- Jhoola should be made with angles and flats and tested like any lifting tools before use.
- Lanyard must be anchored always and in case of double lanyard, each should be anchored separately.
- In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
- In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
- Empty drums must not be used.
- For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure along with separate fall arrestor. Rope ladder should be discouraged.

11.3.11 WORKING PLATFORM

Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform gangways provided is more than 3.6 m above ground level or floor level, they shall be closely boarded and shall have adequate width which shall not be less than 750 mm and be suitably fenced as described above. Every opening in the floor or a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm.

11.3.12 EXCAVATION

Wherever there are open excavation in ground, they shall be fenced off by suitable railing and danger signals installed at night so as to prevent persons slipping into the excavations.

11.3.13 LADDER SAFETY

Safe means of access shall be provided to all working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 m in the length while the width between side rails in rung ladder shall in no case be less than app. 29.2 cm for ladder upto and including 3 m in length. For longer ladders this width shall be increased at least ¼" for each additional foot of length.

A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer obtained prior to Construction.

11.3.14 LIFTING SAFETY

- It will be the responsibility of the subcontractor to ensure safe lifting of the equipment, taking due precaution to avoid any incident and damage to other equipment and personnel.



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- All requisite tests and inspection of handling equipment, tools & tackle shall be periodically done by the subcontractor by engaging only the Competent Persons as per law.
- Defective equipment or uncertified shall be removed from service.
- Any equipment shall not be loaded in excess of its recommended safe working load.

11.3.15 HOISTING APPLIANCE

- Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safe guards.
- Hoisting appliance should be provided with such means as will reduce to the minimum the risk of any part of a suspended load becoming incidentally displaced.
- When workers employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided.
- The worker should not wear any rings, watches and carry keys or other materials which are good conductor of electricity.

11.4 ENVIRONMENTAL CONTROL

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

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

In the event of any spillage, the principle is to recover as much material as possible before it enters drainage system and to take all possible action to prevent spilled materials from running off the site. The subcontractor shall use appropriate MSDS for clean-up technique

All subcontractors shall be responsible for the cleanliness of their own areas.

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

It is imperative on the part of the subcontractor to join and effectively contribute in joint measures such as tree plantation, environment protection, contributing towards social upliftment, conversion of packing woods to school furniture, keeping good relation with local populace etc.

The subcontractor shall carry out periodic air and water quality check and illumination level checking in his area of work place and take suitable control measure.

11.5 HOUSEKEEPING

- Keeping the work area clean/ free from debris, removed scaffoldings, scraps, insulation/sheeting wastage /cut pieces, temporary structures, packing woods etc. will be in the scope of the subcontractor. Such cleanings has to be done by



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subcontractor within quoted rate, on daily basis by an identified group. If such activity is not carried out by subcontractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost along with BHEL overheads will be deducted from contractor's bill. Such decisions of BHEL shall be binding on the subcontractor

- Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis.
- All surplus earth and debris are removed/disposed off from the working areas to identified locations.
- Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
- All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations. Sufficient waste bins shall be provided at
- Different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high location.
- Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
- Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
- Labour camp area shall be kept clear and materials like pipes, steel, sand, concrete, chips and bricks, etc. shall not be allowed in the camp to obstruct free movement of men and machineries.
- Fabricated steel structures, pipes & piping materials shall be stacked properly.
- No parking of trucks/trolleys, cranes and trailers etc. shall be allowed in the camp, which may obstruct the traffic movement as well as below LT/HT power line.
- Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas

11.6 WASTE MANAGEMENT

Take suitable measures for waste management and environment related laws/legislation as a part of normal construction activities. Compliance with the legal requirements on storage/ disposal of paint drums (including the empty ones), Lubricant containers, Chemical Containers, and transportation and storage of hazardous chemicals will be strictly maintained.

11.6.1 BINS AT WORK PLACE

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

11.6.2 STORAGE AND COLLECTION

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

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11.6.3 SEGREGATION

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

11.6.4 DISPOSAL

- Sufficient containers and scrap disposal area should be allocated.
- All scrap bin and containers should be conveniently located.
- Provide self-closing containers for flammable/spontaneously combustible material.
- Keep drainage channels free from choking.
- Make schedule for collection and disposal of waste.

11.6.5 WARNING AND SIGNS

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

11.7 TRAFFIC MANAGEMENT SYSTEM

11.7.1 SAFE WORKPLACE TRANSPORT SYSTEM

- Traffic routes in a work place shall be suitable for the persons or vehicles using them. This shall be sufficient in number and of sufficient size. This shall reflect the suitability of traffic routes for vehicles and pedestrians.
- Where vehicles and pedestrians use the same traffic routes there shall be sufficient space between them. Where necessary all traffic routes must be suitably indicated. Pedestrians or vehicles must be able to use traffic routes without endangering those at work. There must be sufficient separation of traffic routes from doors, gates and pedestrian traffic routes.
- For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
- Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.
- Speed limits shall be clearly displayed. Speed ramps preceded by a warning signs or marker are necessary.
- The traffic route should be wide enough to allow vehicles to pass and re-pass oncoming or parked traffic and it may be advisable to introduce on-way system or parking restrictions.
- Safest route shall be provided between places where vehicles have to call or deliver.
- Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse



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- Safe areas shall be provided for loading and unloading.
- Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
- Ensure road crossings are minimum and clearly signed.
- Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.
- Set sensible speed limits which are clearly sign posted.
- Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.
- Forklift trucks shall not pass over road hump unless of a type capable of doing so.
- Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
- Road traffic signs shall be provided on prominent locations for prevention of incidents and hazards and for quick guidance and warning to employees and public. Safety signs shall be displayed as per the project working requirement and guideline of the state in which project is done. Vehicles hired or used shall not be parked within the 15m radius of any working area. Any vehicle, that is required to be at the immediate/near the vicinity, shall be approved by the person in-charge of the site.

11.7.2 TRAFFIC ROUTE FOR PEDESTRIANS

- Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
- Separate routes shall be provided for pedestrians to keep them away from vehicles. Provide suitable barriers/guard at entrances/exit and the corners or buildings.
- Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.
- Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.
- Provide high visibility clothing for people permitted in delivery area.

11.7.3 WORK VEHICLE

Work vehicle shall be as safe stable efficient and roadworthy as private vehicles on public roads. Site management shall ensure that drivers are suitably trained. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

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

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11.7.4 DAILY CHECK BY DRIVER

- There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used.
 - o Brakes.
 - o Tires.
 - o Steering.
 - o Mirrors.
 - o Windscreen waters.
 - o Wipers.
 - o Warning signals.
 - o Specific safety system i.e. control interlocks
- Management should ensure that drivers carry out these checks.

11.7.5 TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES

- All drivers shall hold a valid driving License for the class of vehicle to be driven and be registered as an authorized BHEL driver with the Administration Department.
 - Securing of the load shall be by established and approved methods, i.e. chains with patented tightening equipment for steel/heavy loads. Sharp corners on loads shall be avoided when employing ropes for securing.
 - All overhangs shall be made clearly visible and restricted to acceptable limits
 - Load shall be checked before moving off and after traveling a suitable distance.
 - On no account is construction site to be blocked by parked vehicles Drivers of vehicles shall only stop or park in the areas designate by the stringing foreman.
 - Warning signs shall be displayed during transportation of material.
- All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement.

11.7.6 MAINTENANCE

All Vehicles used for transportation of man and material shall undergo scheduled inspections on frequent intervals to secure safe operation. Such inspections shall be conducted in particular for steering, brakes, lights, horn, doors etc. Site management shall ensure that work equipment is maintained in an efficient, working order and in good repair. Inspections and services carried out at regular intervals of time and or mileage. No maintenance shall be carried below HT/LT power lines.

11.8 EMERGENCY PREPAREDNESS AND RESPONSE

- Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by Regional HQ
- Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its subcontractors
- All the subcontractor's supervisory personnel and sufficient number of workers shall be trained for fire protection systems. Enough number of such trained personnel must be available during the tenure of contract. Subcontractor should nominate his supervisor to coordinate and implement the safety measures.
- Assembly point shall be earmarked and access to the same from different location shall be shown
- Fire exit shall be identified and pathway shall be clear for emergency escape.



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- Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
- Adequate number of first aid boxes shall be strategically placed at different work places to cater emergency need. Holder of the first aid box shall be identified on the box itself who will have the responsibility to maintain the same.
- First aid center shall be developed at site with trained medical personnel and ambulance
- Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
- Tie up with fire brigade shall be done in case customer is not having fire station.
- Tie up with hospital shall be done in case customer is not having hospital.
- Disaster Management group shall be formed at site
- Mock drill shall be arranged at regular intervals. Monthly report of the above to be given to BHEL safety Officer as per prescribed BHEL formats
- Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

12.0 HSE INSPECTION

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSEMS requirements. The subcontractor shall maintain and ensure necessary safety measures as required for inspection and tests HV test, Pneumatic test, Hydraulic test, Spring test, Bend test etc. as applicable, to enable inspection agency for performing Inspection. If any test equipment is found not complying with proper safety requirements then the Inspection Agency may withhold inspection, till such time the desired safety requirements are met.

12.1 DAILY HSE CHECKS

Both the Site Supervisors and safety officer of Subcontractor are to conduct daily site Safety inspection around work activities and premises to ensure that work methods and the sites are maintained to an acceptable standard. The following are to form the common subjects of a daily safety inspection:

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

The inspection should be carried out just when work starts in beginning of the day, during peak activities period of the day and just before the day's work ends.

12.2 INSPECTION OF PPE

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

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12.3 INSPECTION OF T&Ps

- A master list of T&Ps shall be maintained by each subcontractor.
- All T&Ps being used at site shall be inspected by HSE officer once in a month as per format no. HSEP:14-F07 for its healthiness and maintenance.
- The T&Ps which require third party inspection shall be checked for its validity during inspection. The third party test certificate should be accompanied with a copy of the concerned competent person's valid qualification record.
- The validity of T&P shall be monitored as per "Status of T&Ps" format no. HSEP:14-F08

12.4 INSPECTION OF CRANES AND WINCHES

- Cranes and winches shall be inspected by the operator through a daily checklist for its safe condition (as provided by the equipment manufacturer) before first use of the day.
- Cranes and Winches shall be inspected by HSE officer once in a month as per format no. HSEP:14-F09 for healthiness, maintenance and validity of third party inspection.
- The date of third party inspection and next due date shall be painted on cranes and winches.
- The operators/drivers shall be authorized by sub-contractor based on their competency and experience and shall carry the I-card.
- The operator should be above 18 years of age and should be in possession of driving license of HMV man & goods), vision test certificate and should have minimum qualification so that he can read the instructions and check list.

12.5 INSPECTION ON HEIGHT WORKING

- Inspection on height working shall be conducted daily by supervisors before start of work to ensure safe working condition including provision of
 - o Fall arrestor
 - o Lifelines
 - o Safety nets
 - o Fencing and barricading
 - o Warning signage
 - o Covering of opening
 - o Proper scaffolding with access and egress.
 - o Illumination
- Inspection on height working shall be conducted once in a week by HSE officer as per format no. HSEP:14-F10.
- Medical fitness of height worker shall be ensured.
- Height working shall not be allowed during adverse weather.

12.6 INSPECTION ON WELDING AND GAS CUTTING OPERATION

- Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
- Gas cylinders shall be kept upright.
- Use of Flash back arrestor shall be ensured at both ends.



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- Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per format no. HSEP:14-F11.
- Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
- Availability of fire extinguisher at vicinity shall be ensured.

12.7 INSPECTION ON ELECTRICAL INSTALLATION / APPLIANCES

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

12.8 INSPECTION OF ELEVATOR

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

12.9 INSPECTION OF EXCAVATION

Excavation activities shall be inspected as per Format HSEP:14-F13A

13.0 HSE PERFORMANCE

- Contractor shall be assessed on monthly basis for HSE Compliance by BHEL Safety In-charge at site. The HSE compliance shall be based on Online HSE Evaluation System of BHEL as per Format No. HSEP:14-F33.
- BHEL shall reserve the right to use this assessment for evaluating bidder's capacity for future tenders
- Suitable HSE reward system shall be developed at site level to promote HSE compliance amongst workmen by the subcontractor.
To decide HSE reward, performance towards HSE shall be evaluated for workmen and it shall be awarded regularly in public gathering.
- If safety record of the subcontractor in execution of the awarded job is to the satisfaction of safety department of BHEL, issue of an appropriate certificate to recognize the safety performance of the subcontractor may be considered by BHEL after completion of the job.

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14.0 HSE PENALTIES

- As per contractual provision HSE penalties shall be imposed on subcontractors for non-compliance on HSE requirement as per format no. HSEP:14-F14. The list in the format is only indicative. For any other violation, not listed in the format, the minimum penalty amount is to be decided as per BOCW act.
- If principal customer/statutory and regulatory bodies impose some penalty on HSE due to the non-compliance of the subcontractor the same shall be passed on to them.
- The penalty amount shall be recovered by Site Finance department from subcontractors from the RA/Final bill.

15.0 OTHER REQUIREMENTS

- In case of any delay in completion of a job due to mishaps attributable to lapses by the subcontractor, BHEL shall have the right to recover cost of such delay from the payments due to the subcontractor, after notifying the subcontractor suitably.
- If the subcontractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instruction regarding safety issued by BHEL, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor after giving a notice of not less than 7 days indicating the steps that would be taken by BHEL.
- If the subcontractor succeeds in carrying out its job in time without any fatal or disabling injury incident and without any damage to property BHEL may, at its sole discretion, favorably consider to reward the subcontractor suitably for the performance.
- In case of any damage to property due to lapses by the subcontractor, BHEL shall have the right to recover the cost of such damages from the subcontractor after holding an appropriate enquiry.
- The subcontractor shall take all measures at the sites of the work to protect all persons from incidents and shall be bound to bear the expenses of defense of every suit, action or other proceeding of law that may be brought by any persons for injury sustained or death owing to neglect of the above precautions and to pay any such persons such compensation or which may with the consent of the subcontractor be paid to compromise any claim by any such person, should such claim proceeding be filed against BHEL, the subcontractor hereby agrees to indemnify BHEL against the same.
- The subcontractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.
- The subcontractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard.
- BHEL shall have the right to prescribe the conditions under which such equipment or materials may be handled and the subcontractor shall adhere to such instructions.



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- BHEL may prohibit the use of any construction machinery, which according to the organization is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL.

16. NON COMPLIANCE

NONCONFORMITY OF SAFETY RULES AND SAFETY APPLIANCES WILL BE VIEWED SERIOUSLY AND BHEL HAS RIGHT TO IMPOSE FINES ON THE SUBCONTRACTOR AS UNDER FOR EVERY INSTANCE OF VIOLATION NOTICED:

SN	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
06	Not wearing gloves	50/- *
07.	Grinding Without Goggles	50/- *
08.	Not using 24 V Supply For Internal Work	500/-
09.	Electrical Plugs Not used for hand Machine	100/-
10.	Not Sliding properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

• Legend:-

*: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

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



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17.0 HSE AUDIT/INSPECTION

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

18.0 MONTHLY HSE REVIEW MEETING

- ☐ Site shall hold HSE review meeting every month to discuss and resolve HSE issues of site and improve HSE performance. It will also discuss the incidents occurred since previous meeting, its root cause and Corrective action and Preventive action. The agenda is given below:
 - o Implementation of earlier MOM
 - o HSE performance
 - o HSE inspection
 - o HSE audit and CAPA
 - o HSE training
 - o Health check-up camp
 - o HSE planning for the erection and commissioning and installation activities in the coming month
 - o HSE reward and promotional activities
- ☐ The meeting shall be chaired by Construction Manager, convened by HSE coordinator and attended by all HOS, Site Incharge of Subcontractors and HSE officer of Subcontractors.
- ☐ MOM on the discussion will be circulated to the concerned for implementation.

19.0 FORMATS USED (Details available in Annexure-04)

SL. No.	Format Name	Format No.	Rev No.
01	Inspection of First Aid Box	HSEP:14-F01	00
02	Health Check Up	HSEP:14-F02	00
03	HSE Induction Training	HSEP:14-F03	00
04	Tool Box Talk	HSEP:14-F04	00
05	Monthly Site HSE Report	As specified by BHEL	00
06	Inspection of PPE	HSEP:14-F06	00



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07	Inspection of T&Ps	HSEP:14-F07	00
08	Status of T&Ps	HSEP:14-F08	00
09	Inspection of Cranes and Winches	HSEP:14-F09	00
10	Inspection on Height Working	HSEP:14-F10	00
11	Inspection on Welding & Gas Cutting	HSEP:14-F11	00
12	Inspection on Electrical Installation	HSEP:14-F12	00
13	Inspection on Elevator	HSEP:14-F13	00
14	HSE Penalty	HSEP:14-F14	00
15	Accident /incident / property damage /fire incident report	HSEP:14-F15	00



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20.0 ANNEXURES

ANNEXURE 01

As per Contract Labour (Regulation & Abolition Act), Central Rules, 1971,

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

(a) For establishments in which the number of contract labour employed does not exceed fifty, each first aid box shall contain the following equipment:

(i)	6 small sterilized dressings
(ii)	3 medium size sterilized dressings
(iii)	3 large size sterilized dressings
(iv)	6 pieces of sterilized eye pads in separate sealed packets.
(v)	6 roller bandages 10 cm wide.
(vi)	6 roller bandages 5 cm wide.
(vii)	One tourniquet
(viii)	A supply of suitable splints
(ix)	Three packets of safety pins.
(x)	Kidney tray.
(xi)	3 large sterilized burn dressings.
(xii)	1 (30ml) bottle containing a two percent alcoholic solution of iodine
(xiii)	1 (30 ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label
(xiv)	1 snake bite lancet
(xv)	1 (30gms) bottle of potassium permanganate crystals.
(xvi)	1 pair scissors
(xvii)	1 copy of the First-Aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.
(xviii)	A bottle containing 100 tablets (each of 5 grains) of aspirin
(xix)	Ointment for burns
(xx)	A bottle of suitable surgical anti-septic solution

(b) For establishment in which the number of contract labour exceeds fifty each first-aid box shall contain the following equipment:

(i)	12 small sterilized dressings
(ii)	6 medium size sterilized dressings
(iii)	6 large size sterilized dressings.
(iv)	6 large size sterilized burn dressings
(v)	6 (15 grams) packets sterilized cotton wool
(vi)	12 pieces of sterilized eye pads in separate sealed packets.



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(vii)	12 roller bandages 10 cm wide.
(viii)	12 roller bandages 5 cm wide.
(ix)	One tourniquet.
(x)	A supply of suitable splints.
(xi)	Three packets of safety pins.
(xii)	Kidney tray.
(xiii)	Sufficient number of eye washes bottles filled with distilled water or suitable liquid clearly indicated by a distinctive sign which shall be visible at all times.
(xiv)	4 per cent Xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops.
(xv)	1 (60ml) bottle containing a two percent alcoholic solution of iodine
(xvi)	One (two hundred ml) bottle of mercurochrome (2 per cent) solution in water.
(xvii)	1 (120ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label.
(xviii)	1 roll of adhesive plaster (6 cmX1 meter)
(xix)	2 rolls of adhesive plaster (2 cmX1 meter)
(xx)	A snake bite lancet.
(xxi)	1 (30 grams) bottle of potassium permanganate crystals.
(xxii)	1 pair scissors
(xxiii)	1 copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India.
(xxiv)	a bottle containing 100 tablets (each of 5 grains) of aspirin
(xxv)	Ointment for burns
(xxvi)	A bottle of a suitable surgical anti septic solution.

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



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ANNEXURE 02

HSE AUDIT/INSPECTION CHECKLIST CUM COMPLIANCE REPORT

PROJECT: _____

SUBCONTRACTOR: _____

DATE : _____

OWNER : _____

INSPECTION BY: _____

Note : write 'NA' wherever the items is not applicable

Item	Y e s	N o	Remarks	Action
HOUSEKEEPING				
Waste containers provided and used				
Passageways and walkways clear				
General neatness of working area				
Other				
PERSONNEL PROTECTIVE EQUIPMENTS				
Goggles; shields				
Face protection				
Hearing protection				
Respiratory masks etc.				
Safety belts				
Other				
EXCAVATIONS / OPENINGS				
Openings properly covered or barricaded				
Excavations shored				
Excavations barricaded				
Overnight lighting provided				
Other				
WELDING, CUTTING				
Gas cylinders chained upright				
Cable and hoses not obstructing				
Fire extinguisher (s) accessible				
Others				
SCAFFOLDING				
Fully decked platforms				
Guard and intermediate rails in place				
Toe boards in place				
Adequate shoring				
Adequate access				
Others				
LADDER				
Extension side rails 1 m above				
Top of landing				
Properly secured				



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Angle + 70° from horizontal				
Other				
HOISTS, CRANES AND DERRICKS				
Condition of cables and sheaf OK				
Condition of slings, chains, hooks OK				
Inspection & maintenance log maintained				
Outriggers used				
Signals observed and understood				
Qualified operators				
Others				
MACHINERY, TOOLS & EQUIPMENT				
Proper instruction				
Safety devices				
Proper cords				
Inspection and maintenance				
Other				
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and maintenance				
Licensed drivers				
Other				
TEMPORARY FACILITIES				
Emergency instructions posted				
Fire extinguishers provided				
Fire-aid equipment available				
General neatness				
Others				
FIRE PREVENTION				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas.				
Hydrants				
Clearance				
Others				
ELECTRICAL				
Proper wiring				
ELCB's provided				
Ground fault circuit interrupters				
Protection against damage				
Prevention of tripping hazards				
Other				
HANDLING & STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
Other				
FLAMMABLE GASES AND LIQUIDS				
Containers clearly identified				
Proper storage				
Fire extinguisher nearby				



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Other				
WORKING AT HEIGHT				
Safety nets				
Safety belts				
Safety helmets				
Anchoring of safety belt to the life line rope				
ENVIRONMENT				
Lubricant waste/engine oils properly dispose.				
Waste from Canteen, offices, sanitation etc. disposed properly.				
Disposal of surplus earth, stripping materials, expired batteries, oily rags and combustible materials done properly.				
HEALTH CHECKS				
Hygienic conditions at labor camps O.K.				
Availability of first-aid facilities				
Proper sanitation at site, office & labor camps.				
Arrangement of medical facilities.				
Measures for dealing with illness.				
Availability of potable drinking water for workmen & staff.				
Provision of crèches for children.				



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ANNEXURE 03

REFERENCES

- Contract documents
- Relevant legislations
- HSEMSM
- Relevant Indian standards as listed below (illustrative only):

SL NO	CODE NAME	TITLE
(1)	IS : 818-1888 (Reaffirmed 2003)	Code of Practice for safety and health requirements in Electric and Gas Welding and Cutting operations.
(2)	IS: 1179-1967 (Reaffirmed 2003)	Specification for Equipment for Eye & Face protection during welding.
(3)	IS : 1989 (Part 2):1986 (Reaffirmed 1997)	Specification for Leather Safety Boots & Shoes
(4)	IS:2925 – 1984 (Reaffirmed 2010)	Specification for Industrial Safety Helmets
(5)	IS:3521 : 1999 (Reaffirmed 2002)	Industrial Safety Belts & Harnesses-Specification
(6)	IS:3646(Part II) – 1966 (Reaffirmed 2003)	Code of Practice for Interior Illumination
(7)	IS:3696 (Part I) – 1987 (Reaffirmed 2002)	Safety Code for Scaffolds and Ladders
(8)	IS: 3696(Part 2) : 1991 (Reaffirmed 2002)	Scaffolds and Ladders-Code of Safety
(9)	IS:3786 – 1983 (Reaffirmed 2002)	Method for Computation of Frequency and Severity Rates for Industrial Injuries and Classification of Industrial Incidents
(10)	IS:4770 : 1991 (Reaffirmed 2006)	Rubber Gloves – Electricals purposes-Specification
(11)	IS:4912 : 1978 (Reaffirmed 2002)	Safety Requirements for Floor and Wall Openings, Railings and Toe Boards
(12)	IS: 5983 – 1980 (Reaffirmed 2002)	Specification for Eye-Protectors
(13)	IS:6519 – 1971 (Reaffirmed 1997)	Code of Practice for Selection, Care and Repair of Safety Footwear
(14)	IS:9167:1979	Specification for Ear-Protectors
(15)	IS:6994(Part I)-1973 (Re affirmed 1996)	Specification for Industrial Safety Gloves Leather and Cotton Gloves
(16)	IS:8519 – 1977 (Reaffirmed 1983)	Guide for Selection of Industrial Safety Equipment for Body Protection.
(17)	IS 11006 : 2011	Flash Back(Flame Arrestor) Specification



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(18)	IS:8520 – 1977 (Reaffirmed 2002)	Guide for Selection of Industrial Safety Equipment for Eye, Face and Ear Protection.
(19)	IS:9473:2002	Respiratory Protective Devices-Filtering Half Masks to protect against Particles-Specification.
(20)	IS:9944:1992 (Reaffirmed 2003)	Natural and Man-made Fiber Rope Slings-Recommendations on Safe working loads.
(21)	IS:11057 – 1884 (Reaffirmed 2001)	Specification for Industrial Safety Nets
(22)	IS:12254:1993 (Reaffirmed 2002)	Polyvinyl Chloride (PVC) Industrial Boots-Specification
(23)	IS:13367(Part 1):1992 (Reaffirmed 2003)	Safe Use of Cranes-Code of Practice
(24)	IS:14166:1994 (Reaffirmed 2002)	Respiratory Protective Devices-Full Face Masks Specification
(25)	IS:14746 : 1999 (Reaffirmed 2003)	Respiratory Protective Devices-Half Masks and Quarter Masks - Specification
(26)	IS : 15397 :2003 (Reaffirmed 2008)	Portable Extinguisher Mechanical Foam Type(Stored Pressure)-Specification
(27)	IS: 19011:2002	Guidelines for Quality and/or Environmental Management Systems Auditing



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**ANNEXURE 04 : SAFETY FORMATS
&
ANNEXURE 05 : WORK PERMIT FORMATS**

**POWER SECTOR****INSPECTION OF FIRST AID BOX**

FORMAT NO: HSEP:14-F01

REV NO.: 00

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Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Number of employees on the site: - _____

Sl.No.	Item	No. Available	Remarks
1	No. of small sterilized dressings		
2	No of medium sized sterilized dressings		
3	No of large sized sterilized dressings.		
4	No of large sized sterilized burn dressings		
5	No of (15 grams) packets sterilized cotton wool		
6	No of pieces of sterilized eye pads in separate sealed packets.		
7	No of roller bandages 10 cm wide.		
8	No of roller bandages 5 cm wide.		
9	Whether tourniquet available		
10	Whether supply of Suitable splints available.		
11	No of packets of safety pins.		
12	Whether kidney tray available		
13	Whether sufficient number of eye wash bottles, filled with distilled water or suitable liquid, clearly indicated by a distinctive sign which shall be visible at all times, available.		
14	Whether 4%-xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops available.		
15	Whether (60ml) bottle containing a two percent alcoholic solution of iodine available		
16	Whether (two hundred ml) bottle of mercurochrome (2 per cent) solution in water available.		

**POWER SECTOR****INSPECTION OF FIRST AID BOX**

FORMAT NO: HSEP:14-F01

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Sl.No.	Item	No. Available	Remarks
17	Whether 120ml bottle containing Sal volatile having the dose and mode of administration indicated on the label, available.		
18	Whether roll of adhesive plaster (6 cmX1 meter) available		
19	No of rolls of adhesive plaster (2 cmX1 meter)		
20	Whether snake bite lancet available.		
21	Whether (30 grams) bottle of potassium permanganate crystals available.		
22	Whether a pair scissors available		
23	Whether copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India available.		
24	Whether bottle containing 100 tablets (each of 5 grains) of aspirin available		
25	Whether Ointment for burns available		
26	Whether bottle of a suitable surgical anti-septic solution available		

Signature of Subcontractor's Site I/C:

**POWER SECTOR****HEALTH CHECK UP**

FORMAT NO: HSEP:14-F02

REV NO.: 00

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Name of Site :	
Name of Sub-Contractor :	
Name of Employee :	

NAME:

History Of Past Illness	H/O Epilepsy
	H/O Drug Allergy
	H/O Diabetics/ Hypertension
	H/O Unconsciousness
Personal History	
EXAMINATION	
OBSERVATION	
<u>General Physical Examination</u>	
Height	:
Weight	:
BMI	:
Built And nourishment	:
Pallor	:
Temperature	:
Chest Expansion	: Inspiration Expansion
Lymph Node Enlargement	:
<u>Ear, Nose, Throat</u>	:
Ear	:
Nose	:
Throat	:

**POWER SECTOR****HEALTH CHECK UP**

FORMAT NO: HSEP:14-F02

REV NO.: 00

PAGE NO. 2 OF 02

EXAMINATION	OBSERVATION
<u>Cardiovascular System Examination :</u>	
Inspection :	
Palpation :	Pulse BP
Auscultation (Heart Sounds) :	
<u>Respiratory System :</u>	
Inspection :	Respiratory Rate
Palpation:	
Percussion :	
Auscultation (Breath Sounds) :	
<u>Examination of Abdomen :</u>	
Inspection :	
Palpation :	
Auscultation (Bowel Sounds) :	
Any Other :	
Clinical Impression	

Signature of the examining doctor

**POWER SECTOR****HSE INDUCTION TRAINING**

FORMAT NO: HSEP:14-F03

REV NO.: 00

PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Date :	
Name of Training Co-ordinator	

Sl No.	Name	Designation	Organisation	Signature

Signature of Training co-ordinator :

	POWER SECTOR	FORMAT NO: HSEP:14-F04 REV NO.: 00 PAGE NO. 01 OF 01
	TOOL-BOX TALK	

Name of Site :	
Sub-Contractors Name :	
Date :	

Topic	Name of person delivered Tool Box Talk	No. of Participants attended	Remarks

Signature of Site I/C of Subcontractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F06 REV NO.: 00 PAGE NO. 01 OF 01
	PERSONAL PROTECTIVE EQUIPMENTS	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Item	Issued this Month	Nos. Issued up to the Month	Percentage of usage at site
Safety Helmet			
Safety Shoes			
Full Body Harness			
Fall Arrestor			
Safety Nets			
Other PPEs.			

Signature of Site I/C of Subcontractor :

**POWER SECTOR****INSPECTION OF T&Ps**

FORMAT NO: HSEP:14-F07

REV NO.: 00

PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Date of Inspection :	

Sl.No.	Description	Remarks
1.0	Name of equipment	
2.0	Basic Information of equipment	
2.1	Specification	
2.2	Sr. No. of equipment	
2.3	Make	
2.4	Year of manufacture	
3.0	Major repairs / overhauls(Furnish details of work carried out)	Date(s) of major repair/overhaul
3.1		
3.2		
3.3	Repairs carried out at site	
4.0	Any performance test conducted	Yes/No
5.0	Document Submitted	Yes/No
6.0	Manufacturer's test / guarantee certificate	Available/ Not available
7.0	Performance test	Done/ Not Done
8.0	Acceptance Norms	
9.0	Committee Observations	
10.0	Date of next review (if accepted)	

Signature-Site Safety Officer (BHEL)

Signature-Subcontractor/ Subcontractor's
Safety Officer

	POWER SECTOR	FORMAT NO: HSEP:14-F08 REV NO.: 00 PAGE NO. 01 OF 01
	STATUS OF T&Ps	

Name of Site	
Name of Sub-Contractor	
Date of Inspection	

Item	Nos. Deployed	Identification No.	Nos. Tested by competent person	Validity of Test Certificate
Winches				
Chain Blocks				
Wire Rope Slings				
Man Cages				
D-Shackles				
Air Compressors				
Crawler Cranes				
Mobile Cranes				
Hydra Cranes				
Others				

Signature of Site I/C of subcontractor:

**POWER SECTOR****INSPECTION OF CRANES AND WINCHES**

FORMAT NO: HSEP:14-F09

REV NO.: 00

PAGE NO. 01 OF 03

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Crane Reg. No (Make/Model)

Name of Driver/Operator

Sl.no.	Description	Observation	Measures
1	Valid Driving license		
2	Hook & Hook Latch		
3	Over Hoist limit switch		
4	Boom limit switch		
5	Boom Angle Indicator		
6	Boom limit cutoff switch		
7	Condition of Boom		
8	Condition of ropes		
9	Number of load lines		
10	Size and condition of the slings		
11	Stability of the cranes		
12	Soil Condition		
13	Swing Break And Lock		
14	Proper Break And Lock		
15	Hoist Break And Lock		
16	Boom Break And Lock		
17	Main Clutch		
18	Leakage in Hydraulic Cylinders		
19	Out riggers fully extendable		
20	Tyre pressure		
21	Condition of Battery And Lamps		

**POWER SECTOR****INSPECTION OF CRANES AND WINCHES**

FORMAT NO: HSEP:14-F09

REV NO.: 00

PAGE NO. 2 OF 03

Sl.no.	Description	Observation	Measures
22	Guards of moving and rotating parts		
23	Load chart provided		
24	Number and position of pedant ropes		
25	Reverse Horn		
26	Load Test Details		
27	Operator's fitness		
28	Pollution under control certificate		
29	Fire extinguisher of appropriate type.		
30	Training of the operator		

WINCH

Sl. No.	Description	YES	NO	NA	Remarks
1	Has the copy of Third Party Inspection certificate been provided in winch machine shed?				
2	Is winch machine operator experienced enough to operate the winch machine?				
3	Is the winch machine operated by someone other than the winch machine operator?				
4	Is there guard provided in all moving parts like wheel and motor's shaft?				
5	Will it protect against unforeseen operational contingencies?				
6	Are brakes, clutch and locking arrangement working properly?				
7	Has it been ensured that the guard does not constitute a hazard by itself?				
8	Are the cranks and the connecting rods protected by guardrails?				
9	Is there provision for fully covered shed with wooden plank roof?				

**POWER SECTOR****INSPECTION OF CRANES AND WINCHES**

FORMAT NO: HSEP:14-F09

REV NO.: 00

PAGE NO. 3 OF 03

Sl. No.	Description	YES	NO	NA	Remarks
10	Is wire rope free from any kind of damage or wear and tear?				
11	Is split pin provided for the protection of clutch and brake locking arrangement?				
12	Is pulley inspected by competent person and certified before use?				
13	Is pulley free from any wear and tear visually?				
14	Is winch rope barricaded with clipsheet for the protection of rope and person?				
15	Is the wire rope lubricated by cardium oil?				
16	Is there any friction in wire rope which may damage the wire rope rather than the rolling parts?				
17	Is there any oil leakage in the hydraulic system of the winch machine?				
18	Has it been ensured that the guard will not cause discomfort or inconvenience to operator?				
	Total Number of NO:				
	Total Number of NA:				
	% Compliance :				

Signature of Site I/C of subcontractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F10 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF HEIGHT WORKING	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Sl. No.	Descriptions	Observation (Yes/No)	Remarks
1	All the workers have been explained safe work method?		
2	An established communication system has been established and explained to the workers.		
3	Adequate illumination has been ensured.		
4	Work area inspected prior to the start of the work.		
5	Area below the work place barricaded, particularly below hot work.		
6	Workers provided with bags /box to carry bolts, nuts and hand tools		
7	Arrangement for fastening hand tools made.		
8	All work platforms ensured to be of adequate strength and ergonomically suitable.		
9	Fabricated makeshift arrangements are checked for quality and type of material welding, anchoring etc.		
10.	Work at more than one elevation at the same segment is restricted.		
	ACCESS/EGRESS		
1	Walkways provided with handrail, mid-rail and toe guard?		
2	All checkered plates, gratings properly welded/ bolted?		
3	Are ladders inspected and they are in good condition?		
4	Are ladders spliced?		
5	Are ladders properly secured to prevent slipping, sliding or falling?		
6	Do side rails extend 36" above top landing?		
7	Are built up ladders constructed of sound materials?		

**POWER SECTOR****INSPECTION OF HEIGHT WORKING**

FORMAT NO: HSEP:14-F10

REV NO.: 00

PAGE NO. 02 OF 02

Sl. No.	Descriptions	Observation (Yes/No)	Remarks
8	Are rugs and cleats not over 12" on center?		
9	Metal ladders not used around electrical hazards.		
10	Proper maintenance and storage.		
11	Ladders placed at right slope.		
12	Ladders / staircases welded/ bolted properly.		
13	Any obstruction in the stairs.		
14	Are landing provided with handrails, knee rails, toe boards etc.?		
15	Whether ramp is provided with proper slope.		
16	Proper hand rails / guards provided in ramps.		
	Housekeeping		
1	Walkways, aisles & all overhead workplaces cleared of loose material.		
2	Flammable materials, if any, are cleared.		
3	All the de shuttering materials are removed after de shuttering is done.		
4	Platforms and walkways free from oil/grease or other slippery material.		
5	Collected scrap are brought down or lowered down and not dropped from height.		
	PPE And Safety Devices		
1	Use of safety helmet, safety belts ensured for all workers		
2	Anchoring points provided at all places of work.		
3	Common lifeline provided wherever linear movement at height is required.		
4	Safety nets are use wherever required.		
5	Proper fall arrest system is deployed at critical workplaces.		
6	Crawler boards/Safety system or works on fragile roof are used.		

Signature of Site I/C of subcontractor :

**POWER SECTOR****INSPECTION OF WELDING AND GAS
CUTTING**

FORMAT NO: HSEP:14-F11
REV NO.: 00
PAGE NO. 1 OF 02

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Welding				
Sl.no.	Description	Y e s	N o	Remarks
1	Is electric connection given through 30 mA ELCB/RCCB to welding m/c?			
2	Is electric cable fitted properly in junction box on m/c?			
3	Is electrical cable free from joints?			
4	Are the joints attached firmly & insulated with tape?			
5	Is double earthing given to body of m/c?			
6	Is the physical condition of the m/c good?			
7	Is ON/OFF switch connected to the m/c is working and in good condition?			
8	Are indication lamps on m/c working?			
9	Is the electrode holder in good condition?			
10	Are the cables of the welding m/c lugged & tight properly?			
11	Are return lead connected properly (Rod, Angle, Channels shall not be used)			
	Total No of NO			
	Total No of YES			

**POWER SECTOR****INSPECTION OF WELDING AND GAS
CUTTING**

FORMAT NO: HSEP:14-F11
REV NO.: 00
PAGE NO. 2 OF 02

Gas Cutting				
Sl. no	Description	Yes	No	Remarks
1	Are Cylinders kept on trolleys?			
2	Physical condition of Gas cylinders Good?			
3	Is there Oil/Grease on valve of the cylinder?			
4	Are pressure regulators in good condition?			
5	Condition of hose pipe OK?			
6	Are hose pipe clamped with hose clip?			
7	Is flash back arrestor & NRV fitted on torch both for O2 and LPG cylinder?			
8	Is nozzle of the torch cleaned?			
	Total Number of NO			
	Total No of YES			
	% Compliance			

Signature of Site I/C of subcontractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F12 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF ELECTRICAL INSTALLATION	

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection:	

Sr. No.	Contents	Yes/No	Remarks
A	Cable		
1.	Whether the condition of cable is checked?		
2.	Are cables received from other sites checked for insulation resistance before putting them into use?		
3.	Are all main cables taken either underground / overhead?		
4.	Are welding cables routed properly above the ground?		
5.	Are welding and electrical cables overlapping?		
6.	Is any improper joining of cables/wires prevailing at site?		
B	DBs/SDBs		
1.	Is earth conductor continued up to DB / SDB?		
2.	Whether DBs and extension boards are protected from rain / water?		
3.	Is there any overloading of DBs / SDBs?		
4.	Are correct / proper fuses & CBs provided at main boards and sub-boards?		
5.	Is energized wiring in junction boxes, CB panels & similar places covered all times?		
C	ELCB		
1.	Whether the connections are routed through ELCB?		
2.	Is ELCB sensitivity maintained at 30 mA?		

**POWER SECTOR****INSPECTION OF ELECTRICAL INSTALLATION**

FORMAT NO: HSEP:14-F12

REV NO.: 00

PAGE NO. 02 OF 02

Sr. No.	Contents	Yes/No	Remarks
3.	Are the ELCB numbered and tested periodically & test results recorded in a logbook countersigned by a competent person?		
D	Grounding		
1.	Is natural earthing ensured at the source of power (main DB at Generator or Transformer)?		
2.	Whether the continuity and tightness of the earth conductor are checked?		
3.	Mention the gauge of the earth conductor used at the site.		
4.	Mention the value of Earth Resistance.		
E	Electrically operated Machines or Accessories.		
1.	Whether the plug top is provided everywhere.		
2.	Are all metal parts of electrical equipment and light fittings / accessories grounded?		
3.	Is there any shed or cover for welding machines?		
4.	Are halogen lamps fixed at proper places?		
5.	Are portable power tools maintained as per norms?		
6.	Any other information:		

Signature of Site I/C of subcontractor :

**POWER SECTOR****INSPECTION OF ELEVATOR**

FORMAT NO: HSEP:14-F13

REV NO.: 00

PAGE NO. 01 OF 01

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Sr. No.	Description	Remarks
1.0	Name of equipment	
2.0	Basic Information of equipment	
2.1	Specification	
2.2	Sr. No. of equipment	
2.3	Make	
2.4	Year of manufacture	
3.0	Major repairs/overhauls(Furnish details of work carried out)	Date(s) of major repair/overhaul
3.1		
3.2		
3.3	Repairs carried out at site	
4.0	Any performance test conducted	Yes/No
5.0	Document Submitted	Yes/No
6.0	Manufacturer's test / guarantee certificate	Available/ Not available
7.0	Performance test	Done/ Not Done
8.0	Acceptance Norms	
9.0	Committee Observations	
10.0	Date of next review (if accepted)	
Signature-Subcontractor/ Subcontractor's Safety Officer		Signature-Site Safety Officer (BHEL)

	POWER SECTOR	FORMAT NO: HSEP:14-F13E REV NO.: 00 PAGE NO. 01 OF 01
	Inspection of Excavation	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Sl.no.	Description	Yes	No	Remarks
1	Precautions taken for Underground Electrical Cable			
2	Precautions taken for Under / Above ground sewer/ Drinking Water Line			
3	Precautions taken for Underground Telecommunication Line			
4	Precautions taken for Underground Product/Utility Line			
5	Precautions taken for Underground Fire Water Line			
6	Shoring / Shuttering / Sheet piling done to prevent collapse of excavation walls. Strength of Excavation wall ensured at all times			
7	Slope Cutting / Angle Maintained			
8	Hard Barricading & Edge Protection provided			
9	Separate Safe Access for Man and Vehicle			
10	Lighting arrangement			
11	Banksman Provided			
12	Required basic PPEs provided			
13	Excavated soil / Construction Material / equipment kept away from the edge.			
14	First aid in attendance.			
15	Other:			
	Total No of YES			

Signature-Subcontractor/ Subcontractor's Safety Officer

Signature-Site Safety Officer (BHEL)

**POWER SECTOR****HSE PENALTY**

FORMAT NO: HSEP:14-F14

REV NO.: 00

PAGE NO. 1 OF 02

Sub: MEMO for Penalty for non-compliances in Safety

Following lapse (tick marked) was observed and penalty is imposed as stated at the bottom of this memo. It is requested that such occurrences be please avoided in future.

Safety Area

SN	Violation of Safety Norms	Fine (in Rs)
01.	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03.	Not wearing safety shoe	200/-*
04.	Not keeping gas cylinders vertically	200/-
05.	Not using flash back arrestors	100/-
06.	Not wearing gloves	50/- *
07.	Grinding Without Goggles	50/- *
08.	Not using 24 V Supply For Internal Work	500/-
09.	Electrical Plugs Not used for hand Machine	100/-
10.	Not Slings properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18.	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

Legend: -

*: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

**POWER SECTOR****HSE PENALTY**

FORMAT NO: HSEP:14-F14

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Details (if any) related to non- compliance (Name of persons, Nature of deficiency, etc.)

Penalty imposed:

1, Rate as per above chart _____

2. No. of Persons/ machine/ event/ labour _____

3. Total Penalty= 1. X 2. = _____

Signature:

Witnessed by: (Sub- Contractor representative) (BHEL Personnel)

Name _____

Name _____

Distribution: 1 Copy: to Sub- contractor,

1 Copy to Site Construction Manager (BHEL)

	POWER SECTOR- HQ	FORMAT NO: HSEP:14-F15 REV NO.: 00 PAGE NO. 01 OF 01
	Incident Report (To be submitted within 24 hours of time of incident)	

Type of incident: Fatal/Major/ Minor/Fire/Property Damage/Near-miss

1	NAME OF SITE		3	ACTIVITY AREA	
2	SCOPE OF WORK		4	NAME OF CONTRACTOR	
			5	NAME & DESIGNATION OF BHEL ACTIVITY I/C	
6	DATE & TIME OF ACCIDENT		7	DATE RESUMED	
8	NO. OF WORK-DAYS LOST BY VICTIM (If duty not resumed, give estimated figure)				
9	NO. OF MANHOURS LOST BY OTHERS				
10	PERSONAL DETAILS OF INJURED AND / OR DETAILS OF MATERIALS / EQUIPMENT / PROPERTY DAMAGED				
NAME			NAME OF MATERIAL / EQUIPMENT / PROPERTY		
PERIOD OF EMPLOYMENT					
AGE	YRS	SEX	MALE/ FEMALE	ESTIMATED COST	ACTUAL COST
MARITAL STATUS		SINGLE / MARRIED			
OCCUPATION		NATURE OF DAMAGE			
PART OF BODY INJURED					
NATURE OF INJURY					
AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) MOST RESPONSIBLE FOR CAUSING ACCIDENT / INJURY / DAMAGE					
12	PERSON (NAME & DESIGNATION) WITH MOST CONTROL OVER AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) CAUSING ACCIDENT INJURY / DAMAGE				
13	DESCRIBE CLEARLY HOW THE ACCIDENT OCCURRED (USE ADDITIONAL SHEET, IF REQUIRED)				
ANALYSIS					
14	WHAT ACTS AND / OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS ACCIDENT				
15	WHAT ARE THE BASIC REASON FOR THE EXISTENCE OF THESE ACTS AND / OR CONDITION ?				
16	WHAT CORRECTIVE ACTIONS HAVE BEEN TAKEN TO PREVENT ACCIDENT RECURRENCE ?				
	DATE :		SIGNATURE OF SITE HSE COORDINATOR		
17	COMMENTS OF HEAD / SOX				
	DATE:		SIGNATURE OF HEAD/SOX		



POWER SECTOR

Format for Monthly HSE Planning & Review

FORMAT NO: HSEP:14-F30

REV NO.: 00

PAGE NO. 01 OF 3

Note: This is a template and can be modified in consultation with BHEL

Name of the Site		Name of the Subcontractor	
Scope of Work		Date	
PART- A: PLAN OF HSE ACTIVITIES FOR THE MONTH OF.....		PART-B: REVIEW ON	
SN.	Description of HSE Activity & Formats	Plan & Targets for the month	Review
1	Availability of First Aid Box at Required Places and Inspection thereof as per Format: Fo1	Areas 1.	
2	Health check-up as per Format: Fo2	Health check-up for Nos 1. New inductees 2. Drivers & Operators 3. Workers in following high risk areas: a. ...	
3	Induction training of newly joined workers as per Format: Fo3	Minimum No. of workers:	
4	Toolbox talks (TBT) conducted before start of work as per Format: Fo4	Locations of TBTs & No. of workers 1. ...	
5	PPE usage and issue as per Format: Fo6		
6	Inspection of T&Ps as per Format: Fo7	List of T&Ps to be inspected 1.	
7	Identification & Inspection Status of T&Ps as per Format: Fo8		
8	Inspection of Cranes & Winches as per Format: Fo9	List of Cranes & Winches & Nos. 1. ...	
9	Inspection of Height Working as per Format: F10	Areas: 1. ...	
10	Inspection of Welding & Gas Cutting operations as per Format: F11	Areas: 1. ...	
11	Inspection of Electrical Installations as per Format: F12	Locations: 1. ...	
12	Inspection of Elevators (as applicable) as per Format: F13	Locations: 1. ...	
13	Inspection of Excavation as per Format: F13E	Locations: 1. ...	



POWER SECTOR

Format for Monthly HSE Planning & Review

FORMAT NO: HSEP:14-F30

REV NO.: 00

PAGE NO. 02 OF 3

SN.	Description of HSE Activity & Formats	Plan & Targets for the month	Review
14	Job Safety Analysis as per Format F32B	Activities: 1. ...	
15	Regular Job Specific Training (Re-training) for workers involved in hazardous activities	Topics/ Hazards & No. of workers 1. ...	
16	Mass housekeeping (HK) drive in work areas	Areas 1. ...	
17	Vertigo Test of Height workers	Minimum No. of workers:	
18	Deployment of qualified HSE Officers as per contract	Location(s) & Nos. 1. ...	
19	Deployment of qualified HSE Stewards as per contract	Location(s) & Nos. 1. ...	
20	Deployment of Safety tools & Equipment (Safety Nets, Lifelines, Fall arrestors, Man-cages, flashback arrestors, scaffolding etc.)	Tool/ Equipment & Location 1. ...	
21	Safety Walks by site in charge of agency (4 -Weekly once)	Dates:	
22	Safety walks by departmental head (8-Weekly twice)	Dates:	
23	Availability/ deployment of Safety posters/ placards/ signage at strategic locations	Locations: Nos. 1. ...	
24	Provision of clean drinking water sources for workers	Locations: Nos. 1. ...	
25	Provision of toilets for workers (separate for male & female workers)	Locations: Nos. 1. ...	
26	Rest sheds for workers during lunchtime, rain, dust storm etc.	Locations: Nos. 1. ...	
27	Availability of following in Labor colony	1. Clean drinking water 2. Toilets 3. Cleanliness & Hygiene 4. Grass cutting, 5. Fogging 6. Electrical Inspection ...	

	POWER SECTOR		FORMAT NO: HSEP:14-F30 REV NO.: 00 PAGE NO. 03 OF 3
	Format for Monthly HSE Planning & Review		
SN.	Description of HSE Activity & Formats	Plan & Targets for the month	Review
28	Availability of dust/ waste bins at various locations	Locations: 1. ...	
29	Availability of Ambulance (individual/ joint) in each shift	Ambulance No.	
30	Availability of emergency vehicle in each shift	Emergency vehicle	
31	Deployment/ Availability of tested Fire Extinguishers	Locations & Nos. 1. ...	
32	Tree plantation	Locations & Nos. 1. ...	
33	Waste disposal & Scrap Bins	Locations 1. ...	
34	Illumination checks	Locations 1. ...	
35	Safety award function: 1. Display of good practices Award presentation	Minimum 1 per month	
36	Submission of Daily Reports as per Format No.F31A	Daily Reports (Night & Day Shifts)	

PLAN		REVIEW	
Agency Name: Sign: Date:	BHEL Name: Sign: Date:	Agency Name: Sign: Date:	BHEL Name: Sign: Date:



	POWER SECTOR	FORMAT NO: HSEP:14-F31 A REV NO.: 00 PAGE NO. 01 OF 1
	Format for Daily HSE Reporting	

	POWER SECTOR	FORMAT NO: HSEP:14-F31 A REV NO.: 00 PAGE NO. 01 OF 1
	Format for Daily HSE Reporting	

	POWER SECTOR	FORMAT NO: HSEP:14-F31 A REV NO.: 00 PAGE NO. 01 OF 1
	Format for Daily HSE Reporting	

	POWER SECTOR	FORMAT NO: HSEP:14-F31 A REV NO.: 00 PAGE NO. 01 OF 1
	Format for Daily HSE Reporting	

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	Format for Daily HSE Reporting	

	POWER SECTOR	FORMAT NO: HSEP:14-F31 A REV NO.: 00 PAGE NO. 01 OF 1
	Format for Daily HSE Reporting	

Night		Day	SHIFT	Year	Site
			Submitted By		
			Work Area(s)		
			Staff		
			Man-Power		
			Safety Officers		
			Safety Stewards		
			Tool Box (Topics and No. of Participants)		
			Induction Training (No. of Participants)		
			Vertigo Test (Numbers Tested)		
			On-the-Job Training (Topic & participants)		
			Work Permits		
			Job Safety Analyses conducted		
			Height Work Inspection		
			Other Hazardous Activities Inspection		
NA			T&P Inspection (Names & Nos. Inspected)		
			Safety Walk (Designation, Areas)		
NA			HSE Meeting		
NA			Safety Reward (Details)		
NA			Housekeeping/ Dust Suppression/ Tree Plantation Activities (Locations/Details)		
			Lost time Accident		
			Restricted Work Case		
			Medical Treatment Case		
			First Aid Case		
			Near miss		
			Property Damage/ Fire		
			Non-Compliances Submitted by BHEL		
			Complied by Agency		
			Any other Remarks/ Inputs		



POWER SECTOR

Job Safety Analysis Format

FORMAT NO: HSEP:14-F32B

REV NO.: 00

PAGE NO. 01 OF 1

Name of the Site	
Name of the Subcontractor	
Activity, Area	

HAZARDS				PRECAUTIONS	

(Name)	Submitted By (Agency HSE)		Reviewed By (BHEL Execution)		Approved By (BHEL HSE)	
(Sign)						
(Date)						

**POWER SECTOR- HQ**

FORMAT NO: HSEP:14-F33

REV NO.: 00

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Checklist for Evaluation of HSE Performance

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
1a	Induction training for new workers conducted through audio-visual medium & documented ?	M	1	Induction Training Records
1b	Tool box talk conducted regularly as per plan, and documented?	M	1	Toolbox Talk Records
1c	Contractor in charge and safety in charge attended safety meetings?	M	2	Minutes of Meeting
1d	Whether observations in safety meetings are complied before next meeting?	M	2	-do-
1e	Preparation and submission of Monthly HSE report within stipulated time	M	1	Report submission date
1f	Preparation and submission of Incident/near-miss report and RCA Report (as applicable) within stipulated time	M	1	Incident/ Near Miss Records
1g	Carrying out Inspections and submission of Inspection reports within stipulated time	M	1	Inspection Records
1h	Regular Job Specific Training ensured for High Risk Workers (through audio-visual medium) as per plan	M	1	Training & Attendance Records
2a	Whether the contractor is registered under BOCW	M	2	BOCW Registration Certificate
2b	Availability of Qualified safety officer (1 for every 500 labour)	M	2	Safety Officer qualification & experience records
2c	Availability of Qualified safety supervisor (1 for every 100 labour)	M	2	Safety Officer qualification & experience records
2d	All the workers are provided and using safety helmets and safety shoes/gum boots	M	2	PPE Issue Records, Inspection/ non-conformity records
2e	Housekeeping done on regular basis and scrap removal at site	M	1	Housekeeping records, Inspection/ non-conformity records
2f	Usage of Goggles/Face shields and Hand gloves for gas cutter and grinders		1	PPE Issue Records, Inspection/ non-conformity records
2g	Wall openings & floor openings are guarded?		1	Inspection/ non-conformity records
2h	Adequate illumination provided in all working area?		1	Inspection/ non-conformity records
2i	Safety posters, sign boards and emergency contact numbers in all prominent location are displayed?		1	Inspection/ non-conformity records
2j	Availability of automatic reverse horns, Main horn, hook latches for Vehicles, mobile cranes, Hydras		1	Inspection/ non-conformity records
2k	Ban of carrying mobile phones to work place is implemented for workers		1	Inspection/ non-conformity records
2l	Availability of Tags & Inspection Certificates for Cranes of all capacities		1	Master T&P List with internal & external test details
2l.2	Availability of Tags & Inspection Certificates for Winches of all capacities		1	Master T&P List with internal & external test details
2l.3	Availability of Tags & Inspection Certificates, color coding for Chain pulley blocks		1	Master T&P List with internal & external test details
2l.4	Availability of Tags & Inspection Certificates for Vehicles - Trailers, Dozers, Dumpers, Excavators. Mixers etc.		1	Master T&P List with internal & external test details
2l.5	Availability of Tags & Inspection Certificates for Welding machines, grinders, Drilling machines, etc.		1	Master T&P List with internal & external test details
2l.6	Availability of Tags & Inspection Certificates, colour coding for Wire rope slings etc.		1	Master T&P List with internal & external test details
2l.7	Availability of Tags & Inspection Certificates for Batching plants		1	Master T&P List with internal & external test details

**POWER SECTOR- HQ**

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Checklist for Evaluation of HSE Performance

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
2m.1	Use of Lifting Permit as per requirement		1	Permit Records
2m.2	Use of Height Permit as per requirement		1	Permit Records
2m.3	Use of Hot Work Permit as per requirement		1	Permit Records
2m.4	Use of Excavation permit as per requirement		1	Permit Records
2m.5	Use of Confined space work permit as per requirement		1	Permit Records
2m.6	Use of Grating removal and safety net removal permit as per requirement		1	Permit Records
2m.7	Use of Lockout-Tag out permit as per requirement		1	Permit Records
2m.8	Use of Radiography permit as per requirement		1	Permit Records
2m.9	Use of Night/ Holiday Work Permit as per requirement		1	Permit Records
2m.10	Use of Any other Applicable Permit as per requirement		1	Permit Records
3a	Material safety data sheet(MSDS) available for all chemicals and displayed in usage and storage area?		1	Inspection/ non-conformity records
3b	Spillages of oil/concrete and other chemical is controlled and cleaned by proper method in case of spill?		1	Inspection/ non-conformity records
3c	Availability of adequate number of urinals in workplace and in elevations and maintained	M	1	
3d	Availability of rest rooms for workers at site	M	1	
3e	Availability of Drinking water facility at work spot		1	
3f	Hygienic Labour colony is provided for workers.		1	
4a	Is heavy/complex critical lifting permit obtained for heavy, complex materials before handling/erection activity?		1	Work Permit records
4b	Whether area below lifting activities barricaded		1	Inspection/ non-conformity records
4c	Availability of experienced rigging foreman		1	Experience details of rigging foreman
4d	Is agency is following proper storage and handling procedure as per manufacturer standard for all hazardous material?		1	Procedure for storage & handling
4e	Are oxygen and acetylene cylinders are transported to work place from storage area in trolleys		1	
5a	Whether all deep excavation has been protected by barrier		1	Inspection/ non-conformity records
5b	Sloping/benching & shoring provided for excavation as per requirement?		1	-do-
5c	Proper access and egress provided for excavations?		1	-do-
5d	Blasting is done in controlled manner?		2	-do-
6a	Whether Electrical booth is equipped with Co ₂ fire extinguishers and fire buckets filled with sand?		2	Inspection/ non-conformity records
6b	Availability of Illumination lamp in electric booth?		1	-do-
6c	whether Caution Boards have been displayed?		1	-do-
6d	Usage of Metal Plug top for all hand power tools ?		1	-do-
6e	Usage of Insulated welding cables.		1	-do-
6f	Electrical Booth/Distribution Board to be covered by proper Canopy.		1	-do-
6g	Availability of functional & individual 30mA ELCB / RCCB and MCB for protection and conducting periodical check-up?		1	-do-
6h	Double earthing for panel boards and all machinery & proper earth pit with regular inspection available?		1	-do-
6i	Whether Electrician is qualified and experienced		1	Qualification & Experience records of electrician
6j	Availability and usage of Rubber hand gloves by electrician?		1	Inspection/ non-conformity records

	POWER SECTOR- HQ	FORMAT NO: HSEP:14-F33
	Checklist for Evaluation of HSE Performance	REV NO.: 00 PAGE NO. 03 OF 3

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
7a	Whether Scaffolding pipes made with steel or aluminum, are being used and checked periodically by experienced/ certified scaffolder?		2	Inspection/ non-conformity records
7b	8mm Stainless Steel wire rope with plastic cladding is provided for life line (Vertical / Horizontal) during height work?		2	-do-
7c	Availability of emergency lighting in case of power failure		1	-do-
7d	Whether all the openings are covered with Safety Nets made of fire proof Nylon?		1	-do-
7e	Whether MS pipe rails around staircases & platforms in usage are provided with top, middle rails and toe guard ?		1	-do-
7f	Whether Ladder with vertical life line /Fall arrestor is available to climb?		1	-do-
7g	Whether all workers deployed for working at height have been issued height pass after undergoing vertigo test?		1	Height Pass records
7h	Whether all workers deployed for height work / climbing ladder are provided and using Double lanyard safety belt?		1	PPE Issue records, inspection/ non-conformity reports
7i	Is all hand tools/Small material used by height workers is tied firmly to prevent fall?		1	-do-
8a	Flash back arrestors for all gas cutting sets is available on Torch side and cylinder side		1	Inspection/ non-conformity records
8b	Oxygen/Acetylene/LPG cylinders not in use have caps in place and stored separately?		1	-do-
8c	Availability of Face screen, Hand gloves, and Apron, for welders		1	-do-
8d	Protection from falling hot molten metal during metal cutting / welding at height by providing GI sheet below the cutting area especially in fire prone areas		1	-do-
9a	Pre-employment medical check-up done for all workers and submitted?		1	Medical check records
9b	Availability of first aid center, with MBBS doctor(Own or Sharing basis)	M	2	Attendance records
9c	Availability of Ambulance facility 24 hours (Own or sharing basis)	M	2	-do-
9d	Is First aid trained personnel's are available and their names are displayed at site?	M	1	-do-
9e	Availability of Emergency vehicle at site		1	
9f	Periodical medical check-up is conducted for all the workers and submitted?		1	Medical check records
9g	Availability of sufficient number of first aid box as per standard list and maintaining record		1	Inspection records
10a	Availability of Fire extinguishers, buckets at all vulnerable points		2	Fire extinguisher records
10b	Periodic fire mock drill conducted?		1	Fire, Mock drill records
10c	Are all flammable materials are stored separately?		1	
10d	Periodic grass cutting is done in material storage area?		1	
10e	Availability of 24V DC lighting in confined space work area		1	
10f	Availability of exhaust fan in confined space work area		1	

Note:

- **M: Mandatory; O: Optional.** Points other than mandatory can be excluded with appropriate justification (scope etc.) by BHEL
- Additionally: 30 Marks for each Fatal Accident and 10 mark for each major accident shall be deducted.



SAFETY WORK CLEARANCE

Permit no. _____

Project: _____

Emergency Contact Nos: _____

Subcontractor: _____

BURNING/WELDING /HOT WORK PERMIT

Area : _____ Date: _____ Time: _____

Name of Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Work Performing Contractor: _____

Name of Package In charge: _____ Sign: _____ Date: _____

Description of Work: _____

Work Execution Date: _____ Time Valid from: _____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Proper Access/Exit available		
2.	Proper ventilation and /or lighting provided.		
3.	Proper and safe scaffolding, platform, ladder provided.		
4.	Welding machine located in a clean and dry area.		
5.	Welding machine grounded at the equipment and proper leakage current protection device (ELCB) provided for welding machine.		
6.	Emergency STOP buttons are in working condition. Welder /Helper knows how to operate it.		
7.	Welding machine input/output cables, welding holder and weld return clamp (Holder) are insulated and in good condition.		
8.	Welder & Fitter trained to connect ground/work return clamps (Holder) to work place prior to energization of welding machine.		
9.	Gas cylinders are stacked vertically and not below the welding / cutting area. Regulator key is available with cylinder.		
10.	Pressure gauges/Flash back arrestor provided and in working condition.		
11.	Personal Protective equipment Minimum applicable: safety helmet, safety goggles, welding helmet, safety shoes, leather gloves, long sleeve and nose mask -provided		
12.	In case of pits, water removed from the pit and wood/rubber insulation provided.		
13.	Safety signboards are in place.		
14.	Adequate and Suitable nos. of fire fighting extinguisher provided.		
15.	Nearby combustible material removed. Housekeeping done.		
16.	Other		

Name of Contractor Safety Officer: _____ Sign: _____ Date: _____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name: _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Safety Representative: _____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority: _____ Sign: _____ Date: _____ Time: _____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority: _____ Sign: _____ Date: _____ Time: _____

Name of Site Engr. (Permit Requesting Authority): _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Site Engr. (Permit Issuing Authority): _____ Sign: _____ Date: _____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site

Second Copy – BHEL SAFETY

Third Copy : Contractor



SAFETY WORK CLEARANCE

Permit no. _____

Project: _____

Emergency Contact Nos: _____

Subcontractor: _____

LIFTING ACTIVITY PERMIT

Area : _____ Date: _____ Time: _____

Name of Site Engineer (Permit Requesting Authority): _____ Sign: _____ Name of Work

Performing Contractor: _____

Name of Package In charge: _____ Sign: _____ Date: _____

Description of Work: _____

Work Execution Date: _____ Time Valid from: _____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Crane used for lifting activity tested, certified and approved for rated lifting		
2.	All lifting tackles, gears/appliances are tested and certified for lifting works.		
3.	Crane operator is trained and competent for lifting operation.		
4.	Lifting sling/ belt is protected against sharp edge of the jobs to be lifted.		
5.	Access and exit marked and without obstruction.		
6.	Lifting arrangement adequate.		
7.	Unwanted rubbish material removed from work platform.		
8.	Minimum 2 guidelines have been provided for balancing and guiding jobs to be lifted.		
9.	Periphery area of crane booms as well as lifting job is barricaded and unauthorized/no-entry sign board posted.		
10.	Rigger and signal man is trained and competent for lifting work.		
11.	No lifting activity to be carried out during lightening, heavy wind/rain.		
12.	If scaffolding to be used during lift, scaffolding with valid tag available for use.		
13.	Double lanyards safety harness/belt checked and in working condition.		
14.	Safety shoes (non-slip), helmet with chin strap available with employees.		
15.	Others.		

Name of Contractor Safety Officer: _____ Sign: _____ Date: _____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name: _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Safety Representative: _____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority: _____ **Sign:** _____ **Date:** _____ **Time:** _____**Permit Cancellation:**

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority: _____ Sign: _____ Date: _____ Time: _____

Name of Site Engr. (Permit Requesting Authority): _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Site Engr. (Permit Issuing Authority): _____ Sign: _____ Date: _____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site**Second Copy – BHEL SAFETY****Third Copy : Contractor**



SAFETY WORK CLEARANCE

Permit no. _____

Project: _____

Emergency Contact Nos: _____

Subcontractor: _____

WORKING AT HEIGHT PERMIT

Area : _____ Date: _____ Time: _____

Name of Site Engineer (Permit Requesting Authority): _____ Sign: _____ Name of Work

Performing Contractor: _____

Name of Package In charge: _____ Sign: _____ Date: _____

Description of Work: _____

Work Execution Date: _____ Time Valid from: _____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	All workers on job are medically fit for working at height (Person should not have vertigo)		
2.	Scaffolding with valid tag available for use		
3.	Safety harness with life line support/ fall arrester are checked and in working condition		
4.	Safety shoes (non-slip), Helmet with chin strip available with employees		
5.	Safety nets are provided as per design and provided 25 ft. below working area & extending 8 ft beyond.		
6.	Horizontal life lines are provided to cater to design specification of 2300kg per person.		
7.	Ladders have been inspected and provided as per BHEL standard/contract.		
8.	All lifting / tightening tools, hand tools/equipment checked and in good condition		
9.	Access and exit marked and without obstruction.		
10.	Lighting arrangement adequate.		
11.	Unwanted and rubbish material removed from working platform.		
12.	Electrical cable, welding Hose/Compressed air hose properly secured and lay down without obstruction.		
13.	Signboards provided on working platforms		
14.	Hazards in the vicinity are identified and communicated to the worker.		
15.	Other		

Name of Contractor Safety Officer: _____ Sign: _____ Date: _____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name: _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Safety Representative: _____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority: _____ **Sign:** _____ **Date:** _____ **Time:** _____**Permit Cancellation:**

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority: _____ Sign: _____ Date: _____ Time: _____

Name of Site Engr. (Permit Requesting Authority): _____ Sign: _____ Date: _____ Time: _____

Name of BHEL Site Engr. (Permit Issuing Authority): _____ Sign: _____ Date: _____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site**Second Copy – BHEL SAFETY****Third Copy : Contractor**



Project		Vendor			Package/Unit	
SL	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents`
#1.01	Cumulative number of days in the month, the nominated Quality Officer or his authorised nominee was not available	QUALITY	1.5		Quality Officer or his authorised nominee should be available for all the days of working at site	Daily Log Book entry/Incident Registers/letter references
#1.02	Number of instances of non- compliance wrt FQP, Standard Drawings, Specifications, E&C Manuals etc.	QUALITY	1.5		No deviation from FQP, Standard Drawings, Specifications, E&C Manuals etc. is allowed without BHEL Engineer's approval.	Daily Log Book entry/Incident Registers/letter references
#1.03	Percentage submission of test certificates for batches of welding electrodes, cement, sand, aggregate, consumable, Paints etc. as applicable for this month OR In case of MM & MH package, monthly checks for Storage/Preservation of material.	QUALITY	1		Submission of 100% Test certificates for materials as per FQP is mandatory. MM & MH package: Storage/Preservation as per manual/procedure.	Daily Log Book entry/Incident Registers/letter references
#1.04	Number of incidences of improper storage & preservation (not in accordance to the guidelines of BHEL MUs or approved FQP) of materials, consumables (viz. gases, welding electrodes & fluxes, fuel etc.) & bought-out items (paints, fasteners etc.) under the custody of the contractor	QUALITY	1		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references
#1.05	Rework/ Rejection instances in a month necessitated due to deviation from Standard Drawings /Specifications /Manuals /E&C procedures /FQPs or due to Poor Workmanship by contractor	QUALITY	2		Reworks/ Rejection should be as minimum as possible. Total number of reworks/ rejections due to reasons attributable to contractor.	Daily Log Book entry/Incident Registers/letter references
#1.06	Delay in preparation & submission of signed protocols / log sheets / site register / NDT test reports as per approved FQP/ Qualified Welder List along with photocopies of Welder ID cards / Welder Performance Evaluation records etc. in the month OR in case of MM / MH package reconciliation statement / verification report.	QUALITY	1		Within 2 days of measurements taken or within first 3 working days of next month, as advised by BHEL Engineer	Daily Log Book entry/Incident Registers/letter references
#1.07	Number of instances for Major equipment/product failure due to negligence/improper work/poor workmanship by contractor	QUALITY	1		No such event should happen	Daily Log Book entry/Incident Registers/letter references
#1.08	Total number of complaints received in the month on the quality of finish / aesthetics	QUALITY	1		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

MONTHLY PERFORMANCE EVALUATION OF CONTRACTOR

Form No.: F-15 (Rev 02)

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Project		Vendor			Package/Unit	
SL	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents`
#2.01	Cumulative number of days of delay in submission of Plan FOR THE MONTH supported by deployment plan of Major T&Ps and Manpower (as per Form F-14) and relevant construction/layout drawings - like A4 plan / elevation views of plan status for structures / pressure parts/Civil Works, Piping isometrics for piping, Layout / PID / System reference sketch, Unloading / storage plans etc.as applicable.	PERFORMANCE	5		Number of days delayed from second working day of the month	Daily Log Book entry/Incident Registers/letter references
#2.02	Percentage of timely submission of Daily Reports for Progress of work, Resources, Consumables etc.	PERFORMANCE	1.5		Percentage of timely submission of daily reports/ Scheduled date is successive next day for each day	Daily Log Book entry/Incident Registers/letter references
#2.03	Number of days delayed for submission of FQP log sheets / protocols / Monthly Progress Reports for the work executed during the month under measurement	PERFORMANCE	1.5		Number of days delayed/Scheduled date is first 2 working days of next month	Daily Log Book entry/Incident Registers/letter references
#2.04	Shortfall attributable to contractor w.r.t. Plan as per Form-14 for the subject month	PERFORMANCE	35		Percentage of shortfall to be calculated w.r.t. Total planned target for the month as per part-A of F-14. If more than one work has been planned in a month then Weightages of works shall be assigned at the time of plan to arrive at plan vs achievement calculation.	Progress review formats
#2.05	Number of days delayed in submission of Running bills with complete supporting documents (including updated reconciliation statement of BHEL issued material) for the month	PERFORMANCE	2		Number of days delayed / Scheduled date is 7th day of next month	Daily Log Book entry/Incident Registers/letter references
#2.06	Number of times the Top Management of contractor did not respond to critical issues of site, for the month	PERFORMANCE	1		Total number of instances	Daily Log Book entry/Incident Registers/letter references
#2.07	Cumulative number of days in the month the works were stopped / refused on interpretation of contract clauses/scope due to tendency of taking undue advantage by interpreting contract clauses in their favour	PERFORMANCE	2		Cumulative number of days lost	Daily Log Book entry/Incident Registers/letter references
#2.08	Number of times rework was refused by contractor	PERFORMANCE	1		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Project		Vendor			Package/Unit	
SL	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents`
#2.09	Cumulative number of days in the month recording / logging was not done in daily log / history register / hindrance register / soft form in a PC maintained at BHEL Site Office	PERFORMANCE	1		Cumulative number of days recording or logging was not done / all days of the month	Daily Log Book entry/Incident Registers/letter references
#3.01	Number of days of non-availability of required Manpower including supporting staff as per plan submitted in F-14 for the month.	RESOURCES	7		Cumulative number of days Sufficient Manpower was not available as per Plan in F-14	Daily Log Book entry/Incident Registers/letter references
#3.02	Number of days of non-availability of required T&P as per plan submitted in F-14 for the month.	RESOURCES	7		Cumulative number of days Sufficient T&P was not available as per Plan in F-14	Daily Log Book entry/Incident Registers/letter references
#3.03	Cumulative number of major instances in the month hampering / affecting progress of work due to breakdown or non-availability of major T&P and MME for the work, under the scope of Contractor	RESOURCES	3		Cumulative number of instances	Daily Log Book entry/Incident Registers/letter references
#3.04	Cumulative number of major instances in the month hampering / affecting progress of work due to non-availability of Consumables/ use of improper consumables under the scope of contractor	RESOURCES	3		Cumulative number of instances	Daily Log Book entry/Incident Registers/letter references
#4.01	Number of non-compliances during the month for Statutory requirements like validity of Labour Licence, Insurance Policy, Labour Insurance, PF, BOCW Compliance etc. and any other applicable laws/ Regulation, Electrical Licence, T&P fitness certificate, Contractors' All Risk Policy etc. as applicable	SITE INFRASTRUCTURE & SERVICE	1		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references
#4.02	Cumulative number of days in a month poor illumination is reported at storage area, erection area, pre-assembly area and other designated areas by BHEL site.	SITE INFRASTRUCTURE & SERVICE	0.5		Total number of non-compliances/random checks	Daily Log Book entry/Incident Registers/letter references
#4.03	Cumulative number of days of non-availability of well-maintained toilets facilities for workers (separate for men and women) and non-availability of potable drinking water stations for workers in specified areas.	SITE INFRASTRUCTURE & SERVICE	1		Total number of non-compliances/random checks	Daily Log Book entry/Incident Registers/letter references

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Project		Vendor			Package/Unit	
SL	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents`
#4.04	Total number of instances in the month, Housekeeping NOT attended to in spite of instructions by BHEL -i.e. removal / disposal of surplus earth / debris / scrap / unused / surplus cable drums / other electrical items / surplus steel items / packing materials, thrown out scrap like weld butts, cotton waste etc. from the working area to identified locations	SITE INFRASTRUCTURE & SERVICE	2		Total number of non-compliances/random checks	Daily Log Book entry/Incident Registers/letter references
#4.05	Total number of instances in a month, Site Office with reasonably good facilities including enough nos. of computers and printers etc. for use by office and supporting staff was not made available/maintained.	SITE INFRASTRUCTURE & SERVICE	0.5		No discrepancy during regular or surprise visits	Photograph and report of the Engineer
#5.01	Number of days delayed in making labour payments for the last month	SITE FINANCE	2		Number of days delayed / Scheduled date is 7th day of next month	Daily Log Book entry/Incident Registers/letter references
#5.02	Number of complaints from labour/ sub supplier/ sub-contractor for non-receipt of payments from contractor	SITE FINANCE	1.5		Total number of complaints or reporting	Daily Log Book entry/Incident Registers/letter references
#5.03	Number of times the site operations were hampered for want of funds at the disposal of site-in-charge.	SITE FINANCE	1.5		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references
#6.01	Cumulative number of days in a month the nominated Safety Officer was not available	HSE & SA	1		Safety Officer should be available for all the days	Daily Log Book entry/Incident Registers/letter references
#6.02	Shortfall in number of weekly safety meetings in the month conducted or attended by the Safety Officer	HSE & SA	0.5		Safety meetings to be held every week	Copy of Minutes of meeting
#6.03	Level of compliance w.r.t decisions taken in previous Safety meetings	HSE & SA	0.5		Number of consolidated issues discussed in Safety meetings	Copy of Minutes of meeting, Non-compliance intimation documents from BHEL site
#6.04	Delay in submission of monthly report on safety (including electrical safety for equipment & personnel etc.) in the prescribed form	HSE & SA	1		Number of days delayed/Scheduled date is third working day of next month	Daily Log Book entry/Incident Registers/letter references
#6.05	Number of days taken for lodging FIRs from date of occurrence/notice of incident of theft / accident etc.	HSE & SA	0.5		Number of days delayed/Scheduled date is within 24 Hrs of occurrence/notice of incidence	Copy of FIR lodged by Contractor

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Project		Vendor			Package/Unit	
SL	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents`
#6.06	Number of times written(email, letters etc.) warning issued for non-availability/ use of improper Fall protection and rescue arrangement as lifeline, fall arrestors, safety net, hand-railings, covered floors, man-basket, rescue basket & kit etc. by the contractor	HSE & SA	2		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references
#6.07	Number of times punitive fines imposed for unsafe practices as per contract like non-availability/use of PPEs as safety shoes, helmets, goggles, gloves, lifeline, safety belts etc.	HSE & SA	1		Total number of non-compliances	Non-compliance intimation documents from BHEL site
#6.08	Percentage compliance to Emergency preparedness and response plan: Portable Fire-extinguishers, Buckets, Fire-wardens, display of emergency numbers, mock-drills, Hazard Identification and Risk Assessment(HIRA) etc.	HSE & SA	1		Compliance should be 100% as per HSE Plan or as finalized in Safety Meetings	Non-compliance intimation documents from BHEL site
#6.09	Number of times the agency has defaulted on display of safety posters / safety slogans / safety barriers/emergency numbers etc. in identified areas	HSE & SA	0.5		Total number of instances	Non-compliance intimation documents from BHEL site
#6.10	Non compliances observed during HSE and Safety Audit	HSE & SA	0.5		Total number of non-compliances	Non-compliance intimation documents from BHEL site, Audit Reports
#6.11	Cumulative number of days in the month, non-availability of First Aid Kit, First Aider & Emergency Vehicles/Ambulance.	HSE & SA	0.5		Cumulative number of days	Non-compliance intimation documents from BHEL site
#6.12	Number of days taken for submission of Root Cause analysis (RCA) for the accident from the cut-off date intimated by BHEL for submission of RCA	HSE & SA	0.5		Number of days delayed/Scheduled date is cut-off date intimated by BHEL	Daily Log Book entry/Incident Registers/letter references
#6.13	Non conductance of training (induction, job specific, height work etc.), tool box meeting and health check-up as per Contract requirements	HSE & SA	0.5		Number of incidences of non-conductance during the month	Daily Log Book entry/Incident Registers/letter references
Total			100			

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

MONTHLY PERFORMANCE EVALUATION OF CONTRACTOR

Form No.: F-15 (Rev 02)

Page 6 of 6

Project		Vendor			Package/Unit	
SL	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents`
	Less Deduction in Score Due to Major Accidents (Fatal, Permanent Disability or bodily injury by which person injured is prevented to resume to work within 48 hours or more after accident,, Major Damage to Equipment etc.) @ 3 points/ accident					
	Less Deduction in Score Due to Minor Accidents(All Others) @ 1 point/ accident					
	Less Deduction in Score Due to not Maintaining of Labour Colony (if applicable) as per BHEL HSE policy @2 points in a month on verification any day					
	Final Score					

Performance Score Summary for the Month	Total Score	Score Obtained
QUALITY	10	
PERFORMANCE	50	
RESOURCES	20	
SITE INFRASTRUCTURE & SERVICE	5	
SITE FINANCE	5	
HSE & SA	10	
OTHERS (deductions if any)	0	
TOTAL	100	

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

 PSSR	MONTHLY PLAN & REVIEW WITH CONTRACTOR	Page 2 of 6
Name of Project			Contract No.
Name of Work	Name of Contractor	

PART- A: Contd.....

Note 1: In addition to the work planned as per Col. 'A', Contractor shall also make full efforts to minimize the 'Cumulative shortfall attributable to contractor upto the month' as mentioned in Col. 'B' by enhancing its resources, so as to achieve the completion of activities as per agreed schedule. In case contractor is not able to execute the entire shortfall, then BHEL 'Engineer in-charge', shall decide the priority of work to be executed and it shall be binding on the contractor.

Note 2: Percentage Shortfall attributable to contractor w.r.t. "Plan - Shortfall attributable to BHEL" for the month = $[(\Sigma E - \Sigma B) / (\Sigma A - \Sigma D)] \times 100$
In case, $(\Sigma E - \Sigma B)$ is negative, then it shall be treated as zero percent."

Note 3: Form 14 should include all items being planned in the current month, and all items against which shortfall was attributable to contractor till previous month. However, for practical reason, if it is not possible to mention some of the items in Form-14 being planned to be executed in this month, then also value of such items shall necessarily be included in calculation of Total Value.

Note 4: In case reason for shortfall attributable to contractor is w.r.t. T&P and Manpower, it should be in conformity with Part B1 and B2.

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

 PSSR	MONTHLY PLAN & REVIEW WITH CONTRACTOR	Page 4 of 6
Name of Project	Contract No.	
Name of Work	Name of Contractor	

PART – B-2: PLAN/ REVIEW OF DEPLOYMENT OF MANPOWER FOR THE MONTH OF

Date of Plan/ Review

CONTRACTOR'S SCOPE: -

SN.	Area of Work	Category of Labour	No. of Labour required as per category	Deployment Period (in days)	No. of Labour actually deployed	Actual Deployment Period (in days)	REMARKS (Works affected due to non-availability of labour)
			A	B	C	D	

 Percentage of Manpower Deployed = $100 \times \Sigma(C \times D) / \Sigma(A \times B)$

BHEL

(Sign with name, designation and date)

CONTRACTOR

(Sign with name, designation and date)

Name of Project		Contract No.
Name of Work		Name of Contractor

PART – C: PLAN(PHYSICAL) FOR THE NEXT MONTH i.e.

[illegible]

Note 1: Planned quantity should be based on available/ expected fronts/ inputs in the next month

Note 2: “Original Planned Quantity” shall be as per latest jointly agreed programme between BHEL and Contractor before commencement of work or at the time of latest Time Extension, as the case may be.

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

 PSSR	MONTHLY PLAN & REVIEW WITH CONTRACTOR		Page 6 of 6

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART – D: REASONS FOR SHORTEALL ATTRIBUTABLE TO BHEL IN RESPECT OF PLAN FOR THE MONTH.....

SN.	Description of Work (from Part-A)	Quantities Affected		Reasons for Shortfall attributable to BHEL	Agency responsible for reasons for Shortfall	Remarks (Supporting Documents in respect of agency responsible)
		(Physical Quantity)	Unit of Measu- rement			
1	2	3	4	5	6	7

Note1: Reasons for shortfall shall include non-availability of fronts/ drawings/ materials/ T&P (BHEL Scope)/ clearances etc. and other hindrances for which contractor is not responsible.

Note2: Agency responsible may be BHEL Site/ MUs/ Design Centre/ BHEL Customer/ other Contractors etc.

BHEL
(Sign with name, designation and date)

**REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/06/2019 to 31/5/2021 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/06/2019 to 31/5/2021 (BEYOND USEFUL LIFE)
I.	CRANES :-			
1	Portal Gantry Crane 500T	15	20100.00	19980.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	11370.00	11320.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	56290.00	55940.00
4	PORTAL CRANE, 360T	15	14070.00	13980.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	55460.00	55110.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	68610.00	68180.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	33510.00	33300.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	20940.00	20810.00
9	MANITOWOC M-250T TRUCK CRANE	15	30160.00	29970.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	31660.00	31470.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	26390.00	26220.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	36110.00	36110.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	15130.00	15030.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	18850.00	18850.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	16750.00	16650.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	21780.00	21640.00
15	CRAWLER CRANE SUMITOMO, 150T	15	10890.00	10820.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	13400.00	13320.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	10830.00	10780.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	10720.00	10650.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	8880.00	8820.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	10050.00	9990.00
20	CRAWLER CRANE 100 T (KH 500)	15	10050.00	9990.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	5410.00	5390.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6140.00	6110.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5370.00	5340.00
24	Mobile Crane, 55MT (TIL)	12	4410.00	4390.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3030.00	3010.00
26	MOBILE CRANE, 20MT (TIL)	10	2270.00	2260.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2270.00	2260.00
28	MOBILE CRANE ESCORTS- 14MT	10	710.00	710.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	390.00	380.00
30	ELECTRIC GANTRY CRANE 3T	5	430.00	430.00
31	ELECTRIC GANTRY CRANE 5T	5	540.00	540.00
32	ELECTRIC GANTRY CRANE 30T	5	3640.00	3620.00
33	FORK LIFT 5T	5	650.00	650.00
34	FORK LIFT 3T	5	540.00	540.00

**REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
OUTSIDE AGENCIES**

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/06/2019 to 31/5/2021 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/06/2019 to 31/5/2021 (BEYOND USEFUL LIFE)
I.	CRANES :-			
1	Portal Gantry Crane 500T	15	22340.00	22200.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	12630.00	12570.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	62550.00	62160.00
4	PORTAL CRANE, 360T	15	15630.00	15540.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	61620.00	61240.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	76230.00	75760.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	37230.00	37000.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	23270.00	23120.00
9	MANITOWOC M-250T TRUCK CRANE	15	33510.00	33300.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	35180.00	34960.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	29320.00	29130.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	40120.00	40120.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	16810.00	16700.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	20950.00	20950.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	18610.00	18500.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	24200.00	24050.00
15	CRAWLER CRANE SUMITOMO, 150T	15	12100.00	12020.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	14890.00	14800.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	12030.00	11970.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	11910.00	11840.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	9850.00	9800.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	11170.00	11100.00
20	CRAWLER CRANE 100 T (KH 500)	15	11170.00	11100.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	6010.00	5980.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6830.00	6790.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5970.00	5940.00
24	Mobile Crane, 55MT (TIL)	12	4900.00	4880.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3370.00	3350.00
26	MOBILE CRANE, 20MT (TIL)	10	2520.00	2510.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2520.00	2510.00
28	MOBILE CRANE ESCORTS- 14MT	10	790.00	790.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	430.00	430.00
30	ELECTRIC GANTRY CRANE 3T	5	480.00	480.00
31	ELECTRIC GANTRY CRANE 5T	5	600.00	600.00
32	ELECTRIC GANTRY CRANE 30T	5	4040.00	4030.00
33	FORK LIFT 5T	5	720.00	720.00
34	FORK LIFT 3T	5	600.00	600.00

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	20930
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	310
3	MULTI SHEAVE PULLEY BLOCK 100T	630
4	MULTI SHEAVE PULLEY BLOCK 150T	1260
5	ELCTRIC WINCH 5T	1270
6	ELCTRIC WINCH 10T	2360
7	ELECTRIC WINCH 15 T	2150
8	PASSENGER CUM GOODS HOIST 1T	2270
9	FURNACE MAINTENANCE PLATFORM	5040
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2100
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	16380
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	8190
3	WELDING GENERATOR 320/300 A	300
4	WELDING RECTIFIER 400A/300A	300
5	WELDING RECTIFIER 600A	400
6	DIESEL WELDING GENERATOR 400A/300A	400
7	TRANSFORMER,600A	300
8	TRANSFORMER 300/400A	200
III	SERVICE PLANTS & ALLIED EQUIPT.	0
1	500KVA DIESEL GENERATOR	3800
2	TRANSFORMER OIL FILTRATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	6370
3	-DO- , WITH STORAGE TANK	7280
4	OIL FILTRATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	910
5	OIL FILTRATION M/C, 250GPH/1000LPH (OTHER THAN SILICON	1360
6	OIL FILTRATION M/C, 500GPH/2500LPH (OTHER THAN SILICON	1820
7	OIL FILTRATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON	3640
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750	1270
9	Low Vacuum de-hydration unit	630
10	DIESEL GENERATING SET,250 KVA	1770
11	DIESEL GENERATING SET,25 KVA	500
12	VACUUM PUMP(ABSOLUTE V.C.)	540
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1090
14	ACID TRANSFER PUMP 20/50 T/HR	540
15	DEWATERING PUMP (Kirloskar make,11KW/15HP)	80
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4240

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
17	AIR COMPRESSORS 250/300/330/360/350 CFM	2730
18	AIR COMPRESSORS 140/150/190/210 CFM	910
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	1820
20	Industrial Blower 2000CFM	1270
21	Air Leak Test Blower (Flow: 40000 m ³ /Hr)	1160
22	Air Blower (Flow: 20000 m ³ /Hr)	940
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	630
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1630
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	1800
4	-do- Gun with nose Assembly only	540
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	36980
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	800
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1090
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1270
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1330
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2230
7	BOLT STRETCHING DEVICE	910
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	3640
9	ULTRASONIC FLAW DETECTOR	2730
10	MPI TEST KIT	360
11	GAS LEAK DETECTOR	270
12	VIBRATION/SOUND LEVEL METER IRD-306	360
13	VIBRATION/SOUND LEVEL METER IRD-308	360
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1450
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2540
16	SHOCK PULSE METER	630
17	HV.DC TEST KIT UPTO 50 KV	540
18	HV.DC TEST KIT ABOVE 50 KV	1000
19	HV.AC TEST KIT UPTO 50KV	810
20	HV.AC TEST KIT ABOVE 50KV	2910
21	MOTORISED MEGGER 2.5KV	400
22	MOTORISED MEGGAR 5KV	450
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	450
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1090
25	WAVEFORM ANALYSER	910
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1630
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1090
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	910
29	DIGITAL LOW RESISTANCE METER	630
30	DC POTENTIOMETER	180
31	PRECISION DEAD WEIGHT TESTER	1000
32	OPTICAL ALIGNMENT KIT	1360
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1200
34	VERNIER THEODOLITE,PRECISION	1200
35	VERNIER THEODOLITE,ORDINARY	200
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	120
37	ISKAMATIC 'A'	3200
38	CALIBRATOR '03'	1000
39	48 POLE EXTENDER CARD	200

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
40	MULTIJET NPM	400
41	OSCILLOMETER	10190
42	VOC EQUIPMENT	1400
43	BINARY SIGNAL GENERATOR	290
44	ELECTRIC COUNTER	690
45	FREQUENCY GENERATOR	1000
46	DBF 3 VIBRATION RECORDER/ANALYSER	3270
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	490
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1180
49	VIBROPORT 41/FFT ANALYSER	5460
50	ELCID kit	10010
51	UNIVERSAL CALIBRATION SYSTEM	2730
52	NATURAL FREQUENCY TESTER	2910
53	DIGITAL HARDNESS TESTER	360
54	ADRE 208 VIBRATION ANALYSER	7280
55	PCB 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	Mobile Lighting Mast - 9 metres (4X400 W)	860
61	10KVA RESISTANCE BRAZING MACHINE	140
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	460
63	HYDROGEN GAS LEAK DETECTOR	50
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	4980
65	WEDGE DEFLECTION KIT	80
66	TILE PRESSING MACHINE FOR GAS TURBINE	270
67	INDUCTION BRAZING MACHINE	4870
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	3640
69	ULTRASONIC FLOW METER	180
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	40
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. : FLOW 60 M3/HR	470
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. : FLOW 15 M3/HR	430
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	1810
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1260
75	5KV Insulation Tester	450
76	4 Channel Digital Oscilloscope /Fast Recorder	1710
77	4 Channel Oscillographic Recorder	580
78	Sound Level Meter	230
79	Thermal Imaging Camera	770
80	Videoscope (Video Boroscope)	1510
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1310
82	Conductivity Meter	80
83	Core Flux Test Kit	7280
84	Primary Current Injection Kit (2000A)	870
85	3 Phase Secondary Injection Kit (Relay Test)	3760
86	FRF Filtration Kit	1330
87	FFT Analyser	2290

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
88	Flue Gas Analyser	1030
89	Oil Test Kit (Mineral Oil)-Transformer	1010
90	Winding Resistance kit (R L C Load)	880
91	SFRA test Kit	1190
92	Tan Delta test Kit	4060
93	PF Meter	330
94	Ultrasonic Flow Meter	830
95	Oil Particle Counter	360

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	23250
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	350
3	MULTI SHEAVE PULLEY BLOCK 100T	700
4	MULTI SHEAVE PULLEY BLOCK 150T	1400
5	ELCTRIC WINCH 5T	1410
6	ELCTRIC WINCH 10T	2620
7	ELECTRIC WINCH 15 T	2390
8	PASSENGER CUM GOODS HOIST 1T	2520
9	FURNACE MAINTENANCE PLATFORM	5600
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2330
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	18190
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	9090
3	WELDING GENERATOR 320/300 A	330
4	WELDING RECTIFIER 400A/300A	330
5	WELDING RECTIFIER 600A	440
6	DIESEL WELDING GENERATOR 400A/300A	440
7	TRANSFORMER,600A	330
8	TRANSFORMER 300/400A	220
III	SERVICE PLANTS & ALLIED EQUIPT.	
1	500KVA DIESEL GENERATOR	4220
2	TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH	7070
3	-DO- , WITH STORAGE TANK	8080
4	OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	1010
5	OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON	1510
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON	2020
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON	4040
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750	1410
9	Low Vacuum de-hydration unit	700
10	DIESEL GENERATING SET,250 KVA	1970
11	DIESEL GENERATING SET,25 KVA	560
12	VACUUM PUMP(ABSOLUTE V.C.)	600
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1210
14	ACID TRANSFER PUMP 20/50 T/HR	600
15	DEWATERING PUMP (Kirloskar make,11KW/15HP)	90
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4710

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
17	AIR COMPRESSORS 250/300/330/360/350 CFM	3030
18	AIR COMPRESSORS 140/150/190/210 CFM	1010
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	2020
20	Industrial Blower 2000CFM	1410
21	Air Leak Test Blower (Flow: 40000 m ³ /Hr)	1290
22	Air Blower (Flow: 20000 m ³ /Hr)	1040
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	700
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1810
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	2000
4	-do- Gun with nose Assembly only	600
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	41090
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	880
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1210
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1410
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1480
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2480
7	BOLT STRETCHING DEVICE	1010
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	4040
9	ULTRASONIC FLAW DETECTOR	3030
10	MPI TEST KIT	400
11	GAS LEAK DETECTOR	300
12	VIBRATION/SOUND LEVEL METER IRD-306	400
13	VIBRATION/SOUND LEVEL METER IRD-308	400
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1610
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2830
16	SHOCK PULSE METER	700
17	HV.DC TEST KIT UPTO 50 KV	600
18	HV.DC TEST KIT ABOVE 50 KV	1110
19	HV.AC TEST KIT UPTO 50KV	900
20	HV.AC TEST KIT ABOVE 50KV	3230
21	MOTORISED MEGGER 2.5KV	440
22	MOTORISED MEGGAR 5KV	500
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	500
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1210

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
25	WAVEFORM ANALYSER	1010
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1810
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1210
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	1010
29	DIGITAL LOW RESISTANCE METER	700
30	DC POTENTIOMETER	200
31	PRECISION DEAD WEIGHT TESTER	1110
32	OPTICAL ALIGNMENT KIT	1510
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1330
34	VERNIER THEODOLITE,PRECISION	1330
35	VERNIER THEODOLITE,ORDINARY	220
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	130
37	ISKAMATIC 'A'	3550
38	CALIBRATOR '03'	1110
39	48 POLE EXTENDER CARD	220
40	MULTIJET NPM	440
41	OSCILLOMETER	11320
42	VOC EQUIPMENT	1550
43	BINARY SIGNAL GENERATOR	320
44	ELECTRIC COUNTER	760
45	FREQUENCY GENERATOR	1110
46	DBF 3 VIBRATION RECORDER/ANALYSER	3630
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	540
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1310
49	VIBROPORT 41/FFT ANALYSER	6060
50	ELCID kit	11120
51	UNIVERSAL CALIBRATION SYSTEM	3030
52	NATURAL FREQUENCY TESTER	3230
53	DIGITAL HARDNESS TESTER	400
54	ADRE 208 VIBRATION ANALYSER	8080
55	PCB DIAGNOSTIC REPAIR KIT	2220
56	SECONDARY INJECTION RELAY TEST KIT	5860
57	MICRO OHM METER	1610
58	DIGITAL MICRO OHM METER	3590
59	PMI Machine OLYMPUS make	3730
60	Mobile Lighting Mast -	960
61	10KVA RESISTANCE BRAZING MACHINE	160
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH	510

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/06/2019 to 31/5/2021
63	HYDROGEN GAS LEAK DETECTOR	60
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE	5530
65	WEDGE DEFLECTION KIT	90
66	TILE PRESSING MACHINE FOR GAS TURBINE	300
67	INDUCTION BRAZING MACHINE	5410
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	4040
69	ULTRASONIC FLOW METER	200
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	50
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR	520
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR	480
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL	2010
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1400
75	5KV Insulation Tester	500
76	4 Channel Digital Oscilloscope /Fast Recorder	1900
77	4 Channel Oscillographic Recorder	650
78	Sound Level Meter	260
79	Thermal Imaging Camera	860
80	Videoscope (Video Boroscope)	1680
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1460
82	Conductivity Meter	90
83	Core Flux Test Kit	8090
84	Primary Current Injection Kit (2000A)	960
85	3 Phase Secondary Injection Kit (Relay Test)	4180
86	FRF Filtration Kit	1480
87	FFT Analyser	2550
88	Flue Gas Analyser	1140
89	Oil Test Kit (Mineral Oil)-Transformer	1120
90	Winding Resistance kit (R L C Load)	970
91	SFRA test Kit	1320
92	Tan Delta test Kit	4510
93	PF Meter	360
94	Ultrasonic Flow Meter	920
95	Oil Particle Counter	400

PROFORMA OF BANK GUARANTEE (in lieu of EARNEST MONEY)
(On non-Judicial paper of appropriate value)
(Para 4.7.6 of Works Accounts Manual)

Bank Guarantee No.....

Date.....

To
(Employer's Name and Address)

.....

Dear Sirs,

In accordance with the terms and conditions of Invitation for Bids/Notice Inviting Tender No.....¹ (Tender Conditions), M/s. ² having its registered office at ³ (hereinafter referred to as the 'Tenderer'), is submitting its bid for the work of.....⁴ invited by Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at *BHEL House, Siri Fort, Asiad, New Delhi – 110049* through its unit at *Bharat Heavy Electricals Limited, Power Sector Southern Region, 690, Anna Salai, Nandanam, Chennai 600035*

The Tender Conditions provide that the Tenderer shall pay a sum of Rs ⁵ as Earnest Money Deposit in the form therein mentioned. The form of payment of Earnest Money Deposit includes Bank Guarantee executed by a Scheduled Bank.

In lieu of the stipulations contained in the aforesaid Tender Conditions that an irrevocable and unconditional Bank Guarantee against Earnest Money Deposit for an amount of ⁶ is required to be submitted by the Tenderer as a condition precedent for participation in the said Tender and the Tenderer having approached us for giving the said Guarantee,

we, the(Name & address of the Bank)
..... having our Head Office at
.....(hereinafter referred to as the Bank) being the Guarantor under this Guarantee, hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer without any demur, merely on your first demand any sum or sums of Rs.....⁶ (in words Rupees.....) without any reservation, protest, and recourse and without the beneficiary needing to prove or demonstrate reasons for its such demand.

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. ⁶

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Tenderer in any suit or proceeding pending before any Court or Tribunal, Arbitrator or any other authority, our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment hereunder and the Tenderer shall have no claim against us for making such payment.

We Bank further agree that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Tender or to extend the time of submission of from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said

Tenderer and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Tenderer or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Tenderer or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Tenderer and notwithstanding any security or other guarantee that the Employer may have in relation to the Tenderer's liabilities.

This Guarantee shall be irrevocable and shall remain in force upto and including.....⁷ and shall be extended from time to time for such period as may be desired by the Employer.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Tenderer but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms hereof. However, unless a demand or claim under this Guarantee is made on us in writing on or before the ⁸ we shall be discharged from all liabilities under this Guarantee.

We, ... Bank lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Notwithstanding anything to the contrary contained hereinabove:

- a) The liability of the Bank under this Guarantee shall not exceed.....⁶
- b) This Guarantee shall be valid up to ⁷
- c) Unless the Bank is served a written claim or demand on or before ⁸ all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank

We, ... Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

For and on behalf of
(Name of the Bank)

(Signature of Authorised signatory)

Date.....

Place of Issue.....

¹ Details of the Invitation to Bid/Notice Inviting Tender (Tender Ref. No. Eg. - BHEL PSSR SCT XXXX)

² Name of Tenderer

³ REGISTERED Office Address of the Tenderer

⁴ Details of the Work i.e Tender Description

⁵ EMD Amount as mentioned in Notice Inviting Tender

⁶ BG Amount in words and Figures (BG Amount shall be Minimum of EMD amount less Rs. 2 Lakhs)

⁷ Validity Date

⁸ Date of Expiry of Claim Period (Claim Period shall be minimum of 3 Months after the validity date of Bank Guarantee)

Note:

- 1. The BG should be on Non-Judicial Stamp paper/e-stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG was executed, whichever is higher. The Stamp Paper/e-stamp paper shall be purchased in the name of Vendor/Contractor/Supplier /Bank issuing the guarantee.
- 2. In Case of Bank Guarantees submitted by Foreign Vendors-

- a. From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India) can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.
- b. From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor Country's Bank)
 - b.1 In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by any of the Consortium Banks only will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank's (BHEL's Consortium Bank) branch in India. It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.
 - b.2 In case, Foreign Vendors intend to provide BG from Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at sl.no. b.1 will required to be followed.
 - b.3 The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time).

PROFORMA OF BANK GUARANTEE (in lieu of SECURITY DEPOSIT)

(On non-Judicial paper of appropriate value)

(Para 4.7.6 of Works Accounts Manual)

Bank Guarantee No.....

Date.....

To

(Employer's Name and Address)

.....

In consideration of Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at *BHEL House, Siri Fort, Asiad, New Delhi – 110049* through its unit at *Bharat Heavy Electricals Limited, Power Sector Southern Region, 690, Anna Salai, Nandanam, Chennai 600035* having agreed to exempt

_____ ¹ (Name of the Vendor / Contractor / Supplier) with its registered office at _____ ² (hereinafter called the said "Contractor" which term includes supplier), from demand under the terms and conditions of the Contract arising vide Letter of Intent (LOI) reference No. _____ dated _____ ³ valued at Rs. _____ ⁴ (Rupees _____ only) ⁴ (hereinafter called the said Contract), of Security Deposit for the due fulfilment by the said Contractor of the terms and conditions contained in the said Contract, on production of a Bank Guarantee for Rs. _____ ⁵ (Rupees _____ only),

We, the (Name & address of the Bank) having our Head Office at (hereinafter referred to as the Bank), at the request of _____ [Contractor(s)], being the Guarantor under this Guarantee, do hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer, an amount not exceeding Rs. _____ without any demur, immediately on demand from the Employer and without any reservation, protest, and recourse and without the Employer needing to prove or demonstrate reasons for its such demand

Any such demand made on the bank, shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____ ⁵.

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor(s) in any suit or proceeding pending before any Court or Tribunal or Arbitrator or any other authority, our liability under this present being absolute and unequivocal.

The payment so made by us under this guarantee shall be a valid discharge of our liability for payment hereunder and the Contractor(s) shall have no claim against us for making such payment.

We, further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied & the Employer certifies that the terms and conditions of the said Contract have been fully and properly carried out by the said contractor(s) or acceptance of the final bill or discharge of this guarantee by the Employer, whichever is earlier. This guarantee shall initially remain in force upto and including _____ ⁶ and shall be extended from time to time for such period as may

be desired by the Employer. Unless a demand or claim under this guarantee is made on us in writing on or before the _____⁷, we shall be discharged from all the liability under this guarantee thereafter.

We, _____ (indicate the name of the Bank) further agree with the Employer that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said contractor(s) and to forbear or enforce any of the terms and conditions relating to the said Contract and we shall not be relieved from our liability by any reason of any such variation or extension being granted to the said contractor(s) or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

We, ... BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Notwithstanding anything to the contrary contained hereinabove:

- a) The liability of the Bank under this Guarantee shall not exceed.....⁵
- b) This Guarantee shall be valid up to ⁶
- c) Unless the Bank is served a written claim or demand on or before _____⁷ all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

Date _____ Day of _____ for _____ (indicate the name of the Bank)

(Signature of Authorised signatory)

¹ NAME OF VENDOR /CONTRACTOR / SUPPLIER

² REGISTERED OFFICE ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.

³ LETTER OF INTENT(LOI) REFERENCE NO. WITH DATE

⁴ CONTRACT VALUE (AS MENTIONED IN LOI)

⁵ BG AMOUNT IN FIGURES AND WORDS

⁶ VALIDITY DATE

⁷ DATE OF EXPIRY OF CLAIM PERIOD (CLAIM PERIOD SHALL BE MINIMUM OF 3 MONTHS AFTER VALIDITY DATE)

Note:

1. The BG should be on Non-Judicial Stamp paper/e-stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG was executed, whichever is higher. The Stamp Paper/e-stamp paper shall be purchased in the name of Vendor/Contractor/Supplier /Bank issuing the guarantee.
2. In Case of Bank Guarantees submitted by Foreign Vendors-
 - a. From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India) can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.
 - b. From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor Country's Bank)
 - b.1 In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by any of the Consortium Banks only will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank's (BHEL's Consortium Bank) branch in India. It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.
 - b.2 In case, Foreign Vendors intend to provide BG from Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at sl.no. b.1 will required to be followed.
 - b.3 The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time).

INTEGRITY PACT**Between**

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

and

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

Preamble

The Principal intends to award, under laid-down organizational procedures, contract/s for BHEL: PSSR: SCT: 1891 -Construction of Single Steel Flue RCC Chimney of 275M height including all civil (excluding foundation), electrical and elevator works for Unit 5 at 5x800MW Yadadri Power project, Veerlapalem village, Dameracherla Mandal, Nalgonda District, Telangana State. The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

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

Section 1- Commitments of the Principal

- 1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-
- 1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
- 1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/ additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.
- 1.1.3 The Principal will exclude from the process all known prejudiced persons.
- 1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions.



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

- 2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.
- 2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he/ she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.
- 2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.
- 2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant Indian Penal Code (IPC) and Prevention of Corruption Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
- 2.1.4 Foreign Bidder(s)/ Contractor(s) shall disclose the name and address of agents and representatives in India and Indian Bidder(s)/ Contractor(s) to disclose their foreign principals or associates. The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.
- 2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.
- 2.3 The Bidder(s)/ Contractor(s) shall not approach the Courts while representing the matters to IEMs and will await their decision in the matter.

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

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

Section 4 - Compensation for Damages

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



- 4.2 If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/ Performance Bank Guarantee, whichever is higher.

Section 5 - Previous Transgression

- 5.1 The Bidder declares that no previous transgressions occurred in the last 3 years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.
- 5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

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

- 6.1 The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors. In case of sub-contracting, the Principal contractor shall be responsible for the adoption of IP by his sub-contractors and shall continue to remain responsible for any default by his sub-contractors.
- 6.2 The Principal will disqualify from the tender process all bidders who do not sign this pact or violate its provisions.

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

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

Section 8 -Independent External Monitor(s)

- 8.1 The Principal appoints competent and credible Independent External Monitor for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.
- 8.2 The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.
- 8.3 The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all contract documentation of the Principal including that provided by the Bidder(s)/ Contractor(s). The Bidder(s)/ Contractor(s) will grant the monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his contract documentation. The same is applicable to Sub-contractor(s). The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/ Contractor(s) / Sub-contractor(s) with confidentiality in line with Non- disclosure agreement.
- 8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.



- 8.5 The role of IEMs is advisory, would not be legally binding and it is restricted to resolving issues raised by an intending bidder regarding any aspect of the tender which allegedly restricts competition or bias towards some bidders. At the same time, it must be understood that IEMs are not consultants to the Management. Their role is independent in nature and the advice once tendered would not be subject to review at the request of the organization.
- 8.6 For ensuring the desired transparency and objectivity in dealing with the complaints arising out of any tendering process, the matter should be examined by the full panel of IEMs jointly as far as possible, who would look into the records, conduct an investigation, and submit their joint recommendations to the Management.
- 8.7 The IEMs would examine all complaints received by them and give their recommendations/ views to CMD, BHEL, at the earliest. They may also send their report directly to the CVO and the Commission, in case of suspicion of serious irregularities requiring legal/ administrative action. IEMs will tender their advice on the complaints within 10 days as far as possible.
- 8.8 The CMD, BHEL shall decide the compensation to be paid to the Monitor and its terms and conditions.
- 8.9 IEM should examine the process integrity, they are not expected to concern themselves with fixing of responsibility of officers. Complaints alleging mala fide on the part of any officer of the organization should be looked into by the CVO of the concerned organisation.
- 8.10 If the Monitor has reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant Indian Penal Code/ Prevention of Corruption Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.
- 8.11 The number of Independent External Monitor(s) shall be decided by the CMD, BHEL.
- 8.12 The word 'Monitor' would include both singular and plural.

Section 9 - Pact Duration

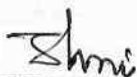
- 9.1 This Pact shall be operative from the date IP is signed by both the parties till the final completion of contract for successful bidder and for all other bidders 6 months after the contract has been awarded. Issues like warranty / guarantee etc. should be outside the purview of IEMs.
- 9.2 If any claim is made/ lodged during currency of IP, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged/ determined by the CMD, BHEL.

Section 10 - Other Provisions

- 10.1 This agreement is subject to Indian Laws and jurisdiction shall be registered office of the Principal, i.e. New Delhi.
- 10.2 Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.



- 10.3 If the Contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.
- 10.4 Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.
- 10.5 Only those bidders / contractors who have entered into this agreement with the Principal would be competent to participate in the bidding. In other words, entering into this agreement would be a preliminary qualification.



For & On behalf of the Principal

SANDIPAN BISWAS

अपर महाप्रबंधक - उप संविदा एवं क्रय

Add. General Manager - Sub Contracting & Purchase

(Office Seal) Bharat Heavy Electricals Limited

Power Sector - Southern Region

690, Anna Salai, Nandanam,

Chennai - 600 035.

Place

Date 21/02/2020

For & On behalf of the Bidder/

Contractor

(Office Seal)

Witness:


(Name & Address) R. SIVA690, Anna Salai, Nandanam,Chennai - 600035.

Witness:

(Name & Address) _____

PROCEDURE FOR CONDUCT OF CONCILIATION PROCEEDINGS

1. The proceedings of Conciliation shall broadly be governed by Part-III of the Arbitration and Conciliation Act 1996 or any statutory modification thereof and as provided herein:
2. The party desirous of resorting to Conciliation shall send an invitation/notice in writing to the other party to conciliate specifying all points of Disputes with details of the amount claimed. The party concerned shall not raise any new issue thereafter. Parties shall also not claim any interest on claims/counter-claims from the date of notice invoking Conciliation till the conclusion of the Conciliation proceedings. If BHEL is to initiate Conciliation, then, the invitation to Conciliate shall be extended to the concerned Stakeholder in **Format 7** hereto. Where the stakeholder is to initiate the Conciliation, the notice for initiation of Conciliation shall be sent in **Format-8** hereto.
3. The party receiving the invitation/notice for Conciliation shall within 30 days of receipt of the notice of Conciliation intimate its consent for Conciliation along with its counter-claims, if any.
4. The Conciliation in a matter involving claim or counter-claim (whichever is higher) up to Rs 5 crores shall be carried out by sole Conciliator nominated by BHEL while in a matter involving claim or counter-claim (whichever is higher) of more than Rs 5 crores Conciliation shall be carried out by 3 Conciliators nominated by BHEL. The appointment of Conciliator(s) shall be completed and communicated by the concerned Department/Group of BHEL Unit/Division/Region/Business Group to the other party and the Conciliator(s) within 30 days from the date of acceptance of the invitation to conciliate by the concerned party in the **Format-9**. The details of the Claim, and counter-claim, if any, shall be intimated to the Conciliator(s) simultaneously in **Format-5**.
5. The Parties shall be represented by only their duly authorized in-house executives/officers and neither Party shall be represented by a Lawyer.
6. The first meeting of the IEC shall be convened by the IEC by sending appropriate communication/notice to both the parties as soon as possible but not later than 30 days from the date of his/their appointment. The hearings in the Conciliation proceeding shall ordinarily be concluded within two (2) months and, in exceptional cases where parties have expressed willingness to settle the matter or there exists possibility of settlement in the matter, the proceedings may be extended by the IEC by a maximum of further 2 months with the consent of the Parties subject to cogent reasons being recorded in writing.

- 7.** The IEC shall thereafter formulate recommendations for settlement of the Disputes supported by reasons at the earliest but in any case within 15 days from the date of conclusion of the last hearing. The recommendations so formulated along with the reasons shall be furnished by the IEC to both the Parties at the earliest but in any case within 1 month from the date of conclusion of the last hearing.
- 8.** Response/modifications/suggestions of the Parties on the recommendations of the IEC are to be submitted to the IEC within time limit stipulated by the IEC but not more than 15 days from the date of receipt of the recommendations from the IEC.
- 9.** In the event, upon consideration, further review of the recommendations is considered necessary, whether by BHEL or by the other Party, then, the matter can be remitted back to the IEC with request to reconsider the same in light of the issues projected by either/both the Parties and to submit its recommendations thereon within the following 15 days from the date of remitting of the case by either of the Parties.
- 10.** Upon the recommendations by the Parties, with or without modifications, as considered necessary, the IEC shall be called upon to draw up the Draft Settlement Agreement in terms of the recommendations.
- 11.** When a consensus can be arrived at between the parties only in regard to any one or some of the issues referred for Conciliation the draft Settlement Agreement shall be accordingly formulated in regard to the said Issue(s), and the said Settlement Agreement, if signed, by the parties, shall be valid only for the said issues. As regards the balance issues not settled, the parties may seek to resolve them further as per terms and conditions provided in the contract.
- 12.** In case no settlement can be reached between the parties, the IEC shall by a written declaration, pronounce that the Conciliation between the parties has failed and is accordingly terminated.
- 13.** Unless the Conciliation proceedings are terminated in terms of para 22 (b), (c) & (d) herein below, the IEC shall forward his/its recommendations as to possible terms of settlement within one (1) month from the date of last hearing. The date of first hearing of Conciliation shall be the starting date for calculating the period of 2 months.
- 14.** In case of 3 members IEC, 2 members of IEC present will constitute a valid quorum for IEC and meeting can take place to proceed in the matter after

seeking consent from the member who is not available. If necessary, videoconferencing may be arranged for facilitating participation of the members. However, the IEC recommendations will be signed by all members. Where there is more than one (1) Conciliator, as a general rule they shall act jointly. In the event of differences between the Members of IEC, the decision/recommendations of the majority of the Members of IEC shall prevail and be construed as the recommendation of the IEC.

- 15.** The Draft Settlement Agreement prepared by the IEC in terms of the consensus arrived at during the Conciliation proceedings between the Parties shall be given by the IEC to both the parties for putting up for approval of their respective Competent Authority.
- 16.** Before submitting the draft settlement agreement to BHEL's Competent Authority viz. the Board Level Committee on Alternative Dispute Resolution (BLCADR) for approval, concurrence of the other party's Competent Authority to the draft settlement agreement shall be obtained by the other party and informed to BHEL within 15 days of receipt of the final draft settlement agreement by it. Upon approval by the Competent Authority, the Settlement Agreement would thereafter be signed by the authorized representatives of both the Parties and authenticated by the members of the IEC.
- 17.** In case the Draft Settlement Agreement is rejected by the Competent Authority of BHEL or the other Party, the Conciliation proceedings would stand terminated.
- 18.** A Settlement Agreement shall contain a statement to the effect that each of the person(s) signing thereto (i) is fully authorized by the respective Party(ies) he/she represents, (ii) has fully understood the contents of the same and (iii) is signing on the same out of complete freewill and consent, without any pressure, undue influence.
- 19.** The Settlement Agreement shall thereafter have the same legal status and effect as an arbitration award on agreed terms on the substance of the dispute rendered by an arbitral tribunal passed under section 30 of the Arbitration and Conciliation Act, 1996.
- 20.** Acceptance of the Draft Settlement Agreement/recommendations of the Conciliator and/or signing of the Settlement Agreement by BHEL shall however, be subject to withdrawal/closure of any arbitral and/or judicial proceedings initiated by the concerned Party in regard to such settled issues.
- 21.** Unless otherwise provided for in the agreement, contract or the Memorandum of Understanding, as the case may be, in the event of likelihood of prolonged

absence of the Conciliator or any member of IEC, for any reason/incapacity, the Competent Authority/Head of Unit/Division/Region/Business Group of BHEL may substitute the Conciliator or such member at any stage of the proceedings. Upon appointment of the substitute Conciliator(s), such reconstituted IEC may, with the consent of the Parties, proceed with further Conciliation into the matter either de-novo or from the stage already reached by the previous IEC before the substitution.

22. The proceedings of Conciliation under this Scheme may be terminated as follows:

- a.** On the date of signing of the Settlement agreement by the Parties; or,
- b.** By a written declaration of the IEC, after consultation with the parties, to the effect that further efforts at conciliation are no longer justified, on the date of the declaration; or,
- c.** By a written declaration of the Parties addressed to the IEC to the effect that the Conciliation proceedings are terminated, on the date of the declaration; or,
- d.** By a written declaration of a Party to the other Party and the IEC, if appointed, to the effect that the Conciliation proceedings are terminated, on the date of the declaration; or,
- e.** On rejection of the Draft Settlement Agreement by the Competent Authority of BHEL or the other Party.

23. The Conciliator(s) shall be entitled to following fees and facilities:

Sl No	Particulars	Amount
1	Sitting fees	Each Member shall be paid a Lump Sum fee of Rs 75,000/- for the whole case payable in terms of paragraph No. 27 herein below.
2	Towards drafting of settlement agreement	In cases involving claim and/or counter-claim of up to Rs 5crores. Rs 50,000/- (Sole Conciliator) In cases involving claim and/or counter-claim of exceeding Rs 5 crores but less than Rs 10 crores. Rs 75,000 (per Conciliator)

Sl No	Particulars	Amount
		In cases involving claim and/or counter-claim of more than Rs 10 crores. Rs 1,00,000/- (per Conciliator) Note: The aforesaid fees for the drafting of the Settlement Agreement shall be paid on the, Signing of the Settlement Agreement after approval of the Competent Authority or Rejection of the proposed Settlement Agreement by the Competent Authority of BHEL.
3	Secretarial expenses	Rs 10,000/- (one time) for the whole case for Conciliation by a Sole Member IEC. Where Conciliation is by multi member Conciliators –Rs 30,000/- (one time)- to be paid to the IEC
4	Travel and transportation and stay at outstation Retired Senior Officials of other Public Sector Undertakings (pay scale wise equivalent to or more than E-8 level of BHEL)	As per entitlement of the equivalent officer (pay scale wise) in BHEL.
	Others	As per the extant entitlement of whole time Functional Directors in BHEL. Ordinarily, the IEC Member(s) would be entitled to travel by air Economy Class.
5	Venue for meeting	Unless otherwise agreed in the agreement, contract or the Memorandum of Understanding, as the case may be, the venue/seat of proceedings shall be the location of the concerned Unit / Division / Region /

Sl No	Particulars	Amount
		Business Group of BHEL. Without prejudice to the seat/venue of the Conciliation being at the location of concerned BHEL Unit / Division / Region / Business Group, the IEC after consulting the Parties may decide to hold the proceedings at any other place/venue to facilitate the proceedings. Unless, Parties agree to conduct Conciliation at BHEL premises, the venue is to be arranged by either Party alternately.

- 24.** The parties will bear their own costs including cost of presenting their cases/evidence/witness(es)/expert(s) on their behalf. The parties agree to rely upon documentary evidence in support of their claims and not to bring any oral evidence in IEC proceedings.
- 25.** If any witness(es) or expert(s) is/are, with the consent of the parties, called upon to appear at the instance of the IEC in connection with the matter, then, the costs towards such witness(es)/expert(s) shall be determined by the IEC with the consent of the Parties and the cost so determined shall be borne equally by the Parties.
- 26.** The other expenditures/costs in connection with the Conciliation proceedings as well as the IEC's fees and expenses shall be shared by the Parties equally.
- 27.** Out of the lump sum fees of Rs 75,000/- for Sitting Fees, 50% shall be payable after the first meeting of the IEC and the remaining 50% of the Sitting Fees shall be payable only after termination of the conciliation proceedings in terms of para 22 hereinabove.
- 28.** The travelling, transportation and stay at outstation shall be arranged by concerned Unit as per entitlements as per Serial No. 4 of the Table at para 23 above, and in case such arrangements are not made by the BHEL Unit, the same shall be reimbursed to the IEC on actuals limited to their entitlement as per Serial No. 4 of the Table at Para 23 above against supporting documents. The IEC Member(s) shall submit necessary invoice for claiming the fees/reimbursements.
- 29.** The Parties shall keep confidential all matters relating to the conciliation proceedings. Confidentiality shall extend also to the settlement agreement,

except where its disclosure is necessary for purposes of its implementation and enforcement or as required by or under a law or as per directions of a Court/Governmental authority/ regulatory body, as the case may be.

- 30.** The Parties shall not rely upon or introduce as evidence in any further arbitral or judicial proceedings, whether or not such proceedings relate to the Disputes that is the subject of the Conciliation proceedings:
- a.** Views expressed or suggestions made by the other party in respect of a possible settlement of the Disputes;
 - b.** admissions made by the other party in the course of the Conciliator proceedings;
 - c.** proposals made by the Conciliator;
 - d.** The fact that the other Party had indicated his willingness to accept a proposal for settlement made by the Conciliator.
- 31.** The Parties shall not present the Conciliator(s) as witness in any Alternative Dispute Resolution or Judicial proceedings in respect of a Disputes that is/was the subject of that particular Conciliation proceeding.
- 32.** None of the Conciliators shall act as an arbitrator or as a representative or counsel of a Party in any arbitral or judicial proceeding in respect of a Disputes that is/was the subject of that particular Conciliation proceeding.
- 33.** The Parties shall not initiate, during the Conciliation proceedings, any arbitral or judicial proceedings in respect of a Disputes that is the subject matter of the Conciliation proceedings except that a Party may initiate arbitral or judicial proceedings where, in his opinion, such proceedings are necessary for preserving his rights including for preventing expiry of period of limitation. Unless terminated as per the provisions of this Scheme, the Conciliation proceedings shall continue notwithstanding the commencement of the arbitral or judicial proceedings and the arbitral or judicial proceedings shall be primarily for the purpose of preserving rights including preventing expiry of period of limitation.
- 34.** The official language of Conciliation proceedings under this Scheme shall be English unless the Parties agree to some other language.

**STATEMENT OF CLAIMS/COUNTER CLAIMS TO BE SUBMITTED TO THE
IEC BY BOTH THE PARTIES**

1. Chronology of the Disputes
2. Brief of the Contract/MoU/Agreement/LOI/LOA
3. Brief history of the Disputes:
4. Issues:
5. Details of Claim(s)/Counter Claim(s):

SI. No.	Description of claim(s)/Counter Claim	Amount (in INR)Or currency applicable in the contract	Relevant contract clause

6. Basis/Ground of claim(s)/counter claim(s) (along with relevant clause of contract)

Note– *The Statement of Claims/ Counter Claims may ideally be restricted to maximum limit of 20 pages. Relevant documents may be compiled and submitted along with the statement of Claims/ Counter Claims. The statement of Claims/ Counter Claims is to be submitted to all IEC members and to the other party by post as well as by email.*

FORMAT FOR NOTICE INVOKING CONCILIATION CLAUSE BY BHEL FOR REFERRING THE DISPUTES TO CONCILIATION THROUGH IEC

To,

M/s. (Stakeholder's name)

Subject: **NOTICE FOR INVOCATION OF THE CONCILIATION CLAUSE OF THE CONTRACT BY BHEL**

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Dear Sir/Madam,

As you are aware, with reference to above referred Contract/MoU/Agreement/LOI/LOA, certain disputes have arisen, which, in spite of several rounds of mutual discussions and various correspondences have remained unresolved. The brief particulars of our claims which arise out of the above- referred Contract/MoU/Agreement/LOI/LOA are reproduced hereunder:

Sl. No.	Claim description	Amount involved

As you are aware, there is a provision in the captioned Contract/MoU/Agreement/LOI/ LOA for referring disputes to conciliation.

In terms of Clause -----of Procedure i.e., Annexure ----- to the Contract/MoU /Agreement / LOI / LOA, we hereby seek your consent to refer the matter to Conciliation by Independent Experts Committee to be appointed by BHEL. You are invited to provide your consent in writing to proceed with conciliation into the above mentioned disputes within a period of 30 days from the date of this letter along with details of counter-claims, if any, which you might have with regard to the subject Contract/ MoU/ Agreement/ LOI/ LOA.

Please note that upon receipt of your consent in writing within 30 days of the date of receipt of this letter by you, BHEL shall appoint suitable person(s) from the BHEL Panel of Conciliators.

This letter is being issued without prejudice to our rights and contentions available under the contract and law.

Thanking you
Yours faithfully

Representative of BHEL

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

**FORMAT FOR NOTICE INVOKING CONCILIATION CLAUSE BY A
STAKEHOLDER FOR REFERRING THE DISPUTES TO CONCILIATION
THROUGH IEC**

To,

BHEL (Head of the Unit/Division/Region/Business Group)

Subject: **NOTICE FOR INVOCATION OF THE CONCILIATION CLAUSE OF THE
CONTRACT BY A STAKEHOLDER**

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Dear Sir/Madam,

As you are aware, with reference to above referred Contract/MoU/Agreement/LOI/LOA, certain disputes have arisen, which, in spite of several rounds of mutual discussions and various correspondences have remained unresolved. The brief particulars of our claims which have arisen out of the above-referred Contract/MoU/Agreement/LOI/LOA are enumerated hereunder:

Sl. No.	Claim description	Amount involved

As you are aware, there is a provision in the captioned Contract/MoU/Agreement/LOI/ LOA for referring inter-se disputes of the Parties to conciliation.

We wish to refer the above-said disputes to Conciliation as per the said Clause of the captioned Contract/MoU/Agreement/LOI/ LOA. In terms of Clause -----of Procedure i.e., Annexure ----- to the Contract/MoU /Agreement / LOI / LOA, we hereby invite BHEL to provide its consent in writing to proceed with conciliation into the above mentioned disputes within a period of 30 days from the date of this letter along with details of counter-claims, if any, which it might have with regard to the subject Contract/ MoU/ Agreement/ LOI/ LOA and to appoint suitable person(s) as Conciliator(s) from the BHEL Panel of Conciliators.

This letter is being issued without prejudice to our rights and contentions available under the contract and law.

Thanking you
Yours faithfully

Representative of the Stakeholder

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

FORMAT FOR INTIMATION TO THE STAKEHOLDER ABOUT APPOINTMENT OF CONCILIATOR/IEC

To,

M/s. (Stakeholder's name)

Subject: **INTIMATION BY BHEL TO THE STAKEHOLDER AND CONCILIATOR(S) ABOUT APPOINTMENT OF CONCILIATOR/IEC**

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Sir,

This is with reference to letter dated ----- regarding reference of the disputes arising in connection with the subject Contract No /MoU/Agreement/LOI/LOA to conciliation and appointment of Conciliator(s).

In pursuance of the said letter, the said disputes are assigned to conciliation and the following persons are nominated as Conciliator(s) for conciliating and assisting the Parties to amicably resolve the disputes in terms of the Arbitration & Conciliation Act, 1996 and the Procedure ---- to the subject Contract/MoU/Agreement/LOI/LOA, if possible.

Name and contact details of Conciliator(s)

a)

b)

c)

You are requested to submit the Statement of Claims or Counter-Claims (strike off whichever is inapplicable) before the Conciliator(s) in Format 5 (enclosed herewith) as per the time limit as prescribed by the Conciliator(s).

Yours faithfully,

Representative of BHEL

CC: To Conciliator(s)... for Kind Information please.

Encl: As above

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

NO DEVIATION CERTIFICATE

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

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **No Deviation Certificate**

Ref : 1) NIT/Tender Specification No:
2) All other pertinent issues till date

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

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

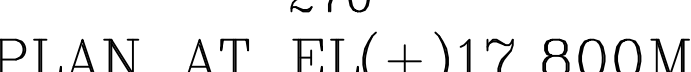
We further confirm our unqualified acceptance to all Terms and Conditions, unqualified compliance to Tender Conditions, Integrity Pact (if applicable) and opening of price bid submitted in the E-tendering portal <https://www.bhel.abcprocure.com>.

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

Thanking you,

Yours faithfully,

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

UNIFORM LINE
FOR CHIMNEY

BHEL-PROJECT ENGINEERING MANAGEMENT (CIVIL)	
THIS DRAWING IS RELEASED FOR COMMENTS/APPROVAL	
STAMP ALL PREVIOUS REVISION AS SUPERSEDED	
ISSUED BY	
NAME	Sachin Jain
SIGNATURE	
DATE	24/09/2019

2 REFERENCE DRGS: -
1, 85, 86, 113, 100, 1001

1. PE-DG-417-100-M001 ----- PLOT PLAN.
2. 0-00-020-77322 ----- LAYOUT OF I.D. SYSTEM PLAN
3. 0-00-020-77321 ----- LAYOUT OF I.D. SYSTEM ELEVATION

NOTES: —

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
2. COMPLIANCE WITH STANDARDS SHALL RELATE TO LATEST PUBLISHED EDITIONS.
3. ALL ELEVATIONS ARE REFERRED TO THE FINISHED GROUND FLOOR LEVEL OF POWER HOUSE BUILDING AS EL+30.00 M WHICH CORRESPONDS TO RL+381.50 M. ABOVE MEAN SEA LEVEL.
4. THE OTHER COMPONENTS OF THE CHIMNEY INCLUDE ROLL UP DOORS, PERSONNEL ACCESS DOORS, HAND RAILS, HOOD HATCH, LINER TEST PORTS, NON METALLIC EXPANSION JOINTS, RAIN WATER DRAINAGE SYSTEM, VENTILATION OPENINGS, ELECTRIC POWER SUPPLY DISTRIBUTION BOARDS, LIGHTING PANELS, SOCKET OUTLETS, POWER AND CONTROL CABLES, RACEWAY SYSTEM, STAIR AND PLATFORM LIGHTING, LIGHTNING PROTECTION & GROUNDING SYSTEM, COMMUNICATIONS SYSTEM ETC. AND SHALL BE PROVIDED AS PER TECHNICAL SPECIFICATIONS.
5. FOR STANDARD NOTES & DETAILS FOR RCC WORKS REFER APPROVED DRG. NO. PE-DG-417-600-C001.
6. FOR STRUCTURAL DETAILS, WELDING, HANDRAILING ETC. REFER APPROVED DRG. NO. PE-DG-417-600-C002.
7. AIRCRAFT WARNING LIGHT (A.W.L) SHALL BE PROVIDED TO MEET THE REQUIREMENT OF RELEVANT STANDARD STATUTORY BODY.

FORMAT SIZE

